

2022 EUROPEAN MOBILITY VENTURE



MCube

Munich Cluster for the Future of
Mobility in Metropolitan Regions



INTRODUCTION	1
METHODOLOGY	3
MUNICH	11
BRUSSELS	57
LISBON	105
MILAN	165
PARIS	233
BENCHMARKING	283
CONCLUSION	291
BIBLIOGRAPHY	293

EXECUTIVE SUMMARY

As more people relocate to cities, the current mobility infrastructure must adapt to satisfy the mobility demands of the growing urban population. Sustainable mobility efforts must be prioritised as a starting point. Given that cities house 75% of Europe's population and urban mobility contributes for 23% of the EU's transportation-related greenhouse gas emissions, the continent's climate and clean air targets will not be achieved without a coordinated effort to cut urban emissions (Transport & Environment, 2022). By performing a comparative assessment of various mobility projects in different European cities, the euMOVE project seeks to contribute to a pathway for future sustainable mobility planning. The interdisciplinary collaboration project between students from the Technical University of Munich thus explores urban mobility solutions in Brussels, Lisbon, Milan, and Paris to evaluate the current status quo and identify how these cities may inspire the future development of a more sustainable, inclusive, fair, and accessible transportation system for Munich.

Desk research was carried out throughout the project. The benchmark cities, and also the experts and stakeholders, were chosen. Through interviews and site visits, we analysed various initiatives and gathered information in the following clusters: urban space redistribution, innovative planning, new transportation infrastructure, digitalization and technology, and COVID-19 adaptations. The applicability index was used to summarise the projects and indicate their applicability to Munich in terms of expected impact and transferability. The selected cities have extremely varied locations, demographics, and climates. Still, they all share a similar desire to improve their cities' quality of life through the introduction of sustainable and active mobility projects. Brussels shows a high reliance on cars similar to Munich. On the other hand, they have an efficient, environmentally friendly urban mobility plan: Good Move. Lisbon, despite its difficult topography, has demonstrated its strengths in terms of sustainability. The city has made plans for a sustainable future with MOVE 2030. The Milan mobility projects demonstrate that effective cooperation, data-driven and need-based problem solving enable mobility innovation. Paris sets a concrete example of changing trends in mobility by incentivizing innovation and encouraging prompt policy implementation.

Through this report, we share our insights and experiences with decision-makers, mobility planners, scholars, and everyone interested in sustainable mobility. Finally, we hope that all cities develop concrete, innovative strategies for achieving their goals for sustainable urban mobility and that the report will also be useful to other cities besides Munich.

INTRODUCTION

Today, cities continue to attract an increasing number of people, accounting for 56% of the global population (The World Bank Group, 2020). The consequences of such global developments continue rising. Transport accounts for almost a quarter of Europe's greenhouse gas emissions and is the leading cause of urban air pollution. More people in cities means more traffic on city streets. They are congested with motorised car traffic and commercial and public transport vehicles, which has a significant impact on global climate crises, as well as broader implications on air and noise pollution in cities and a high number of traffic accidents.

Some possible responses to such alarming trends include laws banning individually owned motorised modes of transportation in cities and replacing them with active modes of transportation such as bikes, excellent pedestrian infrastructure, allowing private providers of micro mobility, or expanding the public transportation system. However, while the implementation of such ideas provides substantial benefits to some, policymakers must consider those who are unable to cycle, walk, hop on a speedy e-scooter, or climb down dozens of stairs at the nearest subway station. Furthermore, there are additional mechanisms of exclusion of certain groups of society, such as the price of houses or the like. This further divides those who can afford to live and commute within cities from those who need to work in cities but can only afford to live far outside of them. All of these effects have a negative impact on citizens' quality of life as well as the overall communal life of societies.

Thus, mobility is a critical driver for transforming metropolitan regions into more environmentally friendly and socially inclusive spaces that meet the needs of all members of society in current and future generations.

As part of the Munich Cluster for the Future of Mobility in Metropolitan Regions (MCube), the euMOVE (European Mobility Venture) brings together 16 students, four groups, four cities, who share the objective to discover how European cities can inspire and inform about changing Munich's mobility landscape.

We are a group of students at the Technical University of Munich, who got the chance to explore in-depth the transformative mobility strategies and solutions of Brussels, Paris, Lisbon, and Milan. We are convinced that it is vital to include a wide range of perspectives and research fields in order to collect various viewpoints on how these cities approach urban mobility. While some of us approach the mobility systems from a more technical standpoint, others do it from a social science perspective. With this team setup, we can discuss findings, challenge one another's thoughts, and draw on the expertise of each student.

In the report that follows, we will transform our knowledge and experience to policymakers, people working on urban mobility planning projects, other scholars, and anyone else who is interested.



METHODOLOGY

The goal of this report is to research future mobility and benchmark other cities as well as their projects, deriving inspiration and learnings for Munich. Towards this end, students in interdisciplinary groups of four conducted research on one city each, exploring and analysing the strategies, innovations and struggles of the respective cities regarding urban mobility.

The study was carried out primarily through the use of methods from multiple fields, including desk research, expert interviews, and ethnographic approaches.

Methods

Desk Research

Desk research was conducted during all stages of the project. Based on desk research, the benchmark cities were selected, the stakeholders or experts were identified, the interviews were prepared, and the projects and information derived from the interviews were supplemented.

Selection of Benchmark Cities

The project objectives defined several criteria for the selection of benchmarking cities. The study had to be performed on an European city and provide the opportunity to benchmark selected strategies, innovations or initiatives in urban mobility planning for application in Munich.

The city or metropolitan region should therefore be comparable in as many of the indicators:

- size
- number of inhabitants
- economic power
- governance
- topology
- climate.

Moreover, cities were analysed regarding their relevance for the research in terms of

- innovative mobility concepts,
- comparable status quo and challenges, as well as
- overall visibility of the city or region.

Ultimately, there have been several limitations. The restriction to Europe and cities already analysed in previous reports, limited the selection of cities. Furthermore, Language barriers were considered so mainly western and southern European cities were taken into account. At the same time, the budget was also limited so for some cities it might have been impossible to finance travel and accommodation. A justification for why each city has been chosen can be found in the introductory part for the respective city.

Selection of clusters

Five different topical clusters were defined to cover all important parts of mobility and urban planning. The clusters were created to focus the research in all cities on these five overarching topics .

The clusters are:

Redistribution of Urban Space: This cluster includes all projects that involve a change in the distribution of public (street) space. Active mobility and public space interventions as well as projects including more green and blue infrastructure can be summarised in this cluster.

Innovative Planning: New planning approaches just as citizen participation formats, special consultations and collaborations as well as planning approaches deviating from the conventional can be implemented in the cluster 'Innovative Planning'.

New Transport Infrastructure: This cluster includes all physical improvements and expansions of existing networks of different transportation modes.

Digitalisation and Technology: Digital and technological solutions in terms of mobility can be integrated in this cluster. Besides Mobility as a Service also mobile applications, charging infrastructure or maintenance monitoring can be included.

Covid-19 Adaptations: This cluster collects actions that were implemented during the Covid-19 pandemic. The projects may be different in each city, but they also reflect how each city dealt with the pandemic in terms of mobility and urban planning.

Since mobility projects and initiatives can cover more than one mentioned topic, the clusters in this report mainly serve as an orientation for the reader. The clusters summarise various mobility projects and initiatives.

Expert Interviews

Once stakeholders or initiatives for each city were identified through publicly available documents, websites, and online newspaper articles, they were contacted by the city groups to schedule a 30-60min expert interview. Not all stakeholders the groups contacted offered to give an interview, partly because of time restraints, especially during vacation season in July, partly due to other reasons. In person interviews could only be arranged during the

stay in the respective cities, but several interviews have also been conducted online via ZOOM or TEAMS, either before, after or also during the stay if personal meetings were not possible. Moreover, several stakeholders may have been overlooked, mostly because there are no public information or contact details available.

Semi-structured expert interviews

The expert interviews were conducted as semi-structured interviews. Goal of the interviews was an explorative, qualitative research on mobility initiatives and projects the experts are involved in as well as a holistic understanding of the mobility environment in the city. In preparing the guideline for the semi-structured interview, students ensured to be well prepared and to communicate with the expert on eye level (Nohl 2006, p. 21); the interviews could thus be carried out as a conversation between the expert and the students as quasi experts (Pfadenhauer, 2005). Additionally, the guideline was a useful aid to memory for the interviewer in case the conversation got stuck at any point. Nevertheless, the semi-structured interview allows the experts the necessary freedom to elaborate on topics they considered most important, or they had the most expertise in (Nohl 2006, p. 21).

The semi-structured interviews also allowed better comparability of the interviews, since all interviews followed the same basic structure and touched upon the same basic topics. However, this does in no way equal a standardisation of interviews; the goal was not to compare the perspective, approach, or knowledge of the different experts but to derive a holistic understanding of how mobility is dealt with in the city and to benchmark the most promising initiatives and strategies for possible application in Munich. No standardization is therefore needed. Hence, the semi-structured interview was the most suitable approach for this research (Nohl 2006, pp. 20-23).

Logging

Every interview was recorded and/or a protocol was written during the interview. Neither a very detailed protocol nor a full transcription was generally needed, since the goal was to identify the most important stakeholders, innovations and initiatives, not to analyse the interview as such. Consequently, only the most important information was noted in the protocol and only in need for clarification the audio recording was revisited. Since the comparison of single projects or interviews was no target of this research, the methodology in analysing the interviews did not need to be comparable and therefore strictly structured. Approaches varied between the groups, except for the goal to derive key take aways regarding stakeholders, innovations and initiatives or projects in terms of urban mobility.

Benchmarking

The applicability index is the method used for evaluating the impact and the transferability of the project. The idea is to benchmark if a similar project would have a similar outcome when applied in Munich, and if it is even possible to create such a project in Munich given the local conditions. Three fields with three criteria each were defined as basis for the evaluation, for impact and transferability, respectively. The different mobility innovations in the four cities will all be assessed according to this method. The resulting applicability index, essentially a table, summarises the transferability and impact of all studied projects and gives an overview for readers to find projects from Lisbon, Milan, Paris, or Brussels that are highly impactful and easily transferable to Munich.

The attempt is made to make the assessment as impartial and objective as possible, but it is based on the interviews conducted and on the experience of the city teams on-site, as well

Nevertheless, all city groups had to make sure that the context and potential biases that may have influenced the interview in any way were reflected upon and taken into consideration when analysing and evaluating the interviews and respective projects. Such biases or context may have been weather, period of stay, external events, personal interest, knowledge, and constitution of the interviewer as well as the interviewee, and the inclusion and exclusion of certain stakeholders, which is especially important regarding diversity and inclusion.

The details of how impact and transferability were evaluated for each project are explained in the following Section.

as biases both the experts and the city teams may have. For this reason, complete objectivity cannot be achieved. The experiences will be included in the project description and highlighted if they affect the evaluation in a strong way. In the end, the results for both impact and transferability are visualised in a spider diagram, respectively. Thereby, the influence on each indicator can be noticed individually. A description can be found in each project chapter.

Impact

For assessing the potential impact of a project in Munich, three fields of impact are considered: **air, time, and space**. The following table gives an overview over the criteria for each field. The euMOVE course is embedded in the MCube Cluster, the Munich Cluster for the Future of Mobility in Metropolitan Regions, which carries out different projects in differ-

ent innovation and strategic integration fields. To evaluate these MCube projects in the same way, the integration project “system analysis and evaluation” (SUE) was generated. It has the objective to create and apply an “analysis toolbox for the design and evaluation of the MCube projects and other, innovative and established transport systems and forms of mobility” (MCube, [SUE Project](#)). The fields and criteria are based on the MCube evaluation process of the SUE project.

Air

“Quality of air refers to traffic-related environmental pollution. All MCube projects aim not only to reduce local air pollutants but also contribute to the global climate by saving CO2 in addition to reducing local air pollutants.” (MCube)

- **Global Climate Protection:** Transport-related environmental impacts; contribution to the global CO2 balance (CO2 Goals of city / country).
- **Compliance with Local Limits:** Local regulations (mainly PM and NO2) (must be looked up for each city).
- **Health Protection:** Impact of emissions (air pollution, noise, pathogens, allergens) and hygiene concepts.

Time

“Quality of time refers on the one hand to the efficiency of the transport system, with a view to infrastructure capacities and traffic flow. On the other hand, it refers to reliable and comfortable mobility between everyday locations.” (MCube)

- **Accessibility:** Ability to reach and use target locations comfortably, reliably and punctually in limited time and with limited resources (internal and external).
- **Traffic Quality:** Level of Services, indicating the traffic flow and efficiency, with a differentiation between the different transport modes.
- **Quality of Experience:** Comfort and ability to use travel time as “high quality time” for other activities.

Space

“Quality of space refers to the impact of mobility innovation on public space and regional open spaces. The aim is to create new diverse recreational and exercise spaces that are accessible to the entire population.” (MCube)

- **Safety:** Physical safety regarding injuries and casualties, and digital safety/data integrity and protection.
- **Diversity of Use:** Land-saving and flexible development of transport and settlement areas.
- **Quality of Stay:** Possibility and attractiveness of spending time in road, urban, natural, and open space.

Impact Evaluation

All nine criteria are rated according to table 1. Depending on the project, the impact can be negative, none, positive or super-positive.

For every project, the results are then visualised in a radar chart to easily identify in which field most of the projects’ impact lies.

Field	Air	Time	Space
Criteria 1	Global climate protection	Accessibility	Safety
Criteria 2	Compliance with local limits	Traffic quality	Diversity of use
Criteria 3	Health protection	Quality of experience	Quality of stay

Table 1. Impact Fields and Criteria

Rating	Description
-1	Negative impact The project has a negative impact on the criterion.
0	No impact The project has no measurable effect on the criterion or the benefits towards the criteria do not justify the investment/effort.
+1	Positive impact The project has a positive impact on the criterion in long- or short-term regard that justifies the investment/effort.
+2	Super positive impact The project has a strong positive impact and includes innovative, sustainable/long-lasting or resilient improvements.

Table 2. Impact Evaluation

Transferability

The assessment of the transferability is done according to evaluation criteria within three fields of Transferability: **Governance**, **Local Context** and **Local Challenges**. The criteria and evaluation rating are based on Macário and Marques (2008) examination of the transferability of sustainable urban mobility measures implemented within the framework of CIVITAS.

Governance refers to the political and legal ecosystem of the respective city.

- **Political Determination:** Political culture represented by the ruling political party and decision making/ power of political parties in favor of such a project.
- **Legal Framework:** Law, regulations and processes already in place supporting and easing the implementation of such a project.
- **Stakeholder Constellation:** Comparable set of necessary stakeholders for harmonic cooperation and successful execution of the project in Munich.

Local Context implies circumstances influencing mobility in Munich as well as mobility behaviour and values/norms of inhabitants within a city.

- **Mobility Strategy:** The project fits to the envisioned goals of Munich's Mobility strategy: to improve livability and common wellbeing, accessibility and quality of stay, efficiency, safety and ease of traffic
- **MCube Strategy:** The project fits to the envisioned goals of MCube's strategy, enabling possibilities together
- **Mobility Culture:** Mobility behaviour and people's openness for behaviour changes align between the two cities

Local Challenges refer to mobility obstacles in Munich and resource and societal responsibility involved in the implementation of a respective project.

- **Problem Pressure:** The project is a solution for an urgent need to act on one or more of the identified mobility challenges in Munich.

- **Resource Expenditure:** The project can be included into existing infrastructures in Munich with little resource effort.
- **Responsible Innovation:** The project maintains the balance between resources (human and material) spent, the innovative output as well as societal support in Munich and allows societal justice

Transferability evaluation

All nine criteria are rated according to the table below. Depending on the project, the transferability is either not possible or afflicted with a high, medium or low level of risk. The risk ranking aligns with Macário and Marques (2008). The visualisation is similar to the impact evaluation.

Field	Governance	Local Context	Local Challenges
Criteria 1	Political Determination	Mobility Strategy	Problem Pressure
Criteria 2	Legal Framework	MCube Strategy	Resource Expenditure
Criteria 3	Stakeholder Constellation	Mobility Culture	Balanced Innovation

Table 3. Transferability Fields and Criteria

Rating	Description
-1	No Effect. The project is not applicable.
0	High Risk Projects that absolutely require some form of support or have a perceived risk if imposed above and beyond what can be considered 'normal'. Consequently, these projects are assessed as requiring careful checking of the preconditions of implementation as well as an adequate supportive packaging. Examples are zones with controlled access, multimodal interchange, car sharing, carpooling and road pricing.
+1	Medium Risk Projects that can typically be undertaken under current common circumstances in most European cities, but still need careful attention in terms of adequate local conditions, and still require particular attention to supportive packaging. Examples are mobility management, clean vehicles and fuels, cycling, goods distribution and logistics services.
+2	Low Risk Projects that can be implemented using existing powers and which are relatively easily enforceable, while perceived to provide clear benefits for the city or to the public. Examples are parking management, transport information and management, and public transport improvements.

Table 4. Transferability Evaluation

Methodology

Applicability Index

The applicability index summarises the studied projects abroad and shows if they are applicable to Munich in terms of expected impact and transferability.

Applicability levels

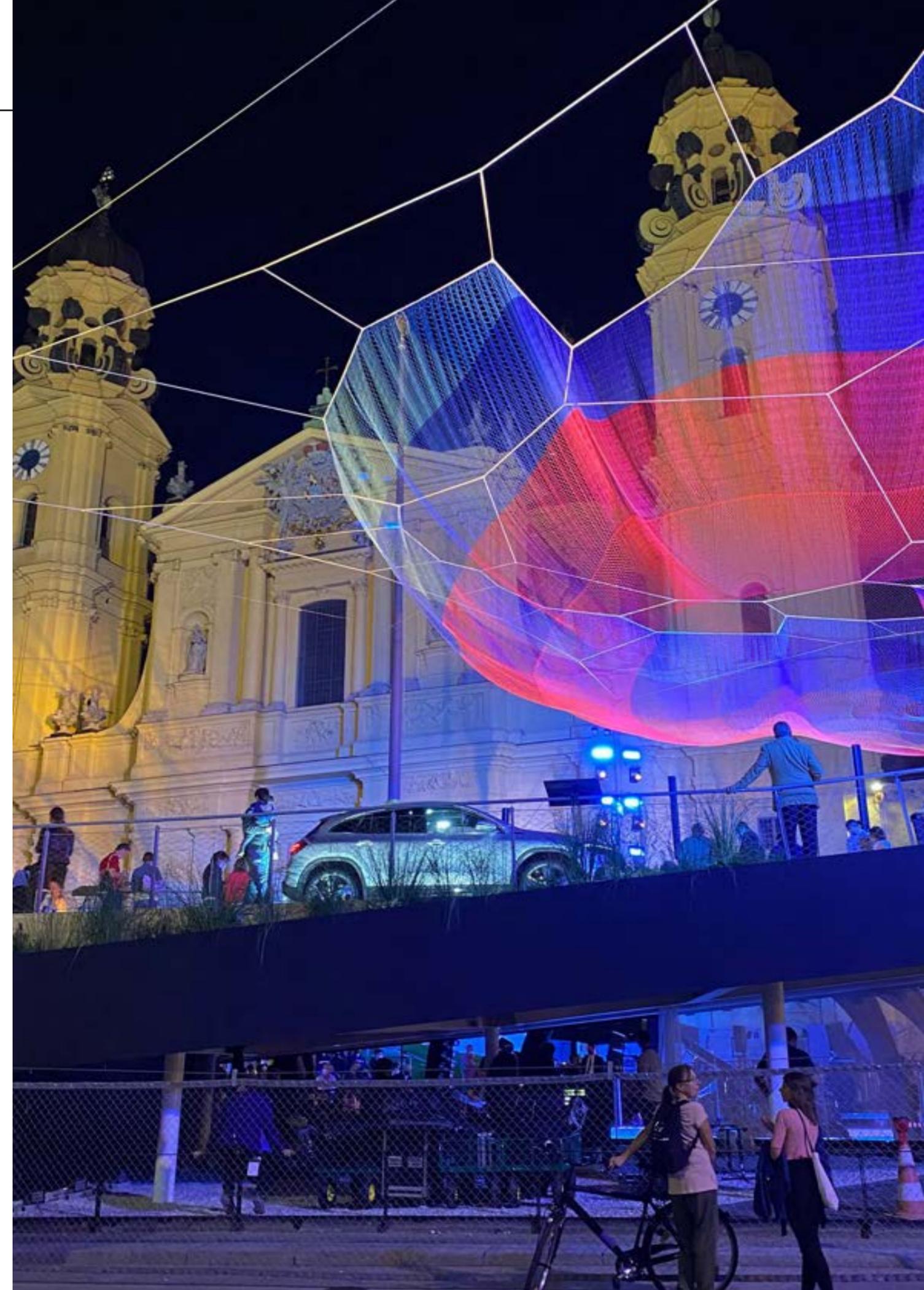
Based on the point ranges for impact [-1,0,1,2] and transferability [0,1,2,3], three applicability levels are assigned: low, medium, and high. The points are added up for each of the projects individually. The division between the applicability levels is made by an equal distribution of the points reachable.

Field	Impact	Transferability
Low	0-6 points	0-9 points
Medium	7-12 points	10-18 points
High	13-18 points	19-27 points

Table 5. Applicability Levels

Applicability index

The colours red, yellow and green represent the applicability levels explained above representing the respective applicability of each project. The overview in a table divided into impact and transferability for each project within a cluster gives a summarised overview for each city.





INTRODUCTION	13
LOCATION ANALYSIS	17
URBAN MOBILITY ANALYSIS	21
SWOT ANALYSIS	23
PROJECTS IN MUNICH	24
<u>SOMMERSTRASSEN</u>	<u>27</u>
<u>PARKING SPACES FOR E-SCOOTERS</u>	<u>29</u>
<u>UPDATE ON RADENTSCHIED AND ALTSTADTRADLRING</u>	<u>31</u>
<u>MOBILITY STATIONS</u>	<u>35</u>
<u>BUS MIT FÜSSEN</u>	<u>37</u>
<u>MÜNCHEN EMOBIL</u>	<u>39</u>
<u>2. STAMMSTRECKE</u>	<u>41</u>
<u>FUTURE OF PUBLIC TRANSPORT IN MUNICH</u>	<u>43</u>
<u>MVGO & MVG SWIPE+RIDE</u>	<u>45</u>
<u>POP-UP BICYCLE LANES</u>	<u>47</u>
GENERAL INFO	49
CHALLENGES	53
CONCLUSION	55

INTRODUCTION

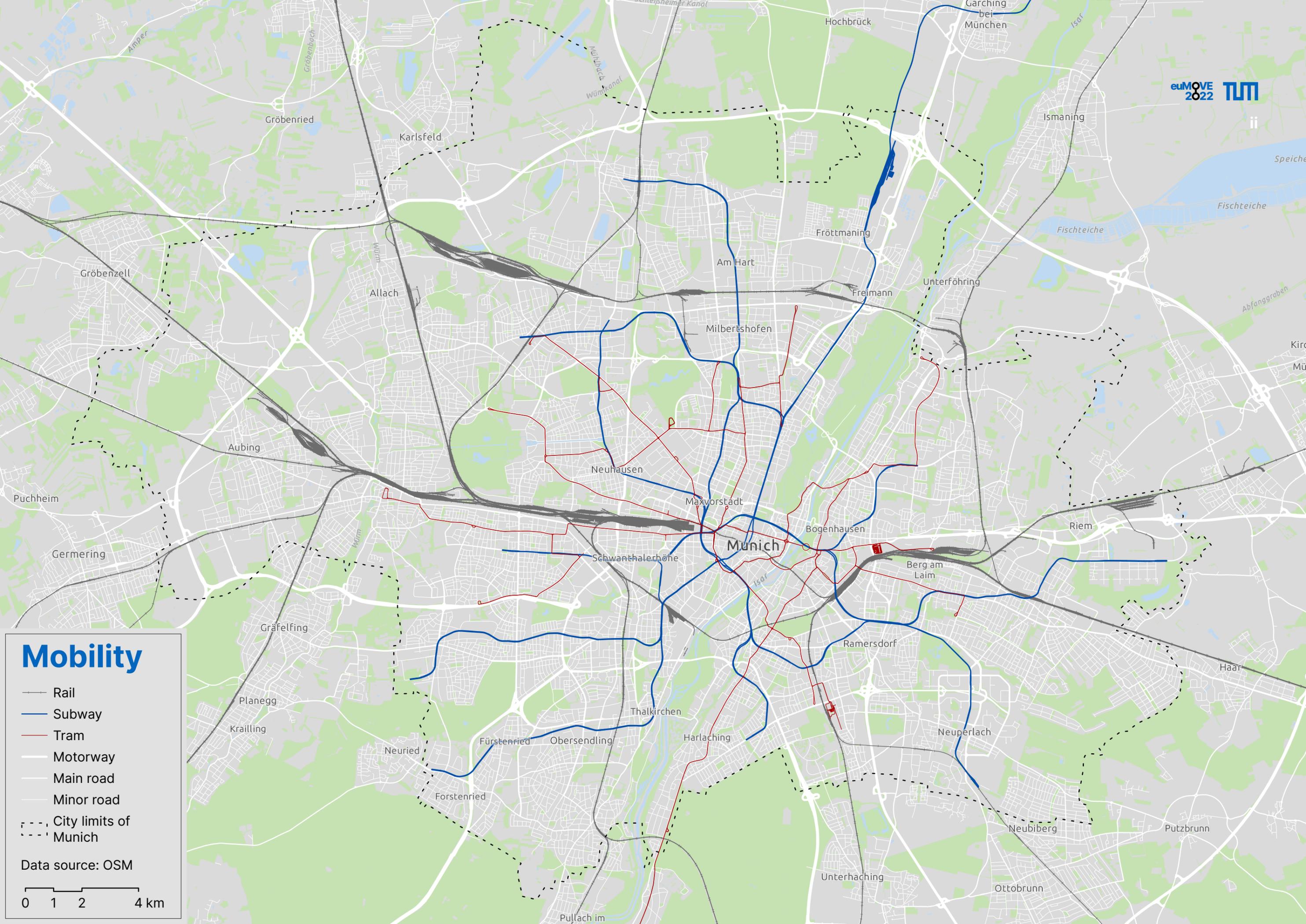
Munich is the third largest city in Germany and the capital of Bavaria. It is characterised by a strong economic background and a growing population. Currently, it counts 1.58 million inhabitants and is projected to increase to 1.85 million by 2040. Its metropolitan area encompasses more than 6 million people by now (Statistisches Amt München, 2022).

In economic terms Munich and its metropolitan region account for more than 30 percent of the GDP of Bavaria making it the economic powerhouse of the Free State (Referat für Arbeit und Wirtschaft, 2022). With the highest GDP per capita in Germany, the Munich metropolitan area is also among the top 5 percent within the OECD and one of the richest regions in the European Union (OECD, 2020). However, Munich is not an industrial city only but is rather shaped by a diverse network of science, technology, and finance as well as arts, culture, tourism and an active civil society (Referat für Arbeit und Wirtschaft 2022). Because of this, it is particularly attractive to the young and qualified workforce.

In Munich, economy links to mobility in the sense that with more than 50.000 employees in the city only, about additional 200.000 in the metropolitan area and a considerable amount of investments in research of related technologies, the automotive sector plays a key role for the regions development (Invest in Bavaria, 2022). It might be for this reason that the private car is still dominant mode of transport (MID, 2020). However, a comprehensive public transport network also characterises Munich. Additionally, in the past years, the uptake of micro mobility and the Covid19-Pandemic were influencing the modal split (McKinsey, 2019).

For the future, the city set itself ambiguous goals, such as achieving climate neutrality by 2035. Thereby, the city development plan "STEP 2040" and the mobility strategy 2035, which objectives will be presented later on, act as a roadmap for the transformation (Mobilitätsreferat München, 2022; Referat für Stadtplanung und Bauordnung München, 2022).

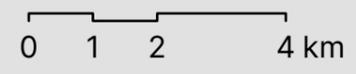
Against the backdrop of Munich's status quo and vision for the future, this chapter will provide information that serves as a starting point for the later city benchmarking analysis. In our location analysis, we will first shed light on stakeholders involved in shaping Munich's mobility ecosystem. Next, we will introduce our urban mobility analysis, which focuses on the vision of the city, mobility behaviour as well as pricing. Hereafter, we will present the mobility projects that we examined for this year's report according to the overarching project categories of Redistribution of Space, Innovative Planning, Digitalisation & Technology, New transport Infrastructure, and Covid-19 adaptations. This chapter then concludes with the challenges found for mobility in Munich. Thereby a SWOT-Analysis helps to provide a big picture, structure our findings and make them comparable to the euMOVE 2022 cities.



Mobility

-  Rail
-  Subway
-  Tram
-  Motorway
-  Main road
-  Minor road
-  City limits of Munich

Data source: OSM



LOCATION ANALYSIS

Research Area

The research area of euMOVE 2022 was defined as the city of Munich embedded in the surrounding municipalities, which are part of the MVV area, namely the Landkreise Bad Tölz-Wolfratshausen, Dachau, Ebersberg, Erding, Freising, Fürstfeldbruck, München and Starnberg.

History and Demographics

The city of Munich has received its name – München meaning home of the monks – from the origin of the city, which was a monastery at the Tegernsee (Britannica, n.d.). Munich prospered due to Henry the Lion, duke of Bavaria, who destroyed a bridge from the bishop Otto of Freising, to build one on his own land and collect the tolls himself. The emperor at the time supported the duke, who gave the monks the right to establish a market (Van der Bey, 2020). The rise of Munich was impacted already at the start by the importance of mobility infrastructure. Today Munich is home to 1 579 380 inhabitants (Landeshauptstadt München, 2022b), with a population density of 50 inhabitants/ha (Landeshauptstadt München, 2021). 28.5% of Munich’s residents are foreign nationals from 191 countries. It is forecasted that the population will exceed 1,85 million residents in 2040 (Landeshauptstadt München, 2022c).

Economy

Munich’s strong economic background arises from the fact that some of Germany’s largest, DAX-listed, corporations such as the BMW Group, Siemens, and MAN are located in Munich. In addition to traditional industry, the

existence of medium and small size enterprises and mobility startups like Ionity and Flixbus make the city a hub for innovation (Referat für Arbeit und Wirtschaft, 2022). Start-ups in the mobility scene of Munich work on fields ranging from air mobility, charging infrastructure for electric vehicles, autonomous personal rapid transit, sensors for parking management and alternatives to the traditional public transport modes. More recently, overseas tech-companies such as Apple increased their presence in Munich (RND, 2021). Munich is not just in the mobility sector a centrepiece of economic activity. 11.3% of Bavaria’s population generate 19% of the GDP (Landeshauptstadt München, 2022d). The service sector accounts for 78.2% of the GDP while the manufacturing sector contributes 21.84 %. In the Munich region 1.5 million people are gainfully employed according to the data derived from the statutory social insurance. This data also shows 2% of new jobs are added every year. The unemployment rate in 2021 was determined to be 4.5% (Landeshauptstadt München, 2022c).

Political System and Governance

The stakeholders in Munich regarding mobility range encompass both the political, economic, and civil sphere. The city of Munich and the surrounding municipalities are embedded in a contraflow system with the state of Bavaria, the German federal level and finally the European Union. The latter has competencies with respect to regulations for border-crossing and international transport, standardizations, safety regulation and competition regulation (Laimer and Perathoner, 2022). The trans-European transport network TEN-T is supported

through funding from the EU. Munich is crossed by two of the ten priority corridors, making up the core network of the TEN-T network, which is to be finished by 2030 (BMVI, 2022). The Scandinavian-Mediterranean corridor as well as the Strasbourg-Danube corridor connect in Munich (European Commission, 2021). European agencies relevant to mobility are the European agency for railways, the European maritime safety agency as well as the European aviation safety agency. On the German federal level the Federal transport infrastructure plan (Bundesverkehrswegeplan) or FTIP defines the funding and transport policy for already existing and new transport infrastructure projects for road, rail and waterways for 10-15 years (BMVI, 2017). The current valid FTIP - Bundesverkehrswegeplan 2030 - was put into force in 2016. A spatial strategic vision for Germany under the Bundesraumordnung is drawn up on this level. It functions as a general framework, with guidelines and spatial planning principles. The German federal level

also has responsibilities for the federal roadways, such as the Bundesautobahn and Bundesstrasse. Exceptions are the crossings of Bundesstrassen through cities with more than 80,000 inhabitants, when the competencies are transferred to the municipality (Strasse der Arbeit, 2018). Aviation and legislation as well as special transport initiatives such as the 9€ ticket also fall under the federal competencies. The Federal Ministry for Digital and Transport is in charge of these issues on the federal level, while on the state level in Bavaria this is the responsibility of the Staatsministerium für Wohnen, Bau und Verkehr (Ministry for Living, Construction and Transport). The state of Bavaria is responsible for state streets and constructs the Landesentwicklungsplan or state development program which details the spatial structure set up in the Bundesraumordnung further to general land planning for the state (Schwedde, 2018).



Figure 1. Stakeholders in Munich (own illustration)

LOCATION ANALYSIS

On the municipal level city and land planning occurs in high detail through the preparatory Flächennutzungsplan, created for the whole of the area of the municipality, and the legally binding Bebauungspläne for parts of the districts. The municipality also draws up plans regarding noise and air quality and defines the amount of space which is given to the different transport infrastructure (Umweltbundesamt, 2021). In this respect the city of Munich is also responsible for parking space management, traffic calming measures and cycling planning. Decisions on these issues are taken by the city council and the mayors and implemented through the various administrative departments such as the Mobilitätsreferat (mobility department), Baureferat (construction department), Referat für Klima und Umweltschutz (department for the protection of climate and environment) and the Stadtkämmerei (financial department) (Landeshauptstadt München, 2021).

The political stakeholders are embedded within the civil society they serve. The wider society presents their own stakeholders – various initiatives, associations and NGOs, that have various stances on mobility in Munich. The non-profit organisation green city e.V. advocates for sustainable mobility and sustainable urban design (GreenCity, 2022). It is an associated partner of the MCube project Transformative Mobility Experiments and is involved among others in the projects City2Share and organisation office for sustainable mobility. The Bündnis für saubere Luft in München is an action alliance for clean air in Munich and consists of various organisations and private individuals advocating for an improvement in the air quality (Luftreinheitsgebot, 2022). The Behindertenbeirat München advises the city of

Munich on participation and inclusion of people with disabilities. It has a special task group dedicated to all issues on mobility, which are in contact with the local public transport providers in addition to the city of Munich (Behindertenbeirat München, 2021). Various transport clubs are based in Munich, such as the car focused ADAC and Mobil in Deutschland (ADAC, 2022; Mobil in Deutschland, 2016). The ADFC München is a transport club with the aim of promoting cycling in Munich and the surrounding area (ADFC, 2022). The VCD München derived from the VCD Deutschland lobbies for S-Bahn and U-Bahn expansion in Munich and advocates for carsharing and more cycle lanes (VCD, 2022). The BUND, which is a non-profit organisation that aims to protect the environment and nature, promotes sustainable mobility to protect resources and quality of life. The local BUND group of Munich advocates additionally for an S-Bahn ring (BUND München, 2021). Similarly, the S-Bahn Bündnis Ost, which is an alliance of different municipalities and the Munich trade fair, lobby for an S-Bahn expansion between Munich East and Markt Schwaben (S-Bahn Bündnis Ost, 2020), while the Verein der Bürgerinitiative Haidhausen S-Bahn Ausbau advocates against the S-Bahn expansion through a 2nd trunk route (s-Bahn Ausbau, 2020). The Münchner Forum provides a platform for Munich residents to debate future issues of the city and also has a working group on attractive public transport (Münchner Forum, 2022). Many other initiatives exist in Munich for example Wohnen ohne Auto and Autofrei Leben!, which both promote a car free life.

Education and Research

Four universities are located in Munich, among others the Technical University of Munich and the Ludwig Maximilian University. There are also 14 Hochschulen or universities of applied sciences in the city, all together educating 107,753 students in the winter semester of 2020/2021 (Bayerisches Landesamt für Statistik, 2021). Furthermore, various research institutes such as the Fraunhofer Gesellschaft and the Max-Planck-Gesellschaft are stationed in Munich as well. The emphasis on research for Munich is also shown in the fact that 3.6% of employees are working in the field of research and development (Landeshauptstadt München, 2022).

Climate and Geography

Munich is located 50 km north of the edge of the Alps and has an elevation of 500 metres above sea level. The river Isar flows through the city. The climate in the capital of Bavaria is slightly continental, meaning the seasons are easily distinguishable from another with a warm summer and a mild winter (Climates to Travel, n.d.). The average temperature reaches 12.8 C during the day and 3.2 at night (Klimatabelle, n.d.). On average there are 1850 hours of sunshine per year and 950mm of precipitation. The rainiest months range from May to August (Climates to Travel, n.d.).



URBAN MOBILITY ANALYSIS

The Vision of the City of Munich

Mobility Strategy 2035

The Mobility Strategy 2035 is the roadmap for the mobility turnaround in Munich. It serves to ensure the quality of life and the common good in our city. It guarantees truly sustainable mobility for all Munich residents and serves as an orientation for politics, administration, urban society and all interested parties and cooperation partners in the state capital. The goals are:

Quality of life and general well-being

Quality of life and general well-being are basic requirements for individual and social life as well as entrepreneurial activity. It's about people-oriented mobility in a people-oriented city.

Accessibility and quality of stay

All people and goods should quickly and safely reach the destinations of the town. In addition, street spaces should not only manage traffic, but also offer a high quality of stay.

Efficiency, safety and ease of transport

These goals no longer apply primarily to car traffic, but to all types of traffic equally.

Other important goals are:

- Climate protection, climate adaptation, environmental compatibility and health
- Social justice, social participation, inclusion and accessibility
- Location attractiveness for companies
- Crisis stability

- Economics
- Quality of the mobility offer: among other things reliability, accessibility and comfort

The concrete quantitative and measurable goals are

- By 2025, at least 80 percent of the traffic in the Munich city area is covered by zero-emission motor vehicles, local public transport and on foot or by bike
- Traffic should be climate-neutral by 2035
- "Vision Zero": Nobody should die in traffic anymore
- The share of local public transport in all due to increase to 30 percent by 2030

STEP 2040

The Urban Development Plan 2040 (STEP2040 for short) is a central component of the "Perspective Munich" urban development concept, which aims to balance social, ecological and economic concerns in a city. Against the background of dynamic population and economic development, the STEP2040 positive and sustainable change The draft of STEP2040 represents the first spatial urban development plan since 1983 and, as an integrated plan, brings together different goals, strategies, concepts, programs and measures is the spatial and infrastructural development of the city for the next 20 years with regard to the six defined fields of action: open space, mobility and districts as well as climate adaptation and climate neutrality.

Some of the recommendations are:

- Make it possible to change living space depending on the phase of life in the neighbourhood

- Hold employers accountable when building housing
- Living, working, living, sports, supply and culture in the district (decentralised 15-minute city)

Modal Split

Car-based mobility dominates Munich, and includes roughly 50 to 60 percent of all kilometres travelled, with more than three-fifths of that done by private car. The city's excellent public-transport system handles 30 to 40 percent of the kilometres travelled. Walking and biking are responsible for the remaining 5 to 10 percent.

Several e-micromobility providers started their services in the city such as Tier, Lime, Bird, Voi, Dott, and the users of e-scooters have become part of the local traffic. According to civcity.com, an e-scooter completes about 5.5 trips a day, with an average trip distance of approximately two kilometres.

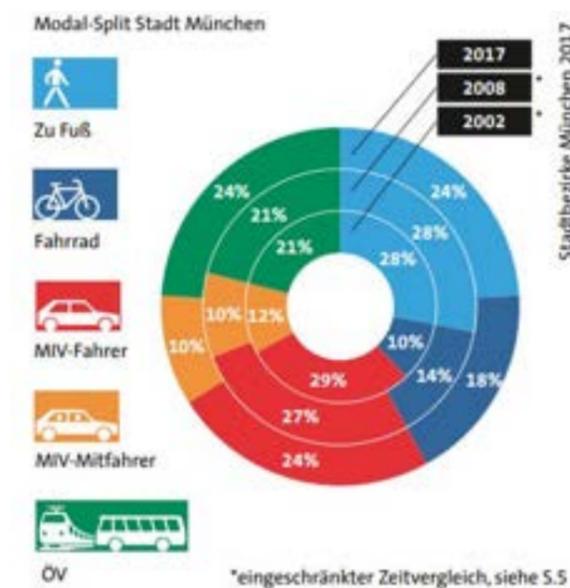


Figure 2. Modal Split and Micromobility (MiD, 2020)

Accessibility

Mobility-impaired travel through Munich:

- 85% of the 150 S-Bahn stations are accessible barrier-free. 90% of the stations are in optimum design
- 100% of U-Bahn stations are usable barrier-free
- 25% of seating in vehicles is marked and designed for mobility impaired travellers
- More than 90% of tram stations are wheelchair accessible
- New vehicles have wide doors, modernised information systems and ramps

Multimodality

Costs

0.5€/Km for cars, 0.16€/Km for public transport and 0.10€/Km for cycling

Type and Price (in Euros)

- Single ticket: 3.5
- Single day ticket: 8.2
- IsarCard weekly: 18.6
- IsarCard monthly: 59.1
- Semesterticket: 72
- Gasoline (1 Litre): 1.6

Commuting Patterns

- Average amount of time people spend commuting with public transit (to and from work) on a weekday is 40 minutes
- 41% of transit riders in Munich ride public transit (Light Rail, Subway, Tram and Bus) for more than 2 hours everyday
- 39% of people in Munich usually travel for over 12 km in a single direction
- There is a willingness to use Ride Hailing services and similar transportation modes.

SWOT ANALYSIS

After having discussed key challenges for mobility in Munich, this section aims to systematise and summarise strengths, weaknesses, opportunities and threats of the mobility ecosystem and its governance. Whereby the clear vision by the municipality, such as demonstrated by its urban planning documents, is a strength of the city, certain weaknesses like long planning and approval processes for new (transport) infrastructure remain. Moving into the future, efforts to improve social equity and mobility impaired travel provide opportunities but come also with certain threats, e.g. limited financial and personal resources (BR24, 2022).

Strengths

- Strong network of research and business actors on site
- Continuous initiatives by the government & academia (e.g. Mobility 2050 initiative, MaaS-solution, Mobility Technology Centre, etc.)
- Powerful economic capacity of the city
- Clear vision by the municipality: Mobility strategy 2035; City development plan 2040

Weaknesses

- Public transport is most cost-efficient for longer trips, but expensive compared to other options for shorter trips
- Long planning and approval processes for new infrastructure
- Tangential PT connections
- Insufficient integration of transport modes

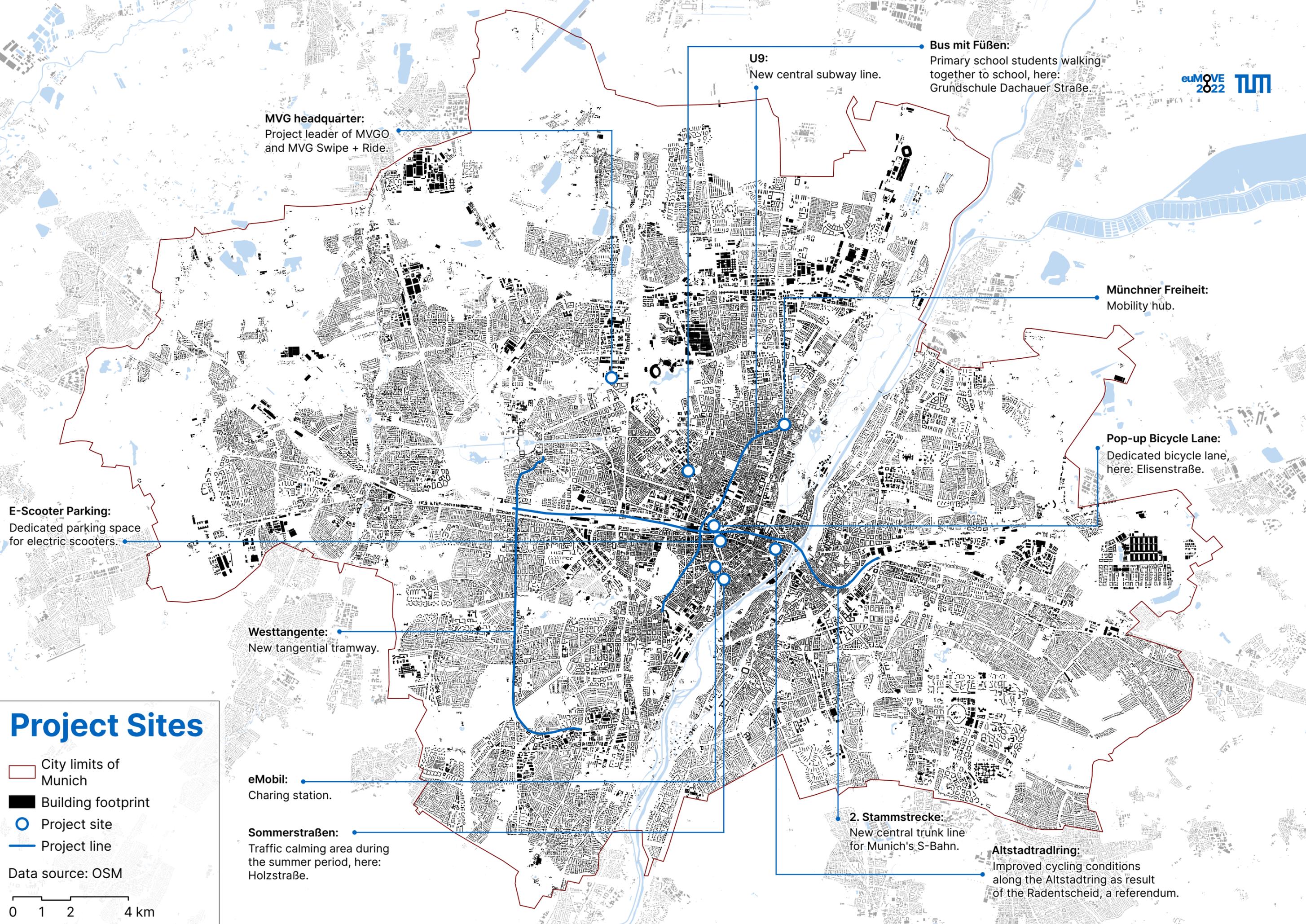
- Cooperation between public transport provider and mobility companies (e.g. MVG+Tier)
- Improved quality of life through redistribution of space, e.g. Car reduced Altstadt for air quality and co-creation
- Attractive job opportunities for people in mobility companies
- Improve social equity and mobility impaired travel

Opportunities

- Persisting urbanisation: Need to maintain functional and affordable mobility system
- Continuous car dependency in Germany
- Increased cyber risk with app-based services and potential personal data protection issues
- Limited financial (and personnel) resources

Threats

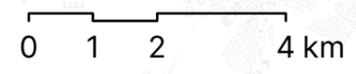
PROJECTS IN MUNICH



Project Sites

- City limits of Munich
- Building footprint
- Project site
- Project line

Data source: OSM



SOMMERSTRASSEN

During the summer months, several streets in the city of Munich are turned into Sommerstraßen or summer streets, which give residents extra recreational space close to their homes. The summer streets have been established across the city of Munich every year since the first try out at Alpenplatz in 2019. Additional areas for resting, dialogue, fun, and movement are available in the neighbourhoods.

Motivation and Goals

Both increasing active movement of citizen and the livability and quality of stay are important elements to implement the project. Summer streets should encourage and incentivize citizens to move around in the fresh air and use streets differently than they have in the past. This aims to improve Munich's livability, encourage active mobility, citizen participation, and community spirit development (Mobilitätsreferat, 2021b).

The goal of the project is to provide public areas to the residents in warmest weeks of the year, when schoolchildren are on holidays and can make use of more safe space to play in the city. The Sommerstraßen project aims to add areas for staying, meeting, playing, and exercising close to the resident's homes. The city also makes the Verkehrswende more tangible and visual, by allowing a temporary redistribution of the streetscape.

Stakeholders

The city of Munich involves the citizens in the design of the Sommerstraßen which should serve the residents. Sommerstraßen are realized as temporary public spaces for the citizens and mainly nearby residents. The city

of Munich organizes the Sommerstraßen and executes the traffic rearrangements. It cooperates with the district committee and the local residents in designing the dedicated streets. The city also encourages the citizens to take initiative to add onto the use and design by events or opening parties (Landeshauptstadt München, 2022).

Implementation

The summer streets are set up in the city of Munich and take place between July to September, each street having its own schedule. Two variations on the summer streets exist: traffic calmed streets and Spielstraßen, in which no vehicles are allowed to enter or park. These are entirely devoted to give children room to play safely outside of the homes. The traffic calmed areas allow all road-users to pass through. However, priority must be given to the pedestrians and cars are only permitted to drive at walking speed (Mobilitätsreferat, 2021a).

Outcomes and Discussion

The project has been implemented every summer since its initiation in 2019. While only one Sommerstraße was tried out in 2019, 14

KEY FACTS

9 Sommerstraßen implemented 2022

Alpenplatz was the first Sommerstraße to be tested in 2019

were executed the following year. In 2021 ten Sommerstraßen and this year 9 Sommerstraßen were realised. Two of the streets were implemented as Spielstraßen this year at Regerplatz and Stuntzstraße, seven as traffic calmed areas at Holzplatz, Fromundstraße, Schnaderböckstraße, Schöttlstraße, Am Kosttor, part of the Drächslstraße and Birkenfeldstraße (Landeshauptstadt München, 2022).

The feedback according to an interview with a spokesperson of the mobility department, was positive from both residents and districts alike, which is also demonstrated in the fact that the

project is carried out the 4th year in a row.

Only very few problems with noise were encountered. The acceptance however reduces if parking spaces are taken away from the residents. A possible solution would be to coordinate nearby parking spaces in garages for the affected residents.

The Sommerstraßen are an established yearly project in the city of Munich. Acceptance for permanent summer streets according to the interview does not exist, since the usage in winter and in variable weather conditions outside of summer would not be high enough to value the investments.



PARKING SPACES FOR E-SCOOTERS

The city of Munich is realizing mandatory parking zones for e-scooters. The parking zones are a pilot project and will become permanent and could be widened to a larger area of the city if successful. The first ones have already been tested since May 2022 and have been made mandatory since 5th of August 2022.

Motivation and Goals

The parking spots are created to reduce wild parked e-scooters, which pose impediments to pedestrians. Munich has seen a large increase of micro mobility alternatives and providers, namely e-scooters. While reducing the number of trips made with private cars, the new vehicles pose challenges to other forms of active mobility. It is very frequent to encounter sidewalks which are blocked by tumbled e-scooters, creating a new problem for people with limited mobility or disabilities (Mobilitätsreferat, 2022).

The city aims to implement 43 parking zones to avoid wild parking and keep sidewalks clear. Many incorrectly parked scooters are a hindrance for pedestrians, people with limited mobility and have been littering the city centre. In the first half of 2022 alone, more than 70 warning fines (20 €) were issued for incorrectly parked e-scooters (Dicke, 2022a).

Stakeholders

Various stakeholders are involved in this regulation. While the mobility department is in the position to locate and construct the parking zones in accordance with the district committee, the city council decides if these are man-

datory. The enforcement of the parking zones takes place through the companies providing the scooter by not letting the user terminate the rental.

Implementation

The parking zones are constructed inside the Altstadttring, marked with yellow paint on dedicated parking spots or areas on sidewalks. In a first step the city of Munich in cooperation with the e-scooter providers, created measures to incentivize proper parking of the vehicles in the city. One example is discounts on its use. They used the usage data from the providers to establish hotspot areas where there was a concentration of vehicles. In those spaces, the city created dedicated parking space, or shared parking spaces with bicycles. All together the city will implement 43 yellow marked parking spaces inside the Altstadttring, mainly around the pedestrian area, which e-scooters are not allowed to enter. Since the use of the parking spaces is mandatory, the rental of the scooter cannot be terminated if parked outside but near to the zones (Dicke, 2022b).

KEY FACTS

Mandatory since 5th of August 2022

43 parking zones inside Altstadttring

Outcomes and Discussion

24 out of the 43 planned parking zones are in operation. As a preliminary outcome the parking spaces have been found to improve the parking situation (Schleicher, 2022).

The regulation has been shown to avoid the blockage of sidewalks and allows for harmonious space distribution between parked vehicles and pedestrian areas.

High impact and improvement for the selected areas, but on non-target areas the problem is not tackled.

If proven successful, the city plans to make the parking zones permanent.



UPDATE ON RADENTSCHIED AND ALTSTADTRADLRING

The demands of two citizen referendums asking for an improvement in cycling infrastructure in Munich were successfully adopted by the city council in 2019, however, since then the progress on cycling infrastructure has been slow. Both citizen initiatives were set up by the Radentscheid alliance, which was initiated by ADFC München, BUND, Green City e.V. and the political parties of ÖDP, Die Grünen and Die Linke. The alliance was supported by many more initiatives, stakeholders and citizens and collected the necessary signatures in three months. After the handover of the demands to the lord mayor on the 4th of July 2019, the city council adopted all requests for both referendums and decided on four measurement packages to change 38 streets towards the betterment of cycling infrastructures in December 2019.

Motivation and Goals

The improvement of cycling infrastructure in Munich leads to a higher quality of stay, increase livability, less noise and less greenhouse gas emission. The Radentscheid alliance advocates for the cycling infrastructure to be revised and completed to raise the safety for cyclists and achieve comfortable cycling conditions, especially for children, seniors or less experienced riders (Bündnis Radentscheid, 2022b). The government sees the planned measures as a step towards the so-called Verkehrswende, which describes a redistribution of space towards pedestrians, cyclists and public transport. It requires less individual traffic and a higher focus on environmental protection (Landeshauptstadt München, 2022).

The goal of the Radentscheid initiative is to implement a comfortable and city-wide seamless cycling network and within this network the second initiative addresses the construction of a cycle path around the old town of Munich. The Radentscheid initiative describes the following goals to be achieved by 2025: To have safe, wide, and comfortable cycling facilities, to attain a city-wide close-knit cycling network, to realise safe and stress-free inter-

sections, to acquire need-based, comprehensive, and safe bicycle parking and finally, to have a socially-just division of public space. The targets of the Altstadt initiative are to implement a closed-cycle ring around the old town with wide and safe cycle paths, which enable fast and relaxed cycling for every type of cyclist. The Radlring connects to the central cycle paths around the city centre.

Stakeholders

Citizen's involvement in the Radentscheid was not limited to the support through signatures during the referendum, but also takes place through the participation processes, when streetscapes are changed and space is redistributed. The Radentscheid alliance is supported by various initiatives, for example The Münchner Forum or different youth associations. Other stakeholders in the process of implementing the Radentscheid demands are the Bezirksausschüsse or district committees, which are directly involved in the participation processes, as well as the city council and the city administration, namely the mobility department.

To be completed by 2025 according to coalition treaty

6,8% of Altstadttring implemented

Implementation

The Altstadtadrlring will be a circumference around the old town of Munich and be part of the city-wide cycle network implemented through the Radentscheid referendum. The cycle pathways are to be constructed in a wide manner, requiring redistribution of the available street space.

Outcomes and Discussion

So far only 700m of the 10.3km Altstadtadrlring has been constructed. The already built cycle paths are located in the Blumenstrasse and Thomas Wimmer Ring and make up 6.8% of the whole planned infrastructure. The initiative was widely supported through Munich's residents and many other groups and organisations representing such.

Support through signatures: The required signatures for the citizen's initiative were more than doubled for each of the referendums, and collection for them was stopped only after three months (Bündnis Radentscheid, 2022d).

Political support: The current coalition in Munich has set the date for the implementation of the citizen's initiatives until 2025 in their coalition agreement (Anlauf, 2022).

The current development is too slow and draws much criticism. The delay in the implementation is due to three main problems according to

an interview with a spokesperson of the mobility department:

Administrative processes: Both the tendering processes as well as internal administrative processes take too much time.

Participation processes: Although important and necessary participatory processes require time to arrive at an agreement between the district committees, local citizens and the city council. One example of such an issue is the elimination of parking spaces. This topic not only affects the residents but also local businesses, which fear that these measures might affect their business negatively.

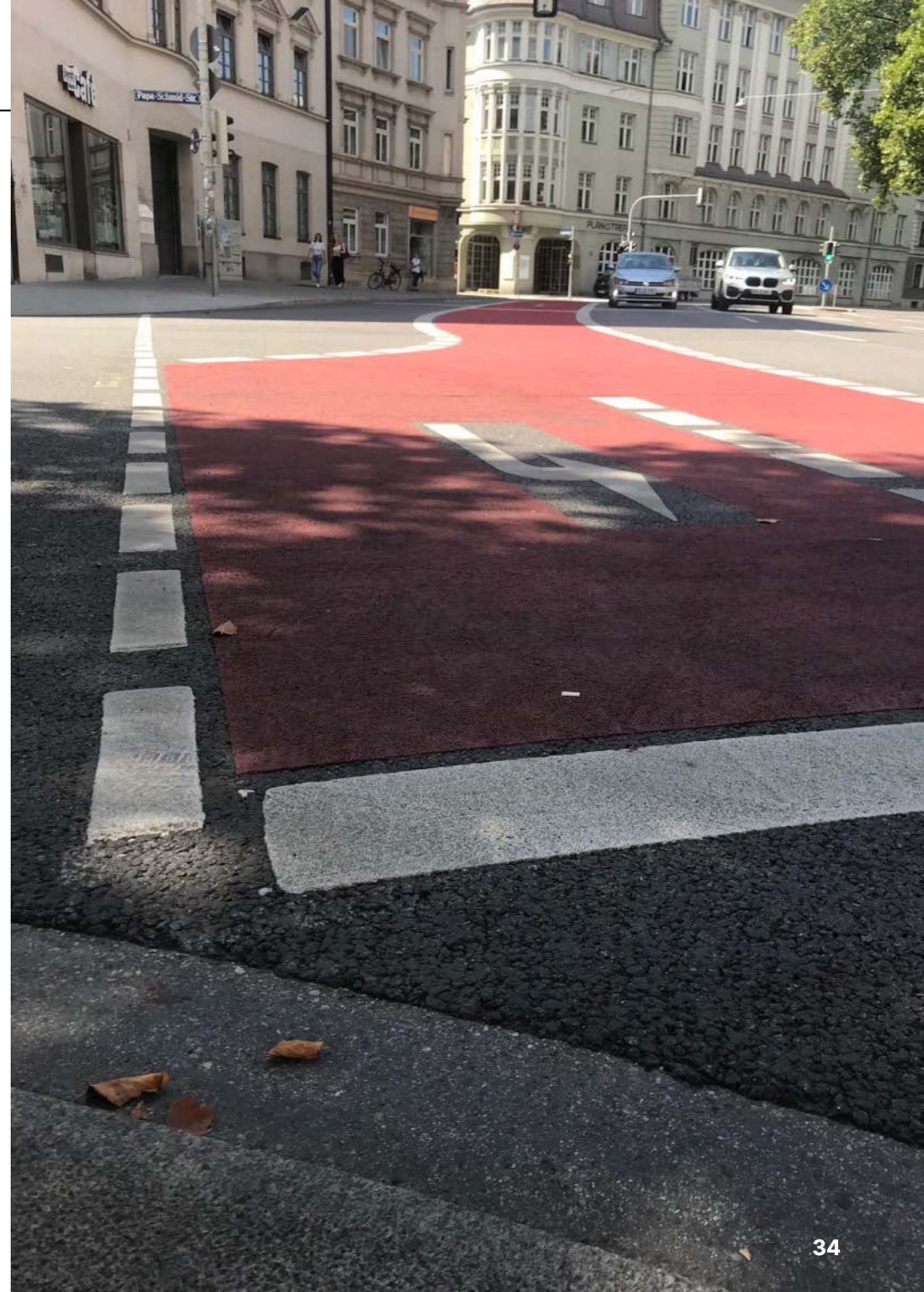
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The Radentscheid alliance is still active in demonstrations and events and has several demands for the city to ensure the implementation of the cycle network according to the referendums (Bündnis Radentscheid, 2022a):

- Concept of implementation: The alliance asks for a concept of implementation until the fall 2022.

UPDATE ON RADENTSCHIED AND ALTSTADTRADLRING

- Evaluation: A transparent evaluation of the progress of implementation to be published on the website of the city of Munich.
- Temporary solutions: For those parts of the Altstadttring, which offer the worst quality of service to cyclists, the alliance demands interim solutions, to increase safety and visibility of the cyclists quickly.
- Planning approach: The planning of the Altstadttring should be in accordance with the demands of the referendum in terms of cycling infrastructure and in equality with public transport.
- Paint Altstadttring: The Radentscheid alliance requests the Altstadttring to be painted green, to help with orientation and visually highlight the importance of this route.



MOBILITY STATIONS

As Munich is constantly growing, new transportation needs are arising. Therefore, the City of Munich would like to provide mobility options for everyone, anytime and anywhere with MVG. Shared mobility offers in combination with public transport relieve the parking spaces and congestion in big cities as well as in Munich so that the so-called mobility stations have been implemented starting November 2014 (Miramontes et al., 2017)

Motivation and Goals

Mobility stations or mobility points combine shared mobility offers and public transport in one place in an affordable, spatially flexible and environmentally friendly way (München Unterwegs, 2022). This type of operation makes the organisation of the cars simpler and also enhances the visibility and reliability of the vehicles. With the mobility stations, it is intended to create an alternative to private cars by offering public transport and shared mobility solutions (vehicle sharing, bike sharing and micromobility) in one location (München Unterwegs, 2022).

Stakeholders

City of Munich, MVG and shared service providers.

Implementation

The implementation of 17 mobility hubs was completed in the 2014-2020 period (City of Munich, 2022). Depending on the location, the following mobility services are offered at mobility stations (München Unterwegs, 2022):

- electric charging stations
- e-parking

- car sharing, e-car sharing
- bike sharing
- e-scooter sharing
- e-cargo bike sharing
- public transport such as S-Bahn, U-Bahn, tram and bus.

One of the mobility stations in Munich is in Münchner Freiheit and within this mobility station, the following transport modes were combined in one spot: underground, bus, tram, taxi, bicycle parking facilities, car-parking spaces, carsharing and MVG Rad (MVG, 2015). Moreover, five parking spaces for car sharing vehicles are offered as well as the charging infrastructure for electric car sharing vehicles. The additional real-time information is also given using the information pillar (MVG, 2015)

Outcomes and Discussion

With mobility stations, someone can choose the best mode of transportation for every need without needing to commute that much. It could be a bicycle, e-scooter, a car or a PT offer depending on the location. Moreover, anyone who takes the advantage of these deals saves money, has more freedom, and benefits from mobility that is specifically tailored to them (München Unterwegs, 2022) and there have been researches about evaluating the perfor-

The project was started in 2014

By 2026, up to 200 stations are planned to be built

mance of the mobility stations. According to Wulfhorst et al., one third of the respondents learnt about the mobility station concept by chance when they were passing by, and it is also showing that the better promotion needs to be intended for the future so that more users will be able to take the advantage of the offerings of a mobility station (Wulfhorst et al., 2017).

By 2026, it was planned that up to 200 mobility stations will be established according to the shared mobility sub-strategy that the city council approved on January 19, 2022 (München Unterwegs, 2022). To create a dependable and alluring multimodal overall transportation system, the vision of the geographical, temporal, and functional availability of shared mobility offerings in Munich is being pursued (München Unterwegs, 2022).

BUS MIT FÜSSEN

How to get to the school is a crucial topic, especially for the first graders. To do that in an effective and environmentally friendly way, the City of Munich launched a project called "Bus mit Füßen" to provide children with a safe environment when there is a need to go to school (Bus mit Füßen, n.d.). With this project, the children walk to their schools together with the assistance of one parent in turn (Bus mit Füßen, n.d.).

Motivation and Goals

The project aims to socialise and teach responsibility and mobility safety to young school children. The project presents a mobility alternative through a collective organisation of parents and schools. A responsible parent acts as a bus driver, collecting up to 8 children at bus stops on the fixed route to school (München, n.d.). The children learn in a playful way, several aspects that make them engaged citizens, sociable, and who understand from an early age that mobility is not only about cars.

Stakeholders

As indicated before, the project is organised by the City of Munich and it is run by the effort of the parents and their children.

Implementation

Initially, the children are accompanied by a parent so that the arrival to the school is ensured in a safe way. After that, when children start to make their way to their school confidently and safely, they can go to the school even without any assistance from the parents (Greencity, 2018).

The city provides information, support and the platform. The project execution is totally run by

the children and their parents. The predetermined routes are selected to pick up the children from the designated "stops" (Greencity, 2018). Moreover, the city provides a map of the official school routes and there are additional volunteers that are spread across the city on those routes that help children to cross streets (Bus mit Füßen, n.d.).

Outcomes and Discussion

With "Bus mit Füßen", walking to the school with friends is not only more fun and at the same time, it teaches the right behaviour in traffic and makes sure that children can better navigate themselves in their neighbourhood (Greencity, n.d.). Moreover, the children can become more independent step by step and the possible dangers related to road traffic can be discussed in a real life environment (Greencity, n.d.).

In addition to that, it will reduce the total amount of car trips in the city thus avoiding gas and noise emissions. Moreover, this project is creating a good opportunity to develop a sense of community between both parents and children. However, it might raise some of the safety concerns regarding leaving children with others as well.

KEY FACTS

Safe arrival of children to their schools with parents

Helping people to socialise with each other by learning traffic rules



Figure 3. Children on their way to school (Greencity, 2022)

MÜNCHEN EMOBIL

The climate neutral “München emobil” funding program supports vehicles, charging infrastructure, and consulting services to help reduce local CO2 emissions and the consumption of fossil fuels in Munich (City of Munich, 2022). The funding program is part of the “Integrated Action Program to Promote Electromobility in Munich”. It has been possible to apply for funding for the “Munich emobil” funding program since 01.01.2021 (City of Munich, 2022).

Motivation and Goals

Internal combustion engines with high mileage in the middle of the city are to be replaced by electric drives. City of Munich is convinced about the fact “We can’t do without cars completely” (Hutter, 2019). Thus, individual transportation will continue to be necessary for numerous services in the city. In this respect, the environmental officer of the City of Munich is claiming that there is the need for electricity used vehicles instead of gasoline and diesel, at least directly on the spot (Hutter, 2019). To support that, the “environmentally-friendly” funding program has been supporting cargo bikes, bicycle trailers, electric vehicles, charging infrastructure and consulting services (City of Munich, 2022).

Stakeholders

- City of Munich is regarded as the authority for project financing.
- The citizens of Munich and consulting services are the possible receivers of the grant.

Implementation

The program provides funding for vehicles, charging infrastructure and consulting services:

- Vehicles: Eligible vehicles for funding are cargo bikes, bicycle trailers as well as light electric vehicles. Cargo bikes will be supported with 25% of the net costs up to a maximum of 500 Euros and three and four wheel light electric vehicles are also subsidised up to a maximum amount of 25% of net costs (City of Munich, 2022).
- Charging infrastructure: The charging infrastructures which are publicly accessible and non-publicly accessible are funded within the scope of “München eMobil”. For normal and fast charging stations, up to a 40% of the net costs are subsidised (City of Munich, 2022).
- Consulting services: The consulting companies are also encouraged to contribute to the München eMobil program. They are supported up 80% of the net costs on electromobility provided by certified consultants. (City of Munich, 2022).

KEY FACTS

Funding program for vehicles, charging stations and consulting services

Promotion of e-mobility to reduce the CO2 emissions

Outcomes and Discussion

Vehicles, charging infrastructure and consulting services are eligible for the funding program as indicated before. Applications can be submitted by private individuals, companies, non-profit organisations and homeowners associations (City of Munich, 2022). More than 12,000 electrified vehicles and over 1,300 charging points on private property have now been supported by München eMobil (Werwitzke, 2020). At the beginning phase of the project, the department for health and the environment received only under 600 applications in 2016. However, in 2019 it was more than 4,000 (Werwitzke, 2020).

New funding was approved on June 29, 2022 with a new software in use. The funding program will start on April 1, 2023 (City of Munich, 2022). The funding program also faced some criticism from some of the politicians. According to Michael Mattar (FDP), the funding program is not a well thought-out concept. He claims that the city needs to concentrate on the infrastructure first rather than focusing on promoting the electric car and in his opinion, public subsidies need to be directed prioritising the infrastructural investments (Süddeutsche Zeitung, 2016).

2. STAMMSTRECKE

KEY FACTS

Planned to be finished earliest in 2033

The project cost increased from 3.8 to 5 billion Euros

The metropolitan area of Munich is growing fast and currently, the S-Bahn system which was designed to carry 250,000 people carries 840,000 passengers every working day (DB Netze, 2021). Followingly, the need for the new S-Bahn line was realised and the project "2. Stammstrecke" began to be launched.

Motivation and Goals

The population expansion will result in more people using local and regional public transportation and it is well aligned with the vision of the city promoting wider usage of public transport (DB Netze, 2021). However, especially for the S-bahn line, there is a bottleneck that all the city's S-Bahn lines are using the same core route from Pasing to Munich East Station and the rising flow of commuters and the resulting increase in passenger numbers are too much for the current route to handle. Therefore, the moment has arrived to assist Munich's S-Bahn system (DB Netze, 2021).

As a result, the solution to relieve the bottleneck in the Munich S-Bahn system is to construct the second-core-route tunnel. This will make it possible for local public transportation to keep up with the metropolitan area's expansion. The project is crucial for improving connections between the entire metropolitan area and the city centre of Munich as well as for offering a quick and alluring route to Munich Airport (DB Netze, 2021).

Stakeholders

The project has involved so many stakeholders both for operation, construction and financing.

Deutsche Bahn, S-Bahn Munich, City of Munich and the Federal State of Bavaria are the main stakeholders helping the project to be finalised in an effective way.

Implementation

The implementation process of "2. Stammstrecke" involves several stages. At the end of the project, there will be three tunnels (two S-Bahn tubes and a safety tube) lasting for seven kilometres long and the line will be operated from Laim to Leuchtenbergring (Figure 4).

The second trunk line also requires new three underground stations which are (Munich Central Station, Marienhof and Munich East Station). In addition to those, there will be new constructions and expansions on the above ground transfer stations between the 1st and 2nd trunk line as well as inclusion of the barrier-free expansion of Leuchtenbergring.

Outcomes and Discussion

With the 1st trunk line, there were a considerable amount of problems that needed to be solved with a new line. In the existing line, even though the service is operated every 2 min, as they are using the same line, when one line is

disrupted, it has an obvious effect on the other lines as well. It results in the delay of all consecutive trains and that punctuality issue is important to make the public transport attractive to the passengers so that a second core route will make sure that passengers will be able to reach the city centre even when there is a major disruption (DB Netze, 2021).

In terms of the construction progress, the second main line of the S-Bahn is experiencing huge delays and expected to be completed more expensive than planned (Effern, 2022). According to Süddeutsche Zeitung, the estimated project cost will be increasing from 3.8

billion to 5 billion euros. Moreover, the first operation start is not expected to happen before 2033 which was scheduled for 2028 at first (Effern, 2022). This news is also perceived by the Munich City Hall with some questions. The questions about the reason of the delay and massive cost increase are still open and waited to be answered clearly (Effern, 2022)



Figure 4. 2. Stammstrecke (DB, Netze)

FUTURE OF PUBLIC TRANSPORT IN MUNICH

Besides 2. Stammstrecke, two other projects are planned for the future of the Munich: U9 Line and Westtangente. U9 Line is covering the districts in the north-south direction from Impler-/Poccistrasse to Münchner Freiheit along 10 km of route (MVG, n.d.).

Another project Tram Westtangente is also one of the most important local transport projects in Munich which is ensuring an improvement in the west part of Munich (MVG, n.d.). It is aiming to connect five districts beginning at Romanplatz, running along Fürstenrieserstrasse and ending at Aidenbachstrasse (Figure 4) (MVG, n.d.).

Motivation and Goals

“More flexible, more reliable, more powerful - and more sustainable”. These are the goals for Munich’s public transport operation determined by MVG (Public Transport Provider of Munich). In alignment with that vision, the new U9 line offers a holistic solution with a new line through the city. It intends to have a mitigation of the busy routes like a kind of bypass and with the launch of U9, the existing lines will be able to be operated much more independently of one another and thus with less disruption (MVG, n.d.). The population growth affected all parts of Munich as well as the Western part. As a result of that with the Westtangente project, the fast direct connections are aimed for the western part of Munich. Passengers will be benefiting from more punctual and efficient tram operations than today’s buses with its own protected lane (MVG, n.d.). In addition to that, with Westtangente, a green grass track and more green areas with trees are going to help to enhance the environment. (MVG, n.d.).

Stakeholders

MVG, City of Munich and Federal State of Bavaria are in close collaboration to finish the project as operational efficiently as possible.

Implementation

As indicated before, U9 is connecting Sendling and Schwabing along 10.5 km of new network which requires the construction of five new underground stations. There is already one planned stop at Munich Central station so that a new transfer option is offered to the second S-Bahn trunk line. Moreover, to handle the high demand during Oktoberfest, at Esperantoplatz, Munich will have a second U-Bahn station (MVG, n.d.). MVG is currently predicting the construction work will start in the early 2030s and expected completion time will be early 2040s.

On the other hand, Westtangente is going to be operated along 8.25 km of line with 17 stops and it will result in the expansion of the current tram network by 10% (MVG, n.d.). In April 2020, the planning documents were submitted to the government of Upper Bavaria and the whole section is expected to be finished in 2027 (MVG, n.d.).

Outcomes and Discussion

The population growth in Munich has a significant effect when determining the new PT infrastructure in the area. The operation in many districts has reached its capacity limits

and the overcrowded transfer stations make some passengers avoid using public transport. To overcome these issues, new projects were planned such as U9 and Westtangente (MVG, n.d.).

With U9, more capacity will be generated in north south traffic and thus it will relieve the overcrowded transfer stations in the centre of Munich by up to 30% (MVG, n.d.). The project financing is still an open subject. It is aimed to be public funding and this process requires a detailed cost-benefit analysis (MVG, n.d.). The construction cost is estimated around 3 billion euros. Furthermore, according to Abendzeitung, it is claimed that the construction work is highly dependent on the progress of second trunk line operation (2. Stammstrecke) as they have common connections at Munich Central Station and the construction work cannot be started before the work for the second trunk line was finished (Schleicher, 2022). Considering the financial and construction uncertainties of the second trunk line, that uncertainty will apply for the progress of the U9 construction as well (Schleicher, 2022).

The Westtangente will also help to solve the congestion problem of Munich by creating a protected tramline in the Western part of the city. It is aiming to bring the passenger in the west of Munich to their intended locations “faster”, “more reliable”, “more punctually” and “more comfortably” (MVG, n.d.). The trams can

carry more passengers than a car or bus with a more reliable time schedule and its capacity is open for the increase in future (MVG, n.d.). As indicated before, the line is expected to be finished in 2027 and the city is pushing to finish the first section between Romanplatz and Waldfriedhof from Spring 2023 (Hertel, 2021).

Expected completion time:

U9: early 2040s

Westtangente: 2027



Figure 5. Westtangente (MVG)

MVGO & MVG SWIPE+RIDE

MVGO is an app of the MVG that provides a platform for multimodal mobility. It is free to use and allows the user to get information on modes as well as to buy tickets.

MVG Swipe+Ride is a pilot project that aims to explore dynamic and distance driven price models rather than fixed rates. The project is part of the eTarif which is a smartphone-based check-in and check-out system for public transport.

Motivation and Goals

Throughout the time more and more solutions and offers appeared in Munich. To bundle public transport and sharing providers the MVG developed an app called MVGO. The main idea behind it is to encourage people to leave behind their private car and shift to shared mobility.

The advantage of the model is that only the actual trip distance has to be paid for. Especially for people that are currently only doing little to no trips by public transport this is quite handy as they do not have to buy a weekly/monthly subscription.

Stakeholders

MVGO: MVG, TIER, Emmy, VOI, Trafi

MVG Swipe+Ride: MVV, Munich, Bayr. Regio-bahn, S-Bahn München, Verbund Landkreise im MVV, FAIRTIQ

Implementation

Currently there are five different sharing options that can be booked in addition to public transport tickets:

- MVG Bike, Emmy Electric-Scooter, Tier Electric-Scooter, Voi City-Scooter, Tier City-Scooter

After downloading the app MVGO one has to create an account at M-Login which is the centralised service portal of the Stadtwerke München. The all-in-one solution allows an

easy transaction and a built-in drivers licence verification tool. The trip planning tool adjusts to real time traffic situations and shows the location of the vehicle in real time. The platform for MVGO is provided by Trafi which is the world's leading mobility-as-a- service technology company. They do not only provide platforms for cities but also for companies and their internal mobility program. Trafi is used in the same way by the cities of Berlin and Vilnius where the company is from. In Switzerland things were taken a step further where the Swiss Federal Railways SBB and the public transport operators of Zurich, Basel and Bern founded a cooperation for a cross-city Maas platform called "yumuv". With a single registration user can access mobility solutions in each of the cities.

The costs of the trips are split in a reduced and a regular fare. The reduced fare is applied for stations with few departures, while the regular fare comes into effect for busy stations (e.g. central station). The total costs consist of a base fare that is always applied and a price per km driven as shown in the table. Though the distance is not calculated based on the railways track length but on the beeline distance between the start and end station of the trip. By making more trips per month the customer gets a price reduction on the monthly invoice. Four rides per month reduce the costs by 10%, while six trips bring in 20% and eight trips 30%. The process of booking or buying a ride is fairly simple. Once a customer has registered on the website of Swipe+Ride and downloaded the app, he or she just has to swipe right on the

Timespan:

MVGO: 2021 - ongoing

MVG Swipe+Ride: 2020 - 2022

KEY FACTS

app before getting on the ride. To end the ride at the destination a simple swipe to the left is enough. The customer can see the ride price afterwards and the invoice is done automatically. The pilot project started at the end of October 2020 and goes on for two years. The market research that runs in parallel to it goes on for another six months. The software and the smartphone app of the eTarif is provided by the Swiss company FAIRTIQ. They specialised on the distance- travelled price model.

Outcomes and Discussion

After half a year of testing, the first feedback loop was done. Main results were that most of the customers (75%) are working from home at least most of the time and are therefore ideal for the project concept. More than half of the users are between 30 and 49 years old and only one quarter of all of them lives outside of the city. Their biggest demand was an automatic check-out function which has been implemented by FAIRTIQ.

Developing an app that contains different modes of transport improves the user experience drastically. Unfortunately though, not all modes or providers can be booked through the app which leaves the user behind with different apps and accounts once again. Nevertheless, the app allows constant updates and new mobility solutions to be added. With that potential, MVGO can develop into a holistic mobility platform and combine the various mobility offers that can be found in Munich already.

While the concept and their product are already usable throughout Switzerland and Lichtenstein, only 11 transport associations in Germany use it. Though cities like Bremen, Flensburg and Magdeburg have already successfully implemented the concept - some of them already in 2020. Currently the eTarif is only accessible to a limited number of 5.300 test customers that are obliged to regularly share feedback on their user experience.

Outlook

On a longer term MVG will probably follow the transport operator in Berlin BVG by adding more mobility solutions. When the app launched in Berlin in 2019 people were already able to book rental bicycles of Deezer, city scooters of Tier electric scooter of Emmy, shuttle-services of BerlKönig as well as rent cars from sharing stations of Miles, DB Flinkster, Mobileeee and Oply.

The concept of a distance-based price model has been proven successful as Flensburg, Bremen and Switzerland have shown. Additionally, the comments of the first feedback loop support the MVV and their pilot project and promise good chances for it to be implemented for daily operation after the test phase.

POP-UP BICYCLE LANES

Pop-up bicycle lanes were temporary measures to improve cyclability in Munich in 2020. During the Covid-19 pandemic, the number of cyclists increased as people switched public transport to bicycles.

Motivation and Goals

The Covid-19 pandemic led to an increase in cyclists of 20% in April 2020 in comparison to the previous year. Unfortunately, though, the number of accidents increased by 16% in the first four months of the same year. So the City of Munich, as well as other cities around the world, decided to improve the situation for cyclists.

Stakeholders

City of Munich, Bündnis Radentscheid, Citizens

Implementation

That's why in May 2020 the City of Munich decided to build non-temporary bicycle lanes on five roads across the city in June 2020. The yellow marked bicycle lanes were easy to construct and provided cyclists with additional comfort, travel speed and safety. Throughout the summer the temporary lanes were very popular and highly appreciated by Munich's cyclists.

It was very surprising for all of them as the City of Munich decided to end this temporary field test and deconstruct the lanes at the beginning of November 2020. The reason behind it was that they were just a temporary measure, more serious and longer solutions are required and that the field test has to be evaluated now.

According to a local SPD- politician the yellow road markings of the pop- up lanes would not be visible enough throughout the winter season. Better no bicycle lane than a poorly visible one.

Outcomes and Discussion

After the evaluation process the City of Munich decided in March 2021 that the temporary measures of the previous year are being turned into real bicycle lanes. The yellow paint is replaced by regular white road markings. The costs were estimated to account to 600,000 Euro. The conservative party of Munich expressed their concerns as parking spots have to be taken away from car users. Until May 2021 four of the five former pop-up bicycle lanes were rebuilt as regular bicycle lanes. The mayor of Munich, Dieter Reiter, stated that these new lanes are also just temporary measures until the city planners found serious constructive solutions for cyclists on these roads.

In June 2021 the automotive club "Mobil in Deutschland" brought an action against the new bicycle lanes as they would take away space of the – as they imply – "main mode of transport in Munich".

Pop-up bicycles lanes were a popular measure to improve cyclability in cities. In London, things were taken to another level as more than 100km of new bicycle lanes were taken into action. While London rightfully took the lead of

pandemic-related mobility adaptation, Munich still implemented bicycle lanes the have proven to be needed and wanted but also to be highly appreciated and extensively used. Further, the City of Munich decided to transform the temporary lanes into permanent bicycle lanes and thereby show their will to improve the situation for cyclists.

Impact

With people switching cars to bicycles air quality can be improved (AIR). Redistribution of public space, especially of roads, is a highly controversial topic (SPACE). Bicycles are usually as fast as cars in urban space (TIME).

Duration: 2019 - ongoing

KEY FACTS

GENERAL INFO

IAA

IAA (Internationale Automobil-Ausstellung) is the trade exhibition where most of the German car manufacturers (BMW, Audi, Mercedes, etc.) show their latest models of their vehicles and innovative proposals. The first show was dated back in 1897 at Berlin's Bristol Hotel. Since then, because of the event's high popularity, the IAA started to be organised in a periodical manner (IAA, 2013).

After 20 years of the fair in Frankfurt, the IAA decided to move to Munich in 2021. The show in Frankfurt was losing its popularity and fewer car companies as well as fewer participants started to attend the show. Therefore, there was a need for change and Munich became the new location to host the IAA starting 2021 (Raynal, 2020).

400,000 visitors from 94 countries attended the IAA Mobility 2021 in Munich (Munich, 2021). For the event, Odeonsplatz and Wittelsbacher were completely transformed besides the main events in Trade Fair Center Messe Munich (Mayer & Wirsing, 2021). In terms of the positive aspects, Mayer and Wirsing are claiming that the timing was pretty good just after a dense Covid period. Moreover, the powerful collaboration between Messe Munich, the City of Munich, the Bavarian State and the VDA made the event organised in a smoother way (Mayer & Wirsing, 2021). In addition to those, according to Munich's Mayor Reiter, it was a satisfactory performance that Munich was showing during the IAA. He claims it was the right decision to bring the show to Munich and it was beneficial for the trade, hotels and gastronomy sector as well as for the automotive industry. He also mentioned that the IAA started to turn into a mobility show rather than being just a car fair.

On the other hand, the objections to the IAA have also happened in Munich's show as well. During the closing weekend of the show, 13,500 people in Munich attended the protests to question the lack of environmentally friendly actions from the car manufacturers (Appunn, 2021). In addition to that, it has also been criticised that the IAA is only organised by VDA, German Association of the Automotive Industry, and thus focuses only on the cars which is opposite to the claims of Reiter's comments about the show (Appunn, 2021).

For next year's show, it is planned that it will be organised again in Munich Messe. Around the dates that IAA will take place, there will be Oktoberfest only with a break of the week and it raises the questions about how these two big events are going to be arranged at the close dates. In addition to that, there are also time conflicts between IAA 2023 and the other events such as Streetlife Festival and Corso Leopold (Hertel, 2021). KVR claims "overall, there are hardly any other locations for those events". Therefore, KVR demands a possible solution for the next IAA 2023 (Hertel, 2021).

9-Euro Ticket

At the end of May 2022, the German government presented new measures to reduce the financial burden of households due to the increasing energy prices. Among other things, a limited offer of a 9-Euro-Ticket was introduced. From June 1st to August 31st, 2022, passengers nationwide could use public transport for only nine euros per month.

The 9-euro ticket does not entitle people to travel on long-distance ICE (Intercity Express), IC (Intercity), EC (Eurocity) or Thalys connections. Other private operators, such as FlixTrain, are not participating in the scheme either. They cannot be used for travel in first class carriages.

The ticket is largely restricted to domestic connections. Certain exceptions do, however, apply. Ticket holders may, for instance, take a Bavarian regional train (BRB) to nearby Salzburg and Kufstein in Austria. Similarly, Aachen transport association in Germany's far west, runs select services to the Netherlands and Belgium, which may be used with the 9-euro ticket.

The €9 monthly travel pass boosted rail usage, particularly in more rural and tourist areas, the latest statistics suggest. In a blow to the hopes of many environmentalists, road usage, however, was virtually unchanged, suggesting little impact on commuters according to a report by the German Federal Statistical Office, Destatis. According to them, the number of train trips longer than 30 kilometres (19 miles) in July was 42% up in comparison to the same month in 2019. A similar increase was logged in June.

In rural areas popular with tourists, the number of trips rose by an average of 80% in both June and July in comparison with the same period in 2019. The rise was particularly high for middle-distance trips covering between 30 and 100 kilometres in such regions. The number of such journeys was more than double that of 2019, having risen 104%.

Increases were smaller for longer-distance journeys. This could be because high-speed trains are not included in the €9 ticket, and long journeys on regional trains can be very time-consuming.

Urban areas that are popular with tourists did not see as big a rise, with the number of trips in June and July 28% higher than in the same months of 2019. Destatis said that as a nationwide average, there was no change in the volume of road traffic in June and July in comparison with 2019, though there were some slight regional differences.

It said the number of trips by road of between 30 and 100 kilometres was, on average, slightly above that in 2019. There were, however, fewer trips between 100 and 300 kilometres, a trend that increased for journeys longer than 300 kilometres. Trips by road fell by 18% in all rural areas and by 10-12% in urban areas, depending on their tourist attraction.

Germany's much-lauded 9 euro ticket, which enables people to make unlimited use of public transport, has mostly resulted in additional journeys. It has not, as was hoped, resulted in people leaving their car at home, preliminary findings show.

MCube

The Munich Cluster for the Future of Mobility in Metropolitan Regions (MCube) pursues the vision of establishing Munich as a pioneer for sustainable and transformative mobility innovations. Due to the unique geographic concentration of innovation actors in the mobility sector, MCube uses the area as a “learning region” to develop scalable solutions with model character for metropolitan regions in Germany and worldwide over the next nine years.

The long-term cluster has the potential to actively shape the mobility transformation beyond the region. Building on existing cross-technology, cross-disciplinary and cross-sector collaborations, MCube unites key players from science, business and society to realise leap innovations with great economic impact and high solution potential for global challenges.

MCube pursues an open and mission-driven culture of innovation. Their vision statement “Innovations for mobility transformation: enabling possibilities together” is an interplay of three missions: the quality of time, the quality of space and the quality of air.

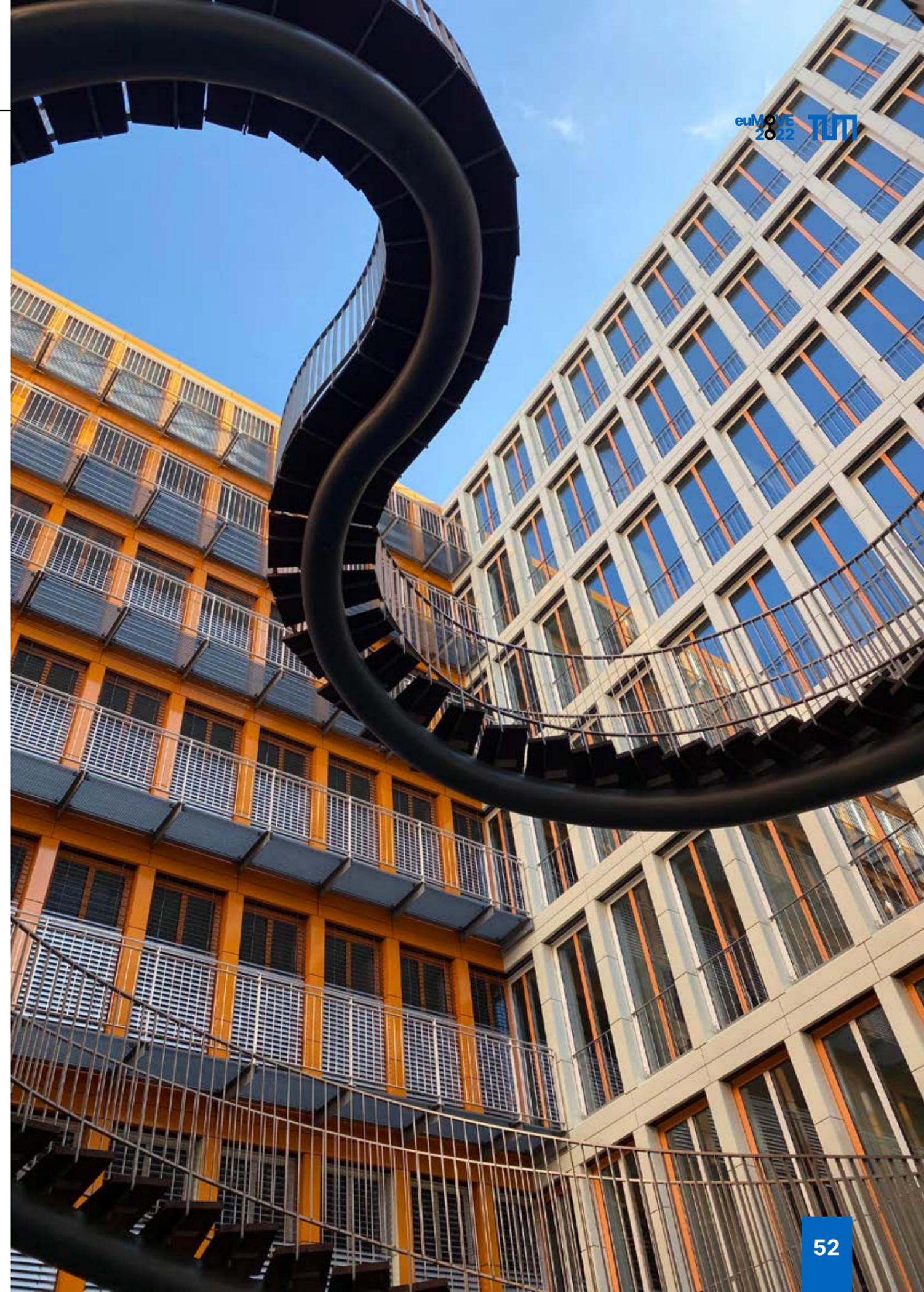
Quality of time refers on the one hand to the efficiency of the transport system, with a view to infrastructure capacities and traffic flow. On the other hand, it refers to reliable and comfortable mobility between everyday locations.

Quality of space refers to the impact of mobility innovation on public space and regional open spaces. The aim is to create new diverse recreational and exercise spaces that are accessible to the entire population.

Quality of air refers to traffic-related environmental pollution. All MCube projects aim not only to reduce local air pollutants but also contribute to the global climate by saving CO₂ in addition to reducing local air pollutants.

The three missions of the MCube cluster strategy are taken up and pursued in the form of concrete projects. At the technological and social level of innovations, MCube comprises eleven innovation projects in three innovation fields, which are being worked on in transdisciplinary consortia and are aligned with current key topics in the mobility sector. Three integration projects in three strategic integration fields are horizontally linked to this.

Mobility innovation requires a holistic innovation process that brings together the results of science and the participation of local stakeholders from business, society and local authorities. MCube links nationally and internationally leading research institutions and corporations with an innovative SME sector, start-ups, and NGOs.



CHALLENGES

In this section, we provide an in-depth study of key challenges for mobility in Munich. We subsumed the identified challenges under the mission objectives of the Munich Cluster for the Future of Mobility in Metropolitan Regions – MCube, which pursues the vision of establishing Munich as a pioneer for sustainable and transformative mobility innovations. Its mission objectives are: Quality of Time, Space and Air.

Quality of Time

Quality of time refers to the efficiency of the transport system, with a view to infrastructure capacities and traffic flow but also to reliability and comfort between everyday locations (MCube 2022). Concerning both efficiency and reliability, rail-bound rapid transit such as the Trunk Line 2 and the Tram Westtangente play a crucial role in moving people in a growing city in the future. In terms of time, the biggest remaining challenge is to achieve an improved intermodality by a better integration of transport modes and ticketing systems. With projects such as MVGO and MVG Swipe and Ride first steps into this direction are made. However, the utilisation of digital technology offers room for even more improvements on both, efficiency of the transport system as well as reliability and comfort.

Quality of Space

Quality of space refers to the impact of mobility innovation on public space and regional open spaces (MCube 2022). This includes the (re-)distribution of space as well as innovative planning solutions. In terms of space, key challenges include the (re-)distribution of space and other resources among transport modes. With initiatives such as the Summerstreets, parking spaces for e-scooters, Radentscheid München, and the creation of Mobility hubs, many projects are underway to address the challenges related to space and planning. However, with the reduction of parking spaces in the inner city, the (not yet) car-free Oldtown (Autofreie Altstadt) and additional spaces for walking and cycling key challenges to improve the quality of public spaces remain. Nevertheless, it is also important to understand that the implementation of some policies such as increasing the currently low resident parking prices (30 Euro/ year) lie beyond the domain of the city but with the Free State of Bavaria (Landeshauptstadt München 2022).

Quality of Air

Quality of air refers to traffic-related environmental pollution (MCube 2022). This can be caused by traffic congestion, the age, type and powertrain of the vehicles and the amount of car registrations. As traffic data shows that congestion is quickly rising to pre-pandemic levels, the most important challenges regarding the air quality therefore include the increasing number of car registrations as well as overall traffic (INRIX 2021). With projects such as the funding program München eMobil and Bus mit Füßen important steps to address them have been undertaken already. However, more steps to nurture a change in mobility patterns, which makes sustainable modes of transport within

the city more and unsustainable mobility patterns less attractive, need to be implemented. Here, the promotion of active mobility but also the introduction of dynamic pricing schemes for driving and parking are of key relevance.

The rise in congestion to pre-pandemic levels, leads to another key challenge: Covid-19 adaptations. Before, it is important to mention that in addition to the quality of air, space and time and the pandemic there are other challenges such as social equity & traffic safety, administration and finance issues and the (im-)balance of mobility supply and demand (BR24 2022). Due to the limited scope of this paper, they can not be addressed.

Covid-19 adaptations

In addition to the mission objectives of MCube, we selected Covid-19 adaptations as a fourth key challenge for mobility in Munich. This is due to its overarching character and the fact that it has not been fully answered yet, in which lessons Munich will draw from the pandemic.

On the one hand, it is clear that mobility patterns have changed during the pandemic. When developments like working from home became more popular, not only congestion levels went down but also a change in citizens' perception of public space occurred: Space efficiency & accessibility gained relevance (Interview, June 15, 2022). From interviews with local mobility experts, we also learned that the strategic considerations and long term planning of public transport operators and municipal administration were not intruded by the pandemic but it rather was a catalyst for previously decided on projects such as the Pop-up bike lanes and accordingly fueled their implementation (Interview, June 14, 2022). On the other hand, the private car became more popular for work and leisure travel as it was perceived as a safe mode of transport in pandemic times. Among other reasons, this led to a rise of congestion to pre-pandemic levels (Bayerisches Staatsministerium für Wohnen Bau und Verkehr 2021; TomTom 2022).

Key challenges for mobility in Munich including answering important open questions concerning the pandemic and the city's reaction: How will change in mobility patterns play out in the long term and how can the city support a change in commuting patterns to greater sustainability? How could they be interlinked with policy measures on other governance levels? Besides Pop-up bike lanes, which changes in the distribution of space and planning processes can be made to make the city more resilient? Which formats are suitable to organise citizen participation in times of social distancing? Which role does digital technology play in this regard? All of this points to the question of how mobility in Munich will look like in the post-pandemic era, if it will be business as usual and how the momentum created by the pandemic can be channelled into policy changes.

CONCLUSION

In this chapter, we presented mobility in the City of Munich and its challenges. Thereby Munich serves as a starting point and kicks off our benchmarking urban mobility analysis across several European cities.

In our location analysis, we argued that Munich is a city with a solid economic background and a growing population. In addition to a strong network of stakeholders with competences in mobility that go beyond traditional industry, including research and startups, it also comprises an active civil society that seeks to influence transport policy and shapes the city and its urban form. In our urban mobility analysis, we were able to demonstrate that the private car is still the dominant mode of transport. Furthermore, Munich includes a comprehensive public rapid transit network, which is although limited due to its tangential public transport connections. Moving forward, the mobility strategy 2035 and the city development plan STEP2040 present a clear municipal vision and strategic roadmap in how to turn desired changes into reality.

With the projects presented in this chapter, Munich presents itself as adaptive to change and echoes developments in other European cities. Concerning Redistribution of Space, Munich follows with the project of Sommerstraßen a popular trend that has by now changed the appearance of many cities and increased the quality of stay. For New Transport Infrastructure we presented Trunk Line 2 (Zweite Strammstrecke), Munichs infrastructure flagship project, which will make its public transport ready for the next decades. With regards to Innovative Planning, München eMobil serves as one example for a municipal funding program to facilitate the shift to non-fossil fuel drive trains that will help to drive local emissions down. For the cluster of Covid-19 Adaptions, we discussed pop-up bicycle lanes but also illustrated that some questions regarding the city's reaction to the pandemic are not fully answered yet.

In our challenges section and SWOT-Analysis we evaluated the impact of projects against the status quo. Overall, our analysis confirms previous findings from euMOVE2020 and euMOVE2021. We highlighted that despite the projects on the way some key challenges remain: For one thing, there is a need for a better integration of transport modes and ticketing systems to improve intermodality (Quality of Time). In terms of quality of space, the reduction of parking spaces in the inner city, the (not yet) car-free Oldtown (Autofreie Altstadt) and additional spaces for walking and cycling remain to be implemented. Moreover, the increasing number of car registrations as well as overall traffic present a challenge to the quality of air.

An important limitation to this report, however is not only Covid-19 as an element of uncertainty for longterm predictions but also the fact that mobility governance in Munich and its performance in comparison to other European cities is interlinked with other levels of governance, such as the state level (e.g. parking prices for residents) or the national level (e.g. 9-Euro-ticket). With this in mind, we will continue with our cities in order to be able to benchmark mobility innovations in different European cities and evaluate their applicability to the City of Munich.





OUR TEAM	60
INTRODUCTION	61
LOCATION ANALYSIS	65
URBAN MOBILITY ANALYSIS	67
SWOT ANALYSIS	71
PROJECTS IN BRUSSELS	72
<u>LOW TRAFFIC NEIGHBOURHOODS</u>	75
<u>CITY30</u>	79
<u>BUILDING A BETTER BIKING BASE</u>	83
<u>WERKEN AAN DE RING</u>	87
<u>E-SCOOTER REGULATIONS WITH GEOFENCING AND VIANOVA</u>	91
<u>MOVE BRUSSELS - MOBILITY AS A SERVICE</u>	95
<u>CONFORMING TO COVID</u>	99
CONCLUSION	103

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INTRODUCTION

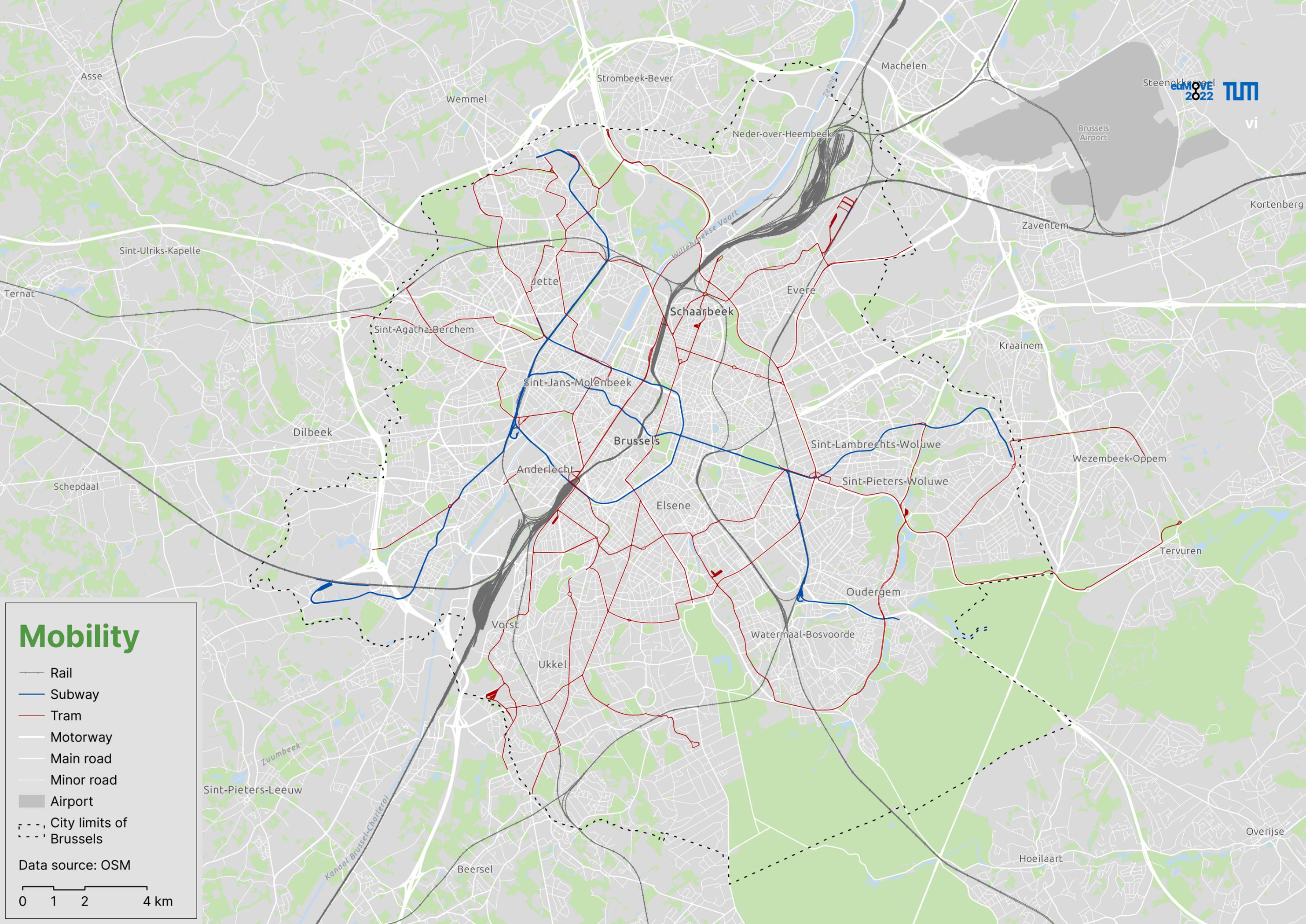
Thinking of Brussels, we thought about one of the European Union's capitals: A city known for accommodating a diverse population with diplomats from all over the world, who come together in a city which is comparable to Munich in size - This made us wonder: How does such a city's mobility landscape look like and what is there to learn and implement in the Metropolitan Area of Munich.

Similarly to Munich, Brussels shows a high reliance on cars. With the long historic record of car domination and public attachment to this mode of transport, the city embarked on its way to transform cities' urban mobility. The main phenomena distinguishing the renowned EU capital is individual car and fuel card as a part of tax rebate implemented due to heavy taxation. In combination with a high number of regular commuters, it strongly influences public mobility behaviour.

Acknowledging the inevitability of a "carrots and sticks" approach, authorities set a focus on modal shift towards public transport, sharing multimodality and infrastructure change, promotion of car-sharing, e-scooters and e-bikes and reallocation of space, ready that certain measures, such as transformation of urban highways and low-speed neighbourhoods may not be popular first but are expected to bring a certain balance in the long run. Governance structure adds more complexity to the unified approach, due to bilingualism and 19 municipalities, each of them with individual visions, representing the inhabitants in their district. But strategic cooperation and dialogue are bringing certain beneficial solutions.

Nevertheless, stakeholders have an ambition and vision to make a shift and reduce reliance on cars by introducing enhancements to multi-modal transportation, revising urban development and introducing traffic-calming measures and sustainable mobility options to support the needs of the residents. In the long term, sustainable urban mobility will remain a cornerstone of future cities, since all the efforts are targeted into general improvement of life quality and residents' benefit. In our analysis of Brussels mobility landscape, we highlight some of them.

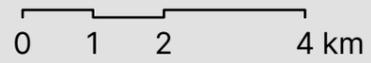
We - this is the Brussels city team formed by Esmá Gelis (Science and Technology Studies), Katia Juliane Schmidt (Environmental Engineering), Martin Schlett (Politics and Technology), and Victoriia Iatckovskaia (Responsibility in Science, Engineering and Technology). Together we conducted a research trip to Brussels between July 11 and July 22, during which we both ethnographically experienced Brussels' pedestrian lanes, public transport and car infrastructure as well as interviewed 19 stakeholders from various backgrounds who are shaping Brussels' mobility in public and political institutions, civil associations and private companies.



Mobility

- +— Rail
- Subway
- Tram
- Motorway
- Main road
- Minor road
- Airport
- - - City limits of Brussels

Data source: OSM



LOCATION ANALYSIS

Demographics

The term Brussels usually refers to the Brussels Capital Region and it is one of three regions, accompanied by the Flemish Region and the Walloon Region, an entity comparable to the German Bundesländer. Here, 19 independent municipalities are unified, of which one is called Brussels. It is home to 1,2 million inhabitants in an area of 161,36 km². The population grew by 550.000 within the past decade, and 10.000 inhabitants from 2019 to 2020 (STATBEL, 2022).

Economy

The GDP per capita is one of the highest in European comparison (The Brussel Times, 2020) with \$42787 (Trading Economics 2022), but the citizenry displays very diverse cultural and economical backgrounds. Individual income tax in Belgium is one of the highest in European comparison, reaching up to 50% (Expectica 2022).

Political System and governance

It hosts both the Belgian government and important institutions of the EU; Brussels is thus often referred to as the EU capital. It is surrounded by the Dutch speaking Flemish region but most residents in the Brussels Capital Region are French speaking. Governance in this complex system of partly independent yet strongly intertwined stakeholders is a complicated issue. Brussels Capital Region is responsible for land management and urban planning, though specific measures or streets are often within the responsibilities of the communes. Cultural and personal affairs

are responsibilities of the Flemish or French community, who often refer decisions to the Common Community Commission (Article 136, Paragraph 2, Belgian Constitution).

History

Mobility in Brussels is heavily car-dependent, partly due to a taxation system strongly prioritising company cars for decades. Brussels Capital Region has to deal simultaneously with a modal shift, increasing population and mobility demand, climate impact as well as an old infrastructure in need of renovation.

Education and Research

Education and Economy are well developed in Brussels capital region with 21 recognized higher education institutions (uniRank 2022) and a high offer of different jobs for over 50.000 businesses (Brussels.com 2022).

Climate and Geography

The topology of the area is comparable to Munich. The region is mostly flat with an elevated plateau in one part. Climate is oceanic with 135 days of rain and 24 days of snowfall per year on average. (Klimaatstatistieken van de Belgische gemeenten, 2021).



URBAN MOBILITY ANALYSIS

Mobility Plan

The regional mobility plan Good Move aims for sustainable, efficient and balanced mobility in the Brussels-Capital Region. It won the 8th SUMP award from the European Commission in 2020 (Brussels Mobility, 2020). The region of Brussels is described in a city vision, which shows an improvement in the quality of life of its residents with a focus on walking and cycling. Seven challenges pertaining to the city vision are identified that are to be integrated into the mobility development. 35% less greenhouse gas emissions in 2030 compared to 2005 is one of the major challenges (Brussels Mobility, 2020). Others are to reduce the household travel expenses, to extend the pedestrian meeting areas, to promote active forms of mobility and to attain vision 0 – meaning zero deaths and zero seriously injured from traffic accidents. The mobility vision described in Good Move has six specific goals: to influence the demand for travel toward a better distribution over the day, to reduce the mode share of car by 24%, to offer mobility services such as MaaS, car-sharing or car-pooling, to develop efficient, and well-structured networks, to support urban delivery services and finally, to adapt the parking policy and the regional vision of mobility (Brussels Mobility, 2020). These goals are translated into the so-called Operational Action Plan, to better the standard of living in the region, to achieve an integrated mobility system and to have a transparent public governance. The Good Move plan implements the stop-principle, which translates to giving the priority to these modes in the following order: walking, cycling, public transport and lastly cars. The networks for these different modes are differentiated between three different levels: the Plus level for major

travel routes, the Comfort level on the scale between Plus and the neighbourhood, which is the last level that consists of the fine services within the different districts. The Action plan consists of 50 actions which can be attributed to 6 focus areas, that describe the goals of the mobility vision. Firstly, Good Neighbourhood focuses on improving the livability in the districts of the region for its residents. The second focus area - Good Network, describes all actions pertaining towards this goal of creating an efficient and organised network. Good Service names the actions that are concentrating on providing services to the region and its residents such as MaaS development. The actions of the fourth focus area – Good Choice, are aiming at influencing the travel choices of the residents through awareness campaigns or road transport tariffs. Partnership and governance actions are organised in the focus area of Good Partner, while the last focus area of Good Knowledge pertains to mobility data management and evaluation of the mobility policy and the Good Move plan. The success of the mobility plan depends on the cooperation of the different stakeholders in the region – namely the region itself, the communal governments through multi year programs as well as the adaptation of the program into the public service companies such as the public transport operator STIB-MIVB.

Modal Split



Figure 6. Modal Split (Enquête MONITOR 2017, SPF Mobilité et Transports, 2019)

The last survey on mobility in Belgium took place in 2017. The Brussels sample was small, and the margins of error are therefore not negligible. Nevertheless, the data can still be used to roughly show the modal share the region and the mobility habits of its inhabitants. As seen in the figure above, the preferred mode is the car with 46%, followed by public transport and walking, both encompassing 24% of the number of trips made in the region. The data, however, does not showcase the current modal split or consider recent developments such as the increasing use of electric scooters. The estimated modal share of cycling for example is approaching 10% as was stated in the interview with the mobility department of Brussel.

Accessibility

For travellers with reduced mobility assistance is offered at metro stations to help cross the gap between train and platform. This assistance is advised to be booked before departure. A system for accessibility signalling regarding bus stops is currently being rolled out. On the audited lines stops are differentiated between compliant stops,

where autonomous alighting and deboarding of the vehicle can occur, and practical stops where additional assistance is required (STIB-MIVB, 2022d). 12 taxi buses from STIB-MIVB offer on-demand door to door service daily between 5am to 1am. One journey here costs 1.70€. Journeys on the taxi buses must be booked at least the eve before departure (Brussels Mobility, 2022c). Free tickets are available for the visually impaired and for the accompanying person of a traveller with a disability recognized by FPS social security (STIB-MIVB, 2022d). In case of a registered disability a reduced yearly ticket of the cost of 85€ may be purchased. The availability of elevators can be checked on the website of STIB and the STIB app. The advocacy groups of people with reduced mobility such as CAWaB campaign for more autonomy in public transport travel. They advise STIB-MIVB on various implementations to create a more independent travel experience for all residents and visitors of Brussels. Out of the 1105 taxis operating in the region 97 are equipped to transport people with reduced-mobility and special needs (Brussels Mobility, 2022).

Multimodality

Car - The entire region of Brussels has been a low emission zone since January 2018 (Mobile LEZ, 2022). Vehicles must be registered and fall within the current allowed emission standards, which become progressively stricter over time. At present for vehicles with up to eight seats, the euro1 for petrol and euro1 to euro4 for diesel cars are banned (Mobile LEZ, 2022). The speed limit within the region has been reduced to 30 km/h except on major axis where a speed of 50 or 70 km/h is allowed (City of Brussels, 2021). Brussels car traffic is ranked by TomTom on the congestion on rank 52 worldwide with a congestion level of 34% (2022a). Brussels is also the most congested city in

URBAN MOBILITY ANALYSIS

Belgium (TomTom, 2022b). Alternatives to the private car are offered via car sharing companies such as cambio, getaround and poppy and various carpooling companies (City of Brussels, 2022a). Taxis in Brussels are black with a yellow-black chequered stripe on the side as well as a lightbox with the same pattern on the roof of the car (Brussel Mobiliteit, 2021). Currently, the taxi services of the region amount to a fleet of 1105 vehicles (Brussels Mobility, 2022).

The influx of commuters to Brussels during the day is very high. Statbel states that 369,000 commuters travel into Brussels from Flanders and Wallonia in 2020, but only 76,000 residents of Brussel travel to work outside of the region (Leefmilieu Brussel, 2022). This results in the fact that half of Brussels employees are commuters. Covid has decreased the amount of commuters in both directions, by 9,000 for incoming and 6,000 for outgoing commuters according to Statbel data published by Brussels Environment. Furthermore, an additional influx of traffic into the region is due to students. 14% of students in Brussels are not residents of the region (Leefmilieu Brussel, 2022).

Walking - is the central focus of the ambition of the Good Move mobility plan as also described in the stop-priority order with walking as the highest priority mode. Good Move aims to increase the modal share of walking to more than 50% by 2030 for trips within the region (Brussels Mobility, 2022a). To achieve this goal a promotional walking campaign is executed every year since 2021. The walking network is divided into the boulevards, which are the major axis, the plus roads, comfort roads and the district roads (Brussels Mobility, 2022a). The pavement maintenance plan, which was put into force in 2020, stated that the walking

network will be resurfaced, repaired and or adapted to the universal accessibility standards according to cahier de l'accessibilité pedelle and plan d'accessibilité de l'avenue et des espaces publiques (Brussels Mobility, 2022a).

Bike - The biking network is divided similarly to the pedestrian network into the Plus level, which describes the cycle highway network, the comfort level for the regional cycle routes and the communal cycle routes (Brussels Mobility, 2020). The cycle highways making up the Plus network are surently still under development and will contain 32 routes in 400km (Brussel Mobiliteit, 2019). For the comfort level 19 regional cycle routes are planned, that all connect to a green promenade which in the future will run around the entire region (Brussels Mobility, 2022b). These routes will also connect with the neighbouring regions Flanders and Wallonia. Bikes in Brussels are allowed to be taken on all metro trains and on the low-floor trams, except during the morning rush hour between 7 to 9am Mondays to Fridays and between 4 and 6:30 pm (Pro Velo, 2022). A bicycle can be rented from Villo!, Bluebike, Pro Velo, Swapfiets and Billy Bike (City of Brussels 2022b). Discussions on topics relating to cycling in Brussels-Capital Region regularly take place within the active modes committee, which was the bike committee before 2019. Here representatives and advocates for cycling and walking as well as mobility experts can elucidate their perspectives on development plans (City of Brussels, 2022c).

Micromobility - Various electric scooter companies operate in Brussels, such as Lime, Dott, Bird, Bolt, Pony, Voi and Tier (City of Brussels, 2022a). For using these scooters Brussels has implemented a speed limit of 25 km/h, which

is temporarily reduced to 20 for the summer, and 8 km/h in the pedestrian areas (Walker, 2022). These speed limits are enforced via geofencing. The scooter users are considered cyclists and are therefore not allowed to ride on the sidewalk but must instead use cycling infrastructure (Brussels Mobility, 2021). It is also not allowed to ride in pairs on one scooter. The rider must be above the age of 16 and park the scooter in designated drop areas (Walker, 2022). Parking scooters must be standing, not lying and cannot be parked on footpaths, cycle ways or in front of zebra crossings.

Airport - Brussels is served by two international airports: Brussels Zaventem Airport (BRU) and Brussels Charleroi Airport (CRL). The latter one is located about 55 km south of Brussels and is mainly frequented by budget airlines. The Brussels Zaventem Airport is positioned closer to the city, only 20 minutes by train. Most long-haul flights start and end at this airport (Brussels Info, 2022).

Public Transport - The public transport operators in the Brussels Capital Region are the STIB-MIVB, offering services on the metro, trams and buses, as well as De Lijn, which offers bus services in the region. The trains are managed by SNCB-NMBS, the national train company. STIB-MIVB operates 4 metro lines on 40 km of track, 17 tram lines on 147km of track and 55 bus lines on 468km of roads through the Brussels region. In addition to this, there are also 11 night bus lines that operate between 0:20 am-3 am. Together these modes serve 2190 stops with 1330 vehicles (STIB-MIVB, 2022a). The trams and

metros are powered by 100% green electricity according to STIB-MIVB. 402 buses are equipped with a hybrid propulsion system and 30 fully electric buses are currently in operation (STIB-MIVB, 2022a). The ticketing system in Brussels is focused on digitised tickets either via contactless payment with the smartphone, smartwatch or bank card. Another option is presented in the personalised or anonymous Mobib card, which can be used to load tickets onto. Paper tickets are slightly more expensive. The costs of tickets can be seen in the table below.

Children under the age of 12 ride for free, and students up to the age of 25 can purchase a year ticket for 12 €. Seniors above the age of 65 can purchase a yearly subscription for 60 €. (STIB-MIVB, 2022b)

STIB-MIVB offers an app, which can be used to plan the journey, find the nearest stop or purchase tickets. It also provides information on accessibility of stations and stops as well as additional features for the Mobib card (STIB-MIVB, 2022c).

In 2021 273.8 million journeys were taken on the STIB-MIVB vehicles on 86 different lines, which amounted to 50.6 million kilometres travelled (STIB-MIVB, 2022e). The revenue in 2019 of STIB-MIVB came to 721,884,000 € of which 54% belongs to subsidies. The expenditures in that year amounted to 723,098,000 € (STIB-MIVB, 2019).

	Single journey	10 journeys	1 Day ticket
Contactless payment	2.10 €		7.50 €
Mobib Card	2.40 €	15.60 €	7.80 €
Paper ticket	2.60 €		8.00 €

Figure 7. Pricing for public transportation (STIB-MIVB, 2022b)

PROJECTS IN BRUSSELS



SWOT ANALYSIS

Strengths

- Elaborate Good Move Plan prioritising pedestrians, cyclists, public transportation users and finally car drivers
- Dense public transport infrastructure
- Digital public transport ticketing system
- Active civil society and high focus on citizen inclusion
- Strong levels of cooperation between different stakeholders
- Cheap public transport tickets for students for 12 € a year

Weaknesses

- High historic reliance on cars and related issues regarding noise and pollution
- Hilly topography at some places

- EU capital, good ties to EU institutions, better understanding of prerequisites for funding
- Potential to shape upcoming regulations as first movers
- Share of Cycling increasing, more potential
- Governance structure of the city in 19 municipalities -high level of public participation

Opportunities

- Ongoing protests from car drivers towards new measures
- High movement of citizens from surroundings to city centre and vice versa due to gentrification
- Issues with enforcing existing measures especially regarding City 30
- 19 municipalities are complication for measures

Threats

Brussels Mobility:
Interviews for the projects of Bike for Brussels, E-Scooter Regulations and Schaerbeek and MoveBrussels.

FietsGEN:
Interview with Beliris.

Werken aan de Ring:
Redeveloping the motorway ring.

Schaerbeek:
Low traffic neighborhood.

Werken aan de Ring:
Interview with Werken aan de Ring.

Dott headquarter Belgium:
Interview concerning e-scooter regulations.

Cycloparking:
Neighborhood box.

Bike for Brussels:
Bike counters.

Conforming to Covid:
One of the pop up bike lanes in Brussels.

Velo Solidaire:
Interview with Pro Velo.

Cycloparking:
Indoor Parking.

Bike to Work:
Interview with Fietsersbond.

Cycloparking:
Interview with Cycloparking.

Conforming to Covid:
perspective.brussels report.

Project Sites

-  City limits of Brussels
-  Building footprint
-  Accomodation
-  Project site

Data source: OSM, own

0 1 2 4 km

LOW TRAFFIC NEIGHBOURHOODS

Low traffic neighbourhoods is an ambitious project by the Brussels metropolitan region in cooperation with the communes, aiming to drive car traffic and specifically transit traffic with private cars out of the neighbourhoods and back on the main roads surrounding these neighbourhoods.

Motivation and Goals

So far, the majority of all trips by car are for distances less than 5km, often even less than 2km. Some of the many reasons for this choice and the generally car-oriented mobility environment are the car prioritising infrastructure with a dense network of wide streets, as well as the immense subsidies for company cars. Owning and using a car is almost cost free for many employees who get a company car as a low taxed part of their salary, for many even including fuel and insurance. Consequently, people take the car no matter how short the distance is, thereby crossing the next neighbourhood and contributing to the massive car traffic in the city.

However, banning all cars from the city is no favourable path and would be met with strong opposition. Such a radical shift would not only be presumably inconvenient for residents, but it would also hinder Public Transport running through the neighbourhoods, as well as services like police, fire brigade, and waste collection. Hence the goal of the project is, as the name suggests, to reduce the traffic as much as possible with minimal influence on local residents and public or emergency service providers.

The low traffic neighbourhoods will prohibit go-through traffic for private cars and reallocate it back to the main road. The resulting detour and additional time needed for car users is considered and intended. The metropolitan region of Brussels wants them to change to walking or biking for short distances and hopes to increase motivation not only with pull factors through other projects but also by

push factors like increasing the duration of car trips with the low traffic neighbourhoods.

By reducing traffic in the neighbourhoods, pollution and accidents are expected to decrease significantly. Streets will be a safer, more liveable space for residents. Without blocking car entry completely for residents, local customers, public transport, or emergency and service vehicles, the local population and especially children can reclaim the streets as an open, public space.

It has a positive social impact. For example, children who can play in the streets experience an independence that is different from any supervised area like playground. They can go to the bakery, if the distance is not too far. This takes a burden off the parents shoulders, especially single parents, who can use the time for other activities.

Making streets calmer increases the attractiveness of local shops and cafés; residents are expected to spend more money in their neighbourhood, which benefits the residents, shop owners and the city; instead of other fiscal measures like increasing social payments or reducing taxes, the low traffic neighbourhoods have a holistic impact on basically everyone. With a similar or even lower budget, the city can thus improve multiple issues at once.

Resistance against such measures have been significantly higher in lower income districts where less than 30% own a car, but safety risks caused by cars as well as space consumption by private parking are the highest. This was especially unexpected to city planners, since the lower income districts in Brussels are located quite central and therefore have good connectivity with public transport.

50

Low-traffic neighbourhoods of 1-2,5 km²

KEY FACTS

5 neighbourhoods per year until 2030

Force transit traffic on main roads



“Put back the traffic where it is supposed to be”

-Stakeholder Manager at Werken aan de Ring



LOW TRAFFIC NEIGHBOURHOODS

Those neighbourhoods would be expected to benefit the most and the earliest. Reasons for this opposition: car is still a status symbol, that means a lot to people living in these districts, on the other hand, a car can be a tool for independence, especially for young adults.

With the low traffic neighbourhoods, car ownership is not encouraged but also not rendered impossible, creating a good compromise. Furthermore, the first neighbourhoods that are currently being transformed have been selected with regards to citizens' acceptance. Consequently, they happen to be to ones with higher average incomes. Planners hope to show that low traffic neighbourhoods work well and convince more critical residents over the years. The city also avoids the impression of using lower income districts as test beds for new, contested concepts.

Stakeholder Constellation

The planning and implementation process follows 4 steps: First an analysis of the status quo is conducted by mobility experts with open and active involvement of citizens. Then, different scenarios are developed and discussed with all stakeholders. After that, the final traffic plan is finalised and the public, especially local residents, are informed about it. Ultimately, the city implements the plan using a range of measures, from short and long term physical alterations and barriers to digital tools based on camera surveillance.

Implementation

Neighbourhoods are implemented one after another, with the city being separated into 50 of these neighbourhoods, each surrounded by

major streets. Step-by-step, all those parcels of 1-2.5 km² will be rebuilt by 2030, equalling 5 neighbourhoods per year. Neighbourhoods were defined beyond political entities and can therefore span multiple communes. Decisive are the land use of the area as well as the location of major streets which could take up the traffic which can no longer evade through the living areas.

The major roads surrounding the neighbourhoods will be rebuilt to separate different users according to their speed, making travel safer for all users. Cars, bikes, pedestrians and all others shall have an equal chance to use these big roads, which is necessary to increase connectivity between the neighbourhoods. Inside the neighbourhoods such mode splits are not necessary, because speed is limited both through the city wide speed limit of 30 km/h but also through further measures like narrow streets, visual differentiation of neighbourhoods and major streets and wider sidewalks, motivating car drivers to reduce their speed.

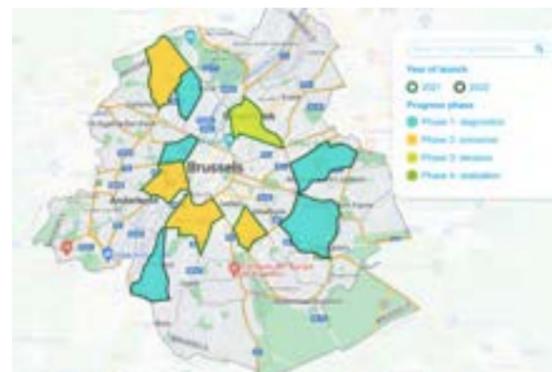


Figure 8. Planning stage in different low traffic neighbourhoods (Brussels Mobility, 2022f)

Outcomes and Discussion

Project bears several risks. First - risk of more induced traffic, if car drivers will still use the car. The consequence would be longer trips, meaning more traffic, congestion, emissions. Another risk is a continuous low acceptance by citizens. Participatory measures and public information will be used to avoid this scenario and experiences from the City 30 initiative suggest that resistance will be limited in scope and time. A third risk has its origin in the overload of the judicial institutions in Brussels. Already with the City 30 initiative, the court announced that it will only prosecute those speed violations that exceed 19 km/h. Should the court expect a similar amount of high cases of lower degree, which have not been detected regarding speed limits by the administration so far, chances are high that the court will also not prosecute those who continue transit through the low traffic neighbourhoods. This could possibly render at least digital surveillance measures and fines ineffective.

Applicability to Munich

Transferability is high, as far as the political will exists. The stakeholder constellation in Munich is less complex than in Brussels capital region with 19 independent communes and law and regulations is not a problem, but some details might be complicated to implement. Camera surveillance is especially difficult in Germany with regards to data protection and privacy. The project aligns very well with Munich's problem pressure and strategy to reduce car dependence and make quarters more habitable, repurposing public space from car-centrism to green and quality space for citizens.

Outlook

So far, interventions are mostly rapid and temporary. Many passages or sections of streets have been blocked for car traffic with large flower pots. They prevent every car traffic and cannot be used everywhere. Digital systems which register the licence plates and time difference for entering and leaving the districts will follow soon.

Project Transferability



Project Impact



CITY30

Paving the road to better road safety, in December 2020 Brussels Mobility launched the information campaign on Brussels transition to a “30 city”, referring to the new 30km/h city-wide speed limit introduction, which set a default speed limit rule for 30 km/h, and was implemented for all roads in the capital starting 1 January 2021.

Motivation and Goals

As the EU Commission is working on the European-wide improvement of road safety, in February 2020 it introduced the Stockholm Declaration on Road Safety. Being a capital of the European Union, Brussels decided to pioneer as one of the cities actively following the aspirations. Main aims listed in the declaration are speed limits and halving the number of fatalities and serious injuries on European roads by 2030. This is considered as a first milestone on the way to “Vision Zero” that sets an ambitious role for zero fatalities and serious injuries by 2050. (European Commission, 2020)

According to Brussels Mobility, each year, 50 people are killed or seriously injured on the capital's roads as a result of speed-related incidents. The main motivation listed on the official website of City30 Initiative - is to reduce the amount of traffic accidents and enhance general quality of life. After the introduction of City30, Brussels Mobility promises safer roads, fewer accidents, and a calmer city by reduction of noise pollution. (Brussels Mobility, 2021)

It is expected that with a 30 km/h speed limit, different road users can co-exist more peacefully – safer roads, reduction of traffic noise as main benefits for residents. Brussels Mobility additionally informs that they plan to monitor average speeds, analyse accident statistics and monitor overall impact of City30 introduction and make adjustments for further improvement.

To support the measure, installed signs are indicating that a driver is entering a built-up

area and the speed limit is 30 km/h unless indicated otherwise by another street sign. In addition, the number of speed cameras operating in the city is expected to increase from 90 to 150 in a 3 year period. penalties apply.

Considering its influence on the whole transportation network, there are certain exceptions to the general rule: for instance, 20km/h in shared spaces, 50 and 70 km/h on main roads. When a driver leaves the shared space or main road, the general 30 km/h rule applies. Speed limit also applies equally to almost all modes of transport, including cars, vans, lorries, motorbikes, mopeds, buses, bikes and scooters. It applies to separated bike lanes and lines for public transport. Exceptions apply among modes of transport are trams, emergency vehicles in blue light mode and snowplows. (Brussels Mobility, 2021)

Stakeholders

All residents and visitors of Brussels Capital Region are generally required to follow the implemented policy by Brussel's mobility institutions.



We put cameras, with the immediate effect of reducing speed - people notice that there's photography when you get in and when you get out,
- Spokesperson of the Minister of Mobility of Brussels Capital Region



KEY FACTS

30 km/h rule for all roads, with exceptions of 20km/h in shared spaces, 50 and 70 km/h on main roads



CITY30

Implementation

Updated Highway Code with speed limit of 30 km/h was applied city-wide starting 01.01.2021 with awareness campaigns and adjustments of traffic lights for smoother traffic flows. The project implies police enforcement and an increased number of speed cameras and speed-limiting infrastructure on roads (for example, 3D zebra crossings) with the majority of accidents and traffic calming projects in residential areas.

Penalties for speeding apply, money from fines will directly transfer to the Road Safety Fund for infrastructure improvement, awareness-raising campaigns, and new speed detection and control devices. (Brussels Mobility, 2021)

Outcomes and Discussion

City30 has been rolled out accompanied by an increase of speed cameras and urban traffic management with 3D zebra crossings to encourage compliance.

In general, the traffic situation seems to have improved in terms of safety, a statistical report with further details is expected at the end of the year. Brussels mobility agency's evaluation showed that the average speed for cars on Brussels' roads fell by as much as 19% after 5 months of implementation. In addition, there was a decrease in the number of road accidents, injuries and deaths compared to last year (EuroCities, 2021).



Figure 9. Banner picture (City30 Brussels website, 2022)

Applicability to Munich

Project is transferable to Munich as cities are comparable in size and road share. Project promises general increase of road safety - less speed and road accidents. Better conditions in terms of residents co-existence, air quality, and city noise pollution.

We believe that regarding Munich project implementation is viable within the premises of Frankfurter Ring and city will benefit from implementation of the speed limit.

Outlook

While City30 is a disruptive measure towards making car driving in the city safer and more sustainable, the city struggles with legal implementation of fines (director at Brussels Mobility, personal communication, July 19, 2022). It remains an open question for the future, whether and how Brussels Capital Region will be able to more strictly enforce the regulation in the webs of its complex governance.

Project Transferability



Project Impact



BUILDING A BETTER BIKING BASE

Bike for Brussels focuses on bringing as many people to use their bikes as possible. Instead of seeing cycling only as a leisure activity, it works towards a change in mentality to promote the bike as a transport mode. The campaign belongs to the Good Choice aspect of the regional mobility plan Good Move, which concentrates on influencing the mode choice (Brussels Mobility, 2020). Bike for Brussels is implemented by Brussels Mobility, the mobility authority for the Brussels Capital Region.

The Dutch speaking activists Fietsersbond have implemented the initiative Bike to Work, which has the intent to motivate cycle friendly personnel policy in facilitating the payout of company benefits for participating employers to those employees, who commute to work by bike. The non-profit organisation Pro Velo together with their partners offer a leasing package under the name of Vélo solidaire, which contains access to a second hand bicycle free of charge for one year, training for both bike riding and in bike mechanics as well as the possibility to buy the cycle at the end of the lease for an affordable price.

Working on the development of cycle highways is Beliris, a public service company for Brussels, which is partly federally funded. Specifically, they focus on the creation of the missing connections between already existing cycle highways from the neighbouring region and the city centre of Brussels.

The project Cycloparking develops safe bicycle parking in Brussels, to remove the issue of finding a place to store professional and private bikes, especially long-term. Because Brussel is a dense city with small houses that often have no courtyard, parking the bike safely can be an obstacle to acquiring and consequently using the bike as a regular mode of transport. The project is implemented by Parking Brussels - the parking agency of the Brussels Capital Region.

Motivation and Goals

The Good Move mobility plan states that by 2030 the share of cycling in the transport modes should be tripled (Brussels Mobility, 2020). Biking for Brussels and the other biking initiatives work towards this goal, through holistically dealing with the various issues which stop Brussels residents from utilizing the bike.

The last national survey placed the share of cycling at 3.5% in 2011, however since then the steady increase rate of 13% new cyclists every year results in a current estimate of 10% cycle share. The particular aim for Bike for Brussels is to help bridge the gap to tripling the mode share by getting as many people to cycle as possible.

The motivation behind the promotional Bike for Brussels campaign, as well as the improvement of the cycle network is the Good Move regional mobility plan. Many other biking initiatives such as Cycloparking or Bike to Work have the ambition to improve the air quality in the region by facilitating the change to the bicycle.

The Bike to Work initiative uses the company benefit system, present in Belgium due to heavily taxed salaries, to motivate a change away from company cards towards using the bicycle as the mode to work. By offering employers a complete solution and through the reward-based system of this solution the Bike to Work project furthers cycle-friendly company culture.

KEY FACTS

1m km/year from 200 participating companies with 34,000 user accounts registered at Bike for Work



BUILDING A BETTER BIKING BASE

The development of the cycle highways in the project FietsGEN represent the Plus level of the cycle network of the region. When this network will be fully completed it will consist of 400 km in 32 routes (Brussel Mobiliteit, 2019). Ideally the aim at the end of 2030 is the completion of the Plus network. Currently, 35% of the network is estimated to be in use, 20% have a tolerable level of service, while the rest does not yet exist. The creation of the last 45% is the aim of this development. Until the end of the Cycloparking project in July 2023, the explicit goal is the implementation of 150 parking spaces for bikes. The residents of the Brussels-Capital Region depend upon safe parking to store their (cargo) bikes safely, sheltered from the elements and theft.

Stakeholders

Modal shift can be encouraged by many parties within the political space and externally – however the implementation can only be achieved through the citizens themselves. Building the biking base in Brussels, therefore, requires direct interaction with citizens through the information and motivation campaigns. The mobility projects include consultation with different non-profit organisations and advocates which represent their group of citizens.

Implementation

The campaigns motivating Brussels' residents to use bicycles are executed in the digital space with an app for Bike to Work and a blog and social media accounts with Bike for Brussels, in addition to information campaigns outside the digital realm. Both the implemented parking spots and the cycle ways are constructed in the districts of the Brussels Capital Region.

Bike for Brussels provides information on cycle events, routes and parking. It comprises different campaigns such as BrusselsFit, which

advocates for the health benefits of cycling through Brussels. For this campaign special events such as spinning classes are also organised and informed through the Brussels-Fit campaign. Other information Bike for Brussels offers is on cycling tips and hacks as well as bike repair days.

Bike to Work is implemented via an app that is purchased by the participating company. All employees have admittance to their personalised accounts within the app, on which they can register their bike trips, the cycled kilometres and the CO2 that was saved through using the bicycle. With the accumulated kilometres the employees can earn coins that can be used in a lottery system. The app can also be utilised to plan cycle routes and is used within their motivational campaigns to track the cycling kilometres of the participants.

Beliris as the public service company for Brussels is participating in the current development of the FietsGEN. At present two feasibility studies and a project realisation study is carried out on three different routes. The cycle highway as a high-quality cycling route must be constructed with good lighting, separated from traffic and wide enough to welcome all types of cyclists. It represents a functional connection, though mostly home-to-work travel, of distances between five and 20 kilometres.

There are 2 types of parking that Cycloparking implements for long-term parking options. 1st is the neighbourhood parking shed, that fits 5 regular bikes or 2 cargo bikes and can be installed on the neighbourhood street. It is accessed via a token or an app. The other type is a larger indoor parking, that can be created within train stations, in (underground) parking lots. These larger parking areas are accessed with the transit card, integrating the parking

into the digital public transport ticketing system. The long-term parking is bought with a yearly subscription for 15 € for regular bikes and 30 € for cargo bikes.

Outcomes and Discussion

All described biking initiatives have been implemented and are currently operating. The success of the various initiatives is discernible in the increase rate of 13% new cyclists a year.

Applicability to Munich

The cycling share in Munich has already reached 18% in 2017 and cyclists are therefore more visible in the city (infas, DLR, IVT and infas 360, 2020). The main problem in Brussels that residents do not see the cycle as a means of transport – is also not as prevalent in Munich. There is however a growing cycling community that demands implementation of infrastructure in Munich, such as the Altstadttring, which shows the similarities between Munich and Brussels. Biking for Brussels works on the promotion of bicycle, while in Munich the image of the bicycle as a mode of transport is already

well established. No continuous promotion nor branding of a biking in Munich campaign exists. It could be disputed if such a promotion is necessary to further push modal shift in Munich.

The benefits expected from employees are not comparable to the Belgian benefits. To apply the exact concept of the app to Germany is consequently not plausible. This system of rewarding employees for cycling could, however, reduce the amount of car commuters and target specifically rush-hour traffic, which is often a peak in the congestion and pollution measurements. This is also of interest to Munich, where during the weekdays especially on the commuter-laden routes on the Ring around the city traffic is very heavy. In Munich cycle highways – so called "Radschnellwege" are currently also on the agenda. The city is planning a cycle connection from the city centre to Garching and Unterschleißheim and is looking into several other potential routes (Landeshauptstadt Muenchen, 2021). The FietsGEN project has therefore a very high transferability to Munich.

Project Transferability



Project Impact



WERKEN AAN DE RING

The ring is a motorway surrounding the metropolitan region of Brussels. Built in the early second half of the 20th century, it was fully oriented towards car traffic. After up to 65 years of intensive use, the entire construction must be renovated. Brussels wants to seize that opportunity to not only rebuild the same infrastructure, but also rethink it and fit it to the Good Move strategy.

Motivation and Goals

The Ring is a complex structure with an excessive number of entries, multiple lanes, and an immense traffic load. Previous plans suggested expanding the ring with even more lanes to increase the car traffic capacity. In accordance with both the altered Zeitgeist as well as the Good Move plan (Brussels Mobility, 2022), today's strategy foresees an integration into a more holistic and smarter mobility concept. The ring should no longer be a huge car infrastructure with much congestion and roughly 1000 accidents per year. Instead, the ring shall integrate different modes of transport, improve road safety as well as quality of air and traffic, water and noise pollution, and the connectivity of the surrounding region especially in nowadays poorly connected villages between the existing bigger feeder roads. Bordering areas shall become more liveable, not only for humans but also for animals and plants. Planners want car traffic to decrease in the entire metropolitan region and especially in the inner-city area. This means on the one hand, that those travelling by car would need to bypass the city via the ring instead of crossing through the centre and neighbourhoods, on the other hand, travellers and commuters are expected to use public transport and bikes to reach the city. This transformation is a huge undertaking that will take time and need resources, citizen participation and good planning.

Implementation

The project is still mostly in the planning stage. Coordination is done by De Werkvennootschap, which is a company fully owned by the Flemish government. The Ring is almost entirely located in Flanders, the region adjoining Brussels Capital Region. The fact that the ring is located in Flanders but mainly serves the Brussels capital region and commuters who are travelling to Brussels complicates planning. De Werkvennootschap is supposed to make the cooperation between Flanders and Brussels easier and more effective, but also to speed up planning and implementation of all projects concerning the Ring. This includes policy advice to decision makers responsible for the projects as well as citizen participation and stakeholder management. Implementation itself as well as maintenance are carried out by private companies.

Towards the renovation of the Ring, a broader vision as well as more detailed measures have already been decided on. The vision is to make the Ring a safe, multi-modal infrastructure for the mobility needs of today and tomorrow and thereby improving environmental, social, and traffic impact.

As mentioned above, about 1000 accidents happen on the Ring every year, most of them at one of the many entry points. Some of these slip roads are very close to one another, and in combination with the high number of up to six lanes excluding slip roads, this causes a lot of rapid, unforeseeable lane changes by drivers. Additional stress comes from the high density of lorries on the right lane, blocking sight and access to the target lane.

KEY FACTS

75 km long motorway ring to improve and diversify travel to Brussels

Performed by De Werkvennootschap, Roads and Traffic Agency, and the Flanders Environment Agency



WERKEN AAN DE RING

Excessive speed is not the problem: one planner told us that even though the limit is 100, car drivers would be lucky if they could even get to 50 at such points of entry due to high congestion. The goal is therefore to reorganise slip roads and reduce access points to reduce the number of accidents.

To improve traffic flow further, the number of cars needs to be reduced which implies a modal shift. The plan hence entails a multi modal approach with special focus on cycling, public transport and park and ride facilities.

115 bike lanes of at least 4 metres width will be constructed to connect the Flemish region to Brussels. In part, they will go along the motorway, where the bordering metres of land are publicly owned. A problem not solved so far is how to connect villages to the planned cycling lanes; if commuters must travel on busy car roads to reach these cycling highways, they will be more likely to choose the car over the bike. Supporting the bike lanes and also pedestrians, there will be numerous new bridges over the so far too often impermeable Ring.

To strengthen public transport, 3 new tram lines will connect the outskirts within a 20km radius to the city centre. Since a dense Public Transport Network will be difficult to install beyond this radius, commuters need the possibility to change from car to other means of transport. Brussels and Flanders will therefore install park and ride facilities, the so called Mobihubs. Those must be strategically located and sized; the goal is to keep cars as far from the city as possible, so larger parking lots closer to the city will motivate commuters to go further by car. At the same time, insufficient parking space will discourage them from changing to public transport at all. But not only cars and

public transport need to be considered, also bikes and micro mobility play an important role in the city's rethought mobility concept. The Mobihubs hence offer car and bike parking, sharing mobility and public transport access in one location.

Stakeholders

The Good Move mobility concept by Brussels Capital Region relies on a modal shift, but also on a mental shift. One important pillar is the infrastructure and access points described above. But to trigger the mental shift, citizens need to be informed and convinced. Participatory processes play a major role in this regard and are a key responsibility of De Werkvennootschap. Every project includes citizens and considers their wishes, ideas, and fears. A lot of times and resources go into this participation. Information must be provided in all three official languages and sometimes this slows the process or blocks a project which could create huge benefits, but a well-built infrastructure without people willing to use it is of no benefit for anyone. Consequently, the planners need to decide who to listen to and who to thoughtfully ignore; there will always be some resistance and in some questions, citizens will not see the entire, bigger picture thus making objectively wrong decisions for future mobility plans. It is the planners' responsibility to decide how far they rely on the local knowledge of residents and when to weigh the professional expertise higher.

Outcomes and Discussion

Only one interview was conducted specifically addressing the Ring, therefore the report

might lack certain perspectives and details. However, De Werkvennootschap is tasked to involve all stakeholders including citizens and has expertise on participatory proceedings – in talking to a stakeholder manager, a relatively wide set of views was aggregated and incorporated into the interview.

Applicability to Munich

The project's transferability is comparably high, considering the high car dependency and old, car-centred infrastructure in both cities. It also fits well into Munich's strategy, especially regarding improved traffic safety, connectivity and the balance with quality of life and environmental improvements. However, resources for renovation or (re-)construction of the necessary infrastructure are high, even though the existing infrastructure for cycling and public transport from the outskirts to the city centre, as well as the stakeholder constellation are more favourable in Munich than they are or

have been in Brussels. Nevertheless, like Brussels, Munich would probably face well organised and vocal opposition from car-dependent commuters.

Outlook

The major risk for this project is the balance between updating car infrastructure to a level that ensures safe and efficient traffic flow on the one hand, and to create motivation among and opportunities for citizens to change to other modes of transport, as well as supporting green infrastructure and wildlife habitats on the other hand, all within a complex stakeholder environment. Should the project be successfully and effectively completed, Brussels Capital Region would benefit from a convenient, multi-modal infrastructure towards and around the capital region which is fit for the future, as well as higher quality of life and wildlife in areas bordering the ring.

Project Transferability



Project Impact



E-SCOOTER REGULATIONS WITH GEOFENCING AND VIANOVA

Like in all major European cities, the use of light, battery-powered e-scooters has been booming in Brussels for several years now, with the share of vehicles constantly rising. At the same time, in addition to overall convenience and micro-mobility benefits, such as “solving the last mile problem”, the introduction of e-scooters aggravated certain issues. Points of major public concern are safety, lack of infrastructure for parking, improper regulatory framework - and recent statistics on accidents and public opinions serve as a call for action. (Politico, 2022) As a measure to tackle the arising problems, Brussels administration has adapted some spaces throughout the city to a number of designated parking zones and introduced a new package of federal laws regarding e-scooters.

Motivation and Goals

Environmental, safety, space allocation issues are caused by the proliferation of e-scooters in the cities. Reliance on ViaNova insights and geofencing helps to regulate speed/parking and ensure that rules are being followed.

Reliance on competition improves the overall dynamics. The city wants to give certain freedoms to micro mobility providers, but also ensure that main regulations are followed. Providers comply with requirements due to heavy competition and go the extra mile with introduction of e-scooters with swappable batteries, appointing in-house employees, collecting with electric vans and e-bikes. As a result there is a win-win situation for both parties - the city makes the e-scooters usage safer and providers keep operating and creating new ways to provide the best experience (general manager of Dott Belgium, personal communication, July 21, 2022)

Stakeholders

Citizens are involved the most - as measures are influencing citizens' mobility behaviour, as they are expected to comply with rules when using an e-scooter. Providers are also involved by collaborating with the authorities and complying with regulations in order to stay within the market and remain in constant exchange with city authorities.



“But the operators who comply the best to the most to the rules, will have more freedom to increase and develop their services in vehicle sites, the ones who have bad performance indicators...will slowly have increasing or dynamic fleet gap lower and lower. If they keep on having bad results, and therefore, eventually will be pushed away from the market.” - New mobility advisor - Brussels Mobility



20

 km/h general speed reduction for e-scooters

KEY FACTS

Limitations in use supported by geofencing technology: speed reduction on sidewalks 8 km/h

Local providers find the regulations necessary and go extra mile by introducing electric vans/e-bikes and swapping batteries for more sustainability across the chain



E-SCOOTER REGULATIONS WITH GEOFENCING AND VIANOVA

Implementation

In general, users of an e-scooter are expected to comply with all traffic rules that apply to cyclists, regarding street use. Starting from July 2022, users riding an e-scooter in Brussels Capital region must be older than 16 and follow speed limits of 20km/h on roads and 8 km/h on pedestrian alleys. Besides that, Brussels Mobility collaborated with local e-scooter providers to support implementation of such restrictive measures with "geofencing" technology. Shared e-scooters providers agreed to automatically limit the maximum speed to 8 km/h in the pedestrian zones and ban parking in certain places. Such limits are set into digital maps that e-scooter apps are based on. By locating the position, the app prevents parking / acts on the electric engine with speed reduction when riding on the pavement. When parking, e-scooters are expected to be standing and cannot be left at entry/exit zones of public transport stops, footpaths and cycle tracks. (The Brussels Times, 2022)

As stated in the interview with the general manager of Dott Belgium (July 21, 2022), e-scooter providers are welcome to start operating in the city, as the city encourages market competition. Brussels administration guarantees granting the licence if the company complies to the general rules with no limit on fleet sizes. The dott representative explained that companies themselves are willing to follow stricter regulations, as they believe they are beneficial for both users and providers and improve the status quo of micro mobility. Therefore companies stay up-to-date with the regulations and sometimes are even ahead of them, in addition to constant exchange with the city authorities. The geofencing technol-

ogy through the ViaNova platform is one of the results of such collaboration. Still, even if a lot is done on the regulation and prevention side, it is mainly expected that users will obey the rules and police will gradually enforce them

Outcomes and Discussion

The regulation is imposed and monitored, speed will determine where you need to ride and geofencing will correct it by slowing down or not letting you park a vehicle in prohibited space.

As mentioned during the interviews, it is yet hard to assess the results due to the short period of time. But respondents mentioned the expectancy of overall speed reduction and less threat to pedestrians, as well as better parking allocation within the city. Here, geofencing supports the general speed reduction by identifying the surface/geolocation and not letting it speed up in certain areas and only enables the parking of e-scooters in designated spaces.

With all the measures, the representative of Dott highlighted that it remains hard to prevent the misuse and road accidents with e-scooters involved, as it is still heavily dependent on the riders whether they drive safely (personal communication, July 21, 2022). Thus, e-scooters can still be seen parked improperly as a lot of people do not take regulations seriously. In addition, it is highly difficult to control some aspects, such as age, via the e-scooter apps.

In the future, providers remain open for the next steps in ensuring the safe usage of e-scooters and are searching for new ways to enhance the experience but stay within the regulations.

Applicability to Munich

The impacts can be summarised as better e-scooter riding conditions, less threat to pedestrians on pavements and less accidents, as well as better space allocation while parking.

As in Munich geofencing is already used for parking tracking, extending the use to e-scooters seems sensible. The ViaNova platform can be used for developing better insights and regulations. E-bikes and electric vans can be introduced as collecting vehicles for more sustainability.

Outlook

Brussels is further and further regulating e-scooters with the respective providers taking additional measures in order to become more competitive in the market. As most measures are relatively new, it remains open what effects these regulations will have on the intended aspects. It also is an open question how users are and will be experiencing the taken measures - interviewing those could have provided an additional perspective to the ones of the policy makers' and e-scooter providers' perspectives.

Project Transferability



Project Impact



MOVE BRUSSELS - MOBILITY AS A SERVICE

MoveBrussels is a project managed by STIB-MIVB, Brussels' public transportation operator, which aims to provide a Mobility as a Service (MaaS) solution as a technological platform in forms of a mobile application. It was mandated by the Brussels Capital Region in the framework of the Good Move Plan. In the region's project of "Developing innovative mobility solutions in the Brussels Capital Region", Brussels Mobility is parallelly working on policy measures and the necessary policy recommendations to ensure a sensible development of MaaS, both in the public and private sector..

Motivation and Goals

The project's motivation is to provide an encompassing overview of all transport modes beyond individual car use and to nudge people to consider more sustainable alternatives. By gathering all means of transport in one app, it enables one to plan the trip, pay for the transportation means and unlock use of shared and micromobility services. This might motivate people to consider modes of transport that facilitate moving across the city with reduced emissions. According to a mobility policy advisor at Brussels Mobility (personal communication, August 10, 2022), this is what MaaS is currently all about: Trying to change the perspective and making sure more and more people start using the new perspective.

Stakeholders

STIB-MIVB considers social inclusion part of their DNA (manager at STIB-MIVB, personal communication, July 14, 2022), thus, citizens have been part of the app development from an early stage on. Once a first version of the app was created, about 1700 early users were gathered to test the user interface and user experience, how they use the app, and what mobility service providers they would want to see included in the future.

The users have been contacted via several

channels: For once, STIB-MIVB used their own social media channels, for example, by creating events through their Facebook page and actively partaking in customer care through corresponding in a Facebook group. Furthermore, Brussels' mobility minister Elke Van den Brandt advertised the application, which resulted in higher interests in the MaaS solution's website presence. In addition, there has been further internal and external publicity within the public transport operator and its partner organisations.

The goal was to directly realise the learnings from the pilot phase in the mobile application. Here, two focuses were mentioned by a manager at STIB-MIVB (personal communication, July 10, 2022): First, the operator closely works with people with reduced mobility to ensure that both the application itself and provided services are as inclusive as possible. Second, it prioritises more safety for women travelling at night. Here, one major measure would be to include a taxi service such that women can easily switch to when feeling insecure. However, a researcher at POLIS (personal communication, July 15, 2022) points out that there are some risks to social inclusion when such an application and further digitalization becomes more and more prevalent: reducing the possibility of acquiring physical tickets in person for people who are not capable of using a mobile application

Planned to launch in October – November 2022 **KEY FACTS**

1700 pilot testers, out of which a third were active users

Adressed transport: Public transport, micromobility, shared mobility services, taxis.



MOVE BRUSSELS - MOBILITY AS A SERVICE

They stress the importance that the objective should not be digitalization, but sustainability regarding all aspects. As at this point, future adoption levels of the application are yet to be seen, how Brussels Capital Region will handle this remains an open question.

Implementation

STIB-MIVB has been working on implementing the project during the past few years, however, the testing phase which had been planned for six months needed to be prolonged until June 2022 due to the Covid19-pandemic and resulting lower levels of mobility. Thus, while the application was almost ready to be published during our team's research stay, the soft launch is aimed for October / November 2022. Then, people in the Brussels Capital Region will be able to plan their trips via MoveBrussels.

Outcomes and Discussion

Until July 2022, the pilot has been extensively tested during 2 years of which some have been characterised with low levels of mobility due to the pandemic. In the meantime, the decision to launch has been taken for autumn 2022.

In addition to the successful testing phase, a STIB-MIVB manager (personal communication, July 10, 2022) praises the cooperation with the external tech partner Trafi as well as with the mobility service providers that are very eager to work with the public transport operator.

However, the digital application still is a challenging and complex architectural project, which opens debates about data protection, especially in the integration of digital ticketing as well as payment service providers.

It is still unclear whether the MaaS solution will be able to create or support a modal shift from individual car use towards more environmentally friendly alternatives. While the responsible people are expecting a certain number of early adopters from citizens appreciating the advantages of regrouping all modes of mobility in one application, it is still questionable how far the app will reach people who have not been using alternative modes of mobility so far. There might be a need beyond flanking measures to successfully tackle this challenge for the future of mobility.

The launch in October-November 2022 and the grander scale availability of the application will provide better answers to all these questions.

Applicability to Munich

Mobility as a Service applications are a field developing across major cities in the EU – as well as in Munich. As described in the Munich section of the report, MVGO already presents a solution which regroups different modes of transport in one application. Similarly to Brussels, both apps are in an earlier stage, thus, how they will further develop and potentially learn from each other will be seen in the future.

Outlook

We have researched the MoveBrussels project at a point in time, where the final testing phase before finalising the launch plans has just been finished. Thus, we did not have the opportunity to gather any information on how the mobile application will perform in reality, how people beyond current public transport users will adopt it and also, in how far it will help to support a modal shift away from individual car use. Additionally, a mobility policy advisor at Brussels Mobility explained that the Brussels Capital Region is currently working on researching regulation of MaaS and potentially introducing a licensing process for MaaS providers to enter the market (personal communication, August 10, 2022). Furthermore, Brussel is yet to build any mobility hubs, which were described as a physical translation of the digital infrastructure (manager at STIB-MIVB, personal communication, July 14, 2022; researcher, personal communication, July 20, 2022). Currently, there is research in line with

the international research project SmartHubs as well as in the context of rebuilding the Ring around the Region.

How will Brussels' MaaS regulation shape the mobile applications? What will the competition between MoveBrussels and other MaaS providers look like? Will MaaS in combination with Mobility Hubs sustainably change Brussels' mobility landscape? These remain open questions for the future.

Project Transferability



Project Impact



CONFORMING TO COVID

The Covid-19 pandemic has accelerated an already ongoing shift towards active modes of transport as well as stressed the importance for qualitative public spaces. Brussels Capital Region answered those upcoming needs by creating additional pop-up bicycle lanes and reassigning further spaces to pedestrians.

Motivation and Goals

According to a report by Perspective, the regional agency in charge of statistics, territorial knowledge and land planning for the Brussels Capital Region, the health crisis additionally unveiled the unbalanced allocation of public spaces towards cars to the detriment of pedestrians and cyclists. This was used as an opportunity to at parts temporarily, and structurally transform usage of public spaces by prioritising pedestrians and cyclists to ensure healthier modes of transport and social interaction in the open air. The goal is to allow the people of Brussels to travel more serenely on foot or by bicycle and to create the necessary infrastructure to avoid the return or increase of the use of private cars and traffic jams after the health crisis. (perspective.brussels, 2022)

Implementation

To counteract the inadequate distribution of Brussels' public space with regards to the crisis constraints, rebalancing the use of streets and car parking spaces across entire Brussels, but specifically in the denser areas was necessary. This was done by devoting space to active mobility

Stakeholders

As the redistribution of space has taken place as measures in line with the Covid-19 pandemic, there has been a top-down approach in

the implementation of these measures during which the municipalities, the mobility ministry, and the mobility administration Brussels Mobility, specifically Bike for Brussels, have planned and finalised the alterations in line with the Good Move plan.

Outcomes and Discussion

The cycling network in the region was gradually strengthened during the pandemic. At the end of April 2020, the Brussels region decided to create 40 additional kilometres of cycle paths on the main regional roads. A large part of the announced paths has since been realised often in the form of temporary arrangement, sometimes via permanent arrangements. For example, in the streets Rue de la Loi and On Lambermont Boulevard, the right-of-way of road traffic was reorganised to build the necessary infrastructure.

In some municipalities, so-called meeting zones have been established. In these zones, a speed limit of 20 km/h enables a further prioritisation of pedestrians and cyclists who are free to use all the space on the road. In addition, public authorities have converted some parking areas and parts of streets to the benefit of other uses of public space.

60 % of public space is dedicated to cars

KEY FACTS

Reduction of on-street parking by 475 spaces to 274.206 by 2022 (Good Move's ambition is a reduction to 200.000 by 2030)



CONFORMING TO COVID

Even if there is no exact count of the number of parking spaces removed temporarily or permanently, this trend is in line with the region's ambition to reduce the amount of car parking in public space in order to offer high quality public spaces to pedestrians as for example enabling interaction in neighbouring activities or offering green spaces for relaxation. This policy is also a partial response to the lack of public spaces in certain dense areas of the region

Changes to public spaces have also taken place in the "Staycation" and "Bruxelles en vacances" projects. In order to reduce (inter) national travel, Brussels Mobility has chosen 50 projects in 2020 and 2021 each to temporarily adapt public space to offer holiday places to local residents by making them more citizen-friendly and greener. In this line, new meeting places, safe playgrounds and green areas have been created all over Brussels.

It is an open question of whether or not the entirety or parts of the new infrastructures will remain. However, the developments have been in accordance with the region's mobility vision and the Good Move plan, and the continuation of the reallocations of public space in combination with secure public transport through prioritisation of the reduction of car travel and support of walking and cycling stays desirable in terms of sustainability. (perspective.brussels, 2022)

Applicability to Munich

Reallocating spaces in this pop-up-manner is a fast and easy solution to deprioritizing cars in cities' dense areas. Similarly to Brussels, Munich has already reallocated parts of roads to pop-up bicycle lanes and parking spaces to the public in forms of summer streets and outdoor seating terraces at restaurants.

Outlook

Travelling to Brussels in the summertime has shown how well received both measures are: Walking around the city one could observe that the bicycle lanes were in active use as well as the transformed public spaces. As of now, these transformations were a short-term reaction to immediate needs, and the lasting impact remains open. Thus, it is necessary to evaluate the initiatives taken, their performance in real-life and consider whether and how to maintain them in the future.

Figure 10. On the right side: Projects subsidised by "Bruxelles en vacances" in 2020 and 2021(perspective.brussels, 2022,p.125)



Project Transferability



Project Impact



CONCLUSION

19 municipalities with 19 individual visions for their own districts, united under the renown sustainable urban mobility plan Good Move - what started with learning about the complications and challenges of shaping mobility in Brussels' distinct political governance landscape quickly turned to uncovering more and more layers in successful mobility transformations in this socio-cultural surrounding by speaking to thought leaders in mobility.

Our team's interdisciplinarity was reflected in our interviewees and their respective project teams: Before, during and after our stay in Brussels, we conducted in total 19 interviews with people from various backgrounds representing pedestrians – specifically people with reduced mobility -, biking, micromobility services, public transport and car issues in mobility administration offices, political institutions and parties, public and private companies, academic research, and non-governmental organisations. This interdisciplinarity also reached the teams of the mobility projects as expertise was often drawn from engineers as well as social and political scientists when implementing a new measure.

As extensively researched, the mobility projects in Brussels are characterised by a two-fold approach: on the one side, impeding more harmful transportation modes and types and on the other hand, incentivizing more sustainable ways of mobility. Hereby, the capital emphasises communication across municipalities and functionalities as well as citizen inclusion. Sometimes, the latter is used as a lever to further encourage more powerful measures through a bottom-up procedure – while in the meantime, more flexible and at times somewhat impromptu solutions function as placeholders.

In summary, we could observe that with the step-by-step implementation of the Good Move plan, the EU capital has the potential to set an example for other European cities, advocating for equally striving for social and environmental sustainability in mobility projects.





OUR TEAM	108
INTRODUCTION	109
LOCATION ANALYSIS	113
URBAN MOBILITY ANALYSIS	117
SWOT ANALYSIS	119
PROJECTS IN LISBON	120
<u>UMA PRAÇA EM CADA BAIRRO</u>	<u>123</u>
<u>A RUA É SUA</u>	<u>127</u>
<u>BICICULTURA</u>	<u>131</u>
<u>BICICULTURA: COMBOIOS DE BICICLETAS</u>	<u>133</u>
<u>BICICULTURA: VELOTECA</u>	<u>137</u>
<u>MUBI</u>	<u>139</u>
<u>PASSE NAVEGANTE</u>	<u>143</u>
<u>CARRIS: ON DEMAND BUSES</u>	<u>147</u>
<u>GIRA: BICICLETAS DE LISBOA</u>	<u>151</u>
<u>MICRO-MOBILITY GOVERNANCE</u>	<u>155</u>
<u>CITY BIKE LANES</u>	<u>159</u>
CONCLUSION	163



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INTRODUCTION

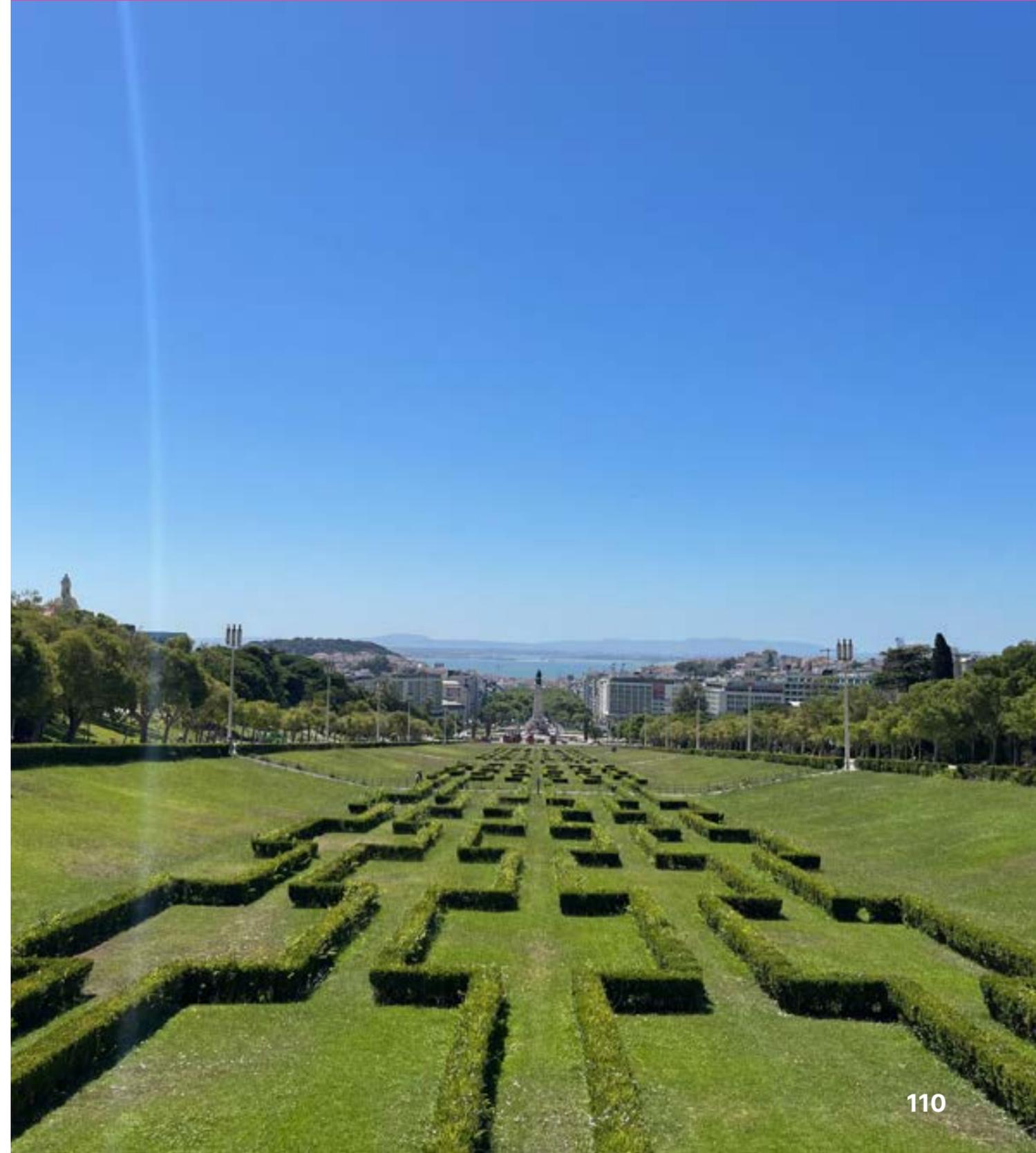
Lisbon was the second city chosen to be examined for this report. Therefore, four of the students from four different study programs – Transportation Systems, Responsibility in Science, Engineering, and Technology, Environmental Engineering, and Politics and Technology – went to this vibrant, innovative, and open-minded city to examine how a Southern European country approaches mobility problems most originally and sustainably. The team travelled to Lisbon from the 27th of June to the 7th of July and had the opportunity to conduct 15 interviews with 25 different people from various institutions and associations all over Lisbon, including public authorities, public transport providers, universities, companies, and numerous other organisations and NGOs in the mobility field. Furthermore, the team had the chance to participate in projects and use several different modes of transport during their stay, making the research more tangible, engaging, and memorable.

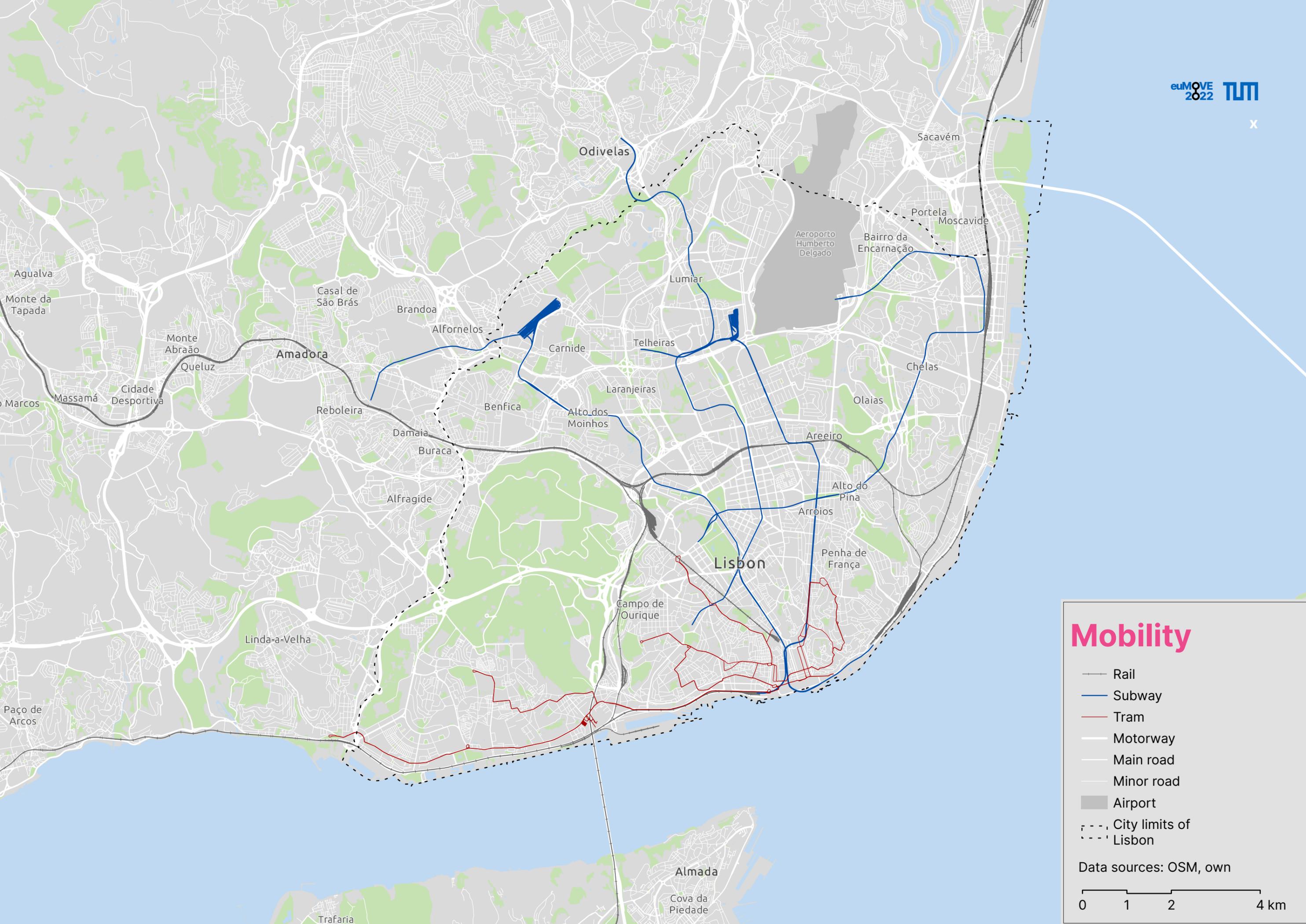
Lisbon is an exceptionally individual case. It is not only the capital of Portugal but also has the potential and aims to become the technology and innovation capital of Europe or even the world due to recent developments (Butcher, 2021; The Portugal News, 2022). This development is something the team also noticed during the stay because the people in Lisbon approach technological enhancements and innovations very openly and enjoy trying new things or instead discovering new ways of approaching problems, including in the mobility field. Moreover, not merely the topography of the city with its hilly layout (Gaspar, Rebelo, and Ehrlich, 2021), which might lead to a few hurdles in implementing some specific projects, is an extraordinary case, but also the people living in Lisbon with their unique sense of community and open-mindedness are significant for this city.

Last but not least, in 2020, Lisbon won the “European Green Capital” award by the EU and thus did not only receive the title and a monetary price but also showed off its strengths concerning sustainability. One of the main reasons why Lisbon won the award was because Lisbon had and still has a clear vision for sustainable mobility, a solid commitment to sustainability goals, and was able to tie sustainable development with economic growth (European Commission, n.d.).

Therefore, examining such a city gave unique insights into what – sustainable – mobility and development can look like and thus made Lisbon the ideal city to research mobility. In particular, when looking for comparisons with Munich, even though the cities are pretty different in geographical and climate respects, numerous projects were detected that can be extraordinarily interesting to examine in a Munich context. This is the case because Lisbon can be seen as a notable pioneer in innovative and sustainable approaches, and Munich can adapt and include some of these new ways of thinking in its distinctive approaches to mobility. The team will examine some special and fitting projects in the following part to enable a more in-depth insight into Lisbon’s approach to sustainable and innovative mobility and how it might fit with the city of Munich and its concepts and plans for mobility.

LISBON

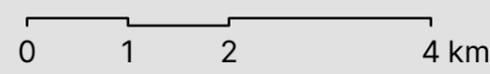




Mobility

- Rail
- Subway
- Tram
- Motorway
- Main road
- Minor road
- Airport
- - - City limits of Lisbon

Data sources: OSM, own



LOCATION ANALYSIS

Demographics

In a European Union context, Lisbon is the largest urban area (World Population Review, 2022a). Moreover, in Lisbon, Portugal's capital, most administrative institutions are located; thus, it is a hub for national and international people (World Population Review, 2022a). Besides this, Lisbon is Portugal's most populated city, with around 545.000 inhabitants in Lisbon city and nearly 2.900.000 inhabitants if the metropolitan area is included (Gaspar, Rebelo, and Ehrlich, 2022). Thereby the population's growth rate is at about 0,49% for Lisbon, including the metropolitan area (World Population Review, 2022), and the population density is estimated at 5 981,4 hab./km² (Câmara Municipal, n.d.).

Moreover, the population's median age is approximately 46 years (ZhujiWorld, n.d.). Most of Lisbon's inhabitants are Portuguese, with a share of around 90.7%, whereas the percentage of foreigners living in Portugal's capital is estimated to be about 9.3%, with Brazilians being the largest minority group with a share of 2.75% (Council of Europe, n.d.).

Economy

The city of Lisbon and its metropolitan area is one of the wealthiest regions of Portugal, representing 36 per cent of the national GDP (City of Lisbon, 2020). Alongside Porto, it is one of the two important economic centres of the country. With an unemployment rate of about 7%, it is less than 1% above the national average, and with 28%, trade, transport, and accommodation are the largest sector of Lisbon's economy by employment (City of Lisbon, 2020).

Most headquarters of multinational corporations in Portugal are located in the Lisbon area. Due to this, Lisbon is providing many well-paid jobs attracting more and more digital nomads who are discovering the benefits of freelancing across Europe (The New Economy, 2022). Besides big corporations, Lisbon also has a growing entrepreneurial ecosystem. In 2015, the city received the European Entrepreneurial Region award for promoting entrepreneurship and innovation in small and medium-sized enterprises (City of Lisbon, 2020).

A growing population of 500.000+ inhabitants for the City of Lisbon and an additional 2+ million for the greater metropolitan region characterise the city (World Population Review, 2022a). In addition to digital nomads and an influx of nearly one million commuters entering the city and its metropolitan region every day, tourism plays a significant role in Lisbon's economy and therefore shapes the city's appearance. Every year, thousands of visitors from all over the world come to Lisbon due to the city's vast natural, historical and cultural heritage (OECD, 2022; The New Economy, 2022).

Because of this, Lisbon is rocketing through the classic gentrification process of dilapidation, artistic renewal, innovative, entrepreneurial action, and increasing prices (The New Economy, 2022; Universidade de Lisboa, 2022). The main challenge arising from Lisbon's economic situation, therefore, is to maintain social inclusiveness concerning housing and transport despite continuing the city's growth.

Political System and Governance

As the capital of Portugal, the City of Lisbon is also the country's political centre, the government's seat, and the residence of the head of state, the President of Portugal.

From a political perspective, governance of mobility in Lisbon is shaped most dominantly by the recent change in the municipal government: In the 2021 local elections for the Lisbon City Council (2021-2025), the social democratic candidate and former EU commissioner Carlos Moedas (PSD) won against the socialist incumbent Fernando Medina (PS) in a head-to-head race by 3000 votes. Accordingly, Fernando Medina (PS), who was in office from 2015 to 2021, lost his re-election bid. With this, the social democrats have replaced the socialists as the party in power after 14 years (Spiegel, 2021; Euronews, 2021).

This political change is relevant for several reasons: For one thing, several interview partners argued that the previous mayor and socialist government took a more progressive

stance on mobility policy. During this time, efforts were made to limit car parking and implement additional road infrastructure for bicycles. The current mayor from the social democratic party instead promised advantages for car drivers during his election campaign. For another thing, the change in government also influences the distribution of financial resources that, again affects public transport and contracts with private mobility companies (Transportation Expert - Yunex, Personal Communication, July 1, 2022).

Concerning the interaction between the public and private sector but also civil society, it is also important to mention that there are inevitable tensions in the relationship. Several interview partners confirmed that the public contractual law includes long approach processes and slows the implementation of innovative projects down. In addition, the tax system is very complicated, which presents a barrier to local and foreign investment (Transportation Expert - Yunex, Personal Communication, July 1, 2022). The figure below gives an overview of stakeholders involved in shaping mobility policy in Lisbon.



Figure 11. Stakeholder Map for Governance of Mobility in Lisbon (Own elaboration)

LOCATION ANALYSIS

History

It is essential to understand how the governance structures have historically grown to explain the status quo. In 1974, during the Carnation Revolution, a coup by leftist military officers overthrew the previously existing authoritarian regime and paved the way for re-democratization. Two years later, in 1986, Portugal joined the European Community and started to receive funding to foster its economic development. Since then, Lisbon has positioned itself as an aspiring city attracting European and international ventures such as the European City of Culture in 1994, the Expo '98, and the European Entrepreneurial Region award in 2015 for its continued efforts to land redevelopment and urban renewal. However, EU funding also created reliance and dependency (City of Lisbon, 2020).

Out of this history, a lack of investment and complex urban governance structures originated. Both private and non-profit actors criticise the lack of investment in transport infrastructure, which occurred due to the economic struggle of Portugal. For the past 20 years, there has been maintenance only but no significant investments in new transport infrastructure. Longer waiting times and lower frequency are the results that make it hard for public transport to meet its demand and unattractive to citizens. On top of that, there is a trend of Portuguese moving from the countryside and small towns to the major cities of Lisbon and Porto, which by now already account for half of the population (Municipal Mobility Expert - TML, Personal Communication, June 30, 2022).

With 20 centuries of history, Lisbon is a truly historic city. This also means that responsibilities within the city and beyond are historically

grown and established in complex urban governance structures. City responsibilities concerning the mobility system are diverse and entangled. Today, 18 municipalities make up Lisbon's metropolitan area. Until recently, 10 public transport providers with independent ticketing systems operated in the metropolitan area. Despite recent efforts to integrate the transportation system by founding a new metropolitan company and introducing simpler ticketing, the structures remain complex (Municipal Mobility Expert - TML, Personal Communication, June 30, 2022).

Climate and Geography

Lisbon, Portugal's largest city with an area of 85 square km, is located next to the Tagus River and is close to the Atlantic Ocean. This location makes the city susceptible to earthquakes but also enables Portugal's most significant share of sea trade, especially between Spain and Portugal. Furthermore, Lisbon is characterised by its well-known hilly landscape (Gaspar, Rebelo, and Ehrlich, 2022).

Due to the proximity to the Atlantic Ocean and the strong influence of the Gulf Stream mediate, the climate is generally mild all year long, with a mean annual temperature of approximately 17 °C. Thereby, January is the coldest month with an average temperature of about 10 °C, and August the hottest month of the year, with 28 °C mostly being the highest temperature. The rainfall varies throughout the year, between 0.1 inches in summer and approximately 4 inches in winter (Gaspar, Rebelo, and Ehrlich, 2022). Overall, the air pollution in Lisbon is moderate but still higher than the established one-year limit defined by the World Health Organization (plume labs, 2022).

Education and Research

Lisbon's education system is similar to the rules and regulations of the rest of Portugal. Therefore, the children are obliged to go to school from the age of 6 to 15. After that, education is, to a certain degree, optional (Gaspar, Rebelo, and Ehrlich, 2022; World Population Review, 2022).

However, Portugal, or rather Lisbon particularly, offers a variety of universities and institutions (Gaspar, Rebelo, and Ehrlich, 2021). More specifically, Lisbon has six universities (University Guru, n.d.) and 69 institutes (Câmara Municipal de Lisboa, n.d.) that are, in most cases, highly ranked in international ranking systems (Study Portal Masters, n.d.).

The research focus of the universities in Lisbon is widespread, including in particular natural sciences (including but not limited to environmental, maritime, and biomedical studies),

engineering and technology studies (including but not limited to innovation, technology, and sustainability research), and business and economic studies (University of Lisbon, 2021; NOVA University Lisbon, 2022).

One of the largest and thus most relevant universities is the University of Lisbon, which is ranked lowest in place 500 in the international university rankings (University Guru, n.d.) and researches various topics surrounding mobility in Lisbon and/or Portugal and was therefore highly relevant to our research project. A specific group of the University of Lisbon, or rather Instituto Superior Técnico, that was significant for the team's research concerning urban mobility in Lisbon was U-Shift which also focuses on all the issues relevant for this report (U-Shift, n.d.).



URBAN MOBILITY ANALYSIS

Modal Split

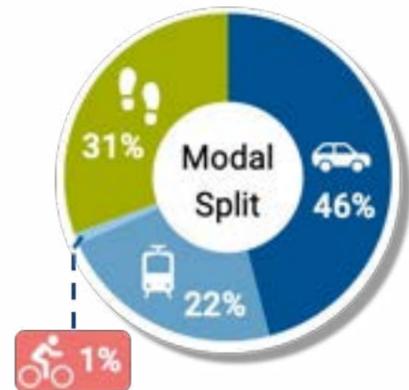


Figure 12. Modal split in Lisbon – 2017 (Câmara Municipal de Lisboa, 2020)

Private vehicles are the predominant transportation mode in Lisbon. According to data published by the Lisbon City Council, in 2017, 46% of all trips in the city performed involved a car. The car dependency in the city has not always been so high. In 1981, only 14% of all trips in Lisbon were made with private vehicles. Still, the years of population growth in the neighbouring cities and government investments skewed the preference and easiness for individual mobility.

The city, however, has great potential for sustainable urban mobility. Lisbon's walking share reached 31% in 2017, against only 18% in 2011. Cycling levels were below 1% in 2017, but the recent efforts from the city with the GIRA bike-sharing scheme (see project "[Gira: Bicicletas de Lisboa](#)", p. 151) and the new bike lanes (see project "[City Bike Lanes](#)", p. 159) resulted in a growth of 154% in cycling between 2017 and 2021.

Public transportation ridership in Lisbon accounted for 22% of all the trips in the modal

split. The city has taken initiatives to reach its 2030 goal of a 66% modal split for car alternatives. The new metropolitan transport agency (TML) offers a simple ticketing system, which led to an increase of 30% in public transport demand since its implementation. On top of that, the City Council recently approved free public transportation for the elderly citizens (above 65 years) and the young ones (below 23 years).

Accessibility

When thinking about Lisbon, the first things that come to mind are the red bridge crossing the river, the hilly neighbourhoods, and the old trams. Quite all very nice things for Lisbon, but regarding accessibility not to advocate. Some sightseeing locations are already designed barrier-free to enable people with reduced mobility (e.g., wheelchair users, older adults, adults with young children), but living in Lisbon with a mobility-reducing property seems quite challenging.

The traditional pavement on the sidewalk, called "Calçada Portuguesa", looks appealing but allows tree roots to up and down-lift the surface easily. This makes moving challenging. The hilly streets are complicating the movements, too. Although it has been studied that the roads in Lisbon have a low slope (Félix, 2021), the length of these streets is crucial: Even a slight incline is exhausting in the long run, additionally to the aggravating characteristics of a mobility-reducing impairment. In terms of public transport, the objective is to install barrier-free access to all metro and train stations. The expansion is proceeding slowly. Due to the old constructions, it is expensive and sometimes unfeasible (Project Manager at

Metro Lisboa, personal communication, July 1, 2022). The traditional trams are unfortunately only accessible via steep stairs and, therefore not accessible for people with reduced mobility. In addition, younger and all accessible low-floor vehicles are used to operate ground-level lines. Buses are accessible with wheelchairs, and additionally, Carris (the local bus operator) provides an on-demand service for mobility-reduced customers (Museu da Carris, 2022).

Public transport stops are generally diverted over the whole city area. The accessibility towards them depends on the different modes of transport. The metro can easily be built in the valley but can only slightly go up a hill. Therefore, the neighbourhoods on the hills are suffering from easy access to a metro station. Buses, pedestrian paths, steps, or elevators connect the stations with the neighbourhoods. For the buses are, several stops installed in an equal distribution. The passengers have to raise their hands to stop the approaching bus. In this case, buses no one wants to board can pass the stop without stopping.

Multimodality

In Lisbon are different transport modes available. The classic public transport modes (train, metro, tram, and bus) can be used within an overall ticketing scheme within the whole metropolitan area. Unlike what many tourists think, are the old trams not just a "touristy decoration". They are still in use and in charge of operating several lines on daily business. At the river are several ferry lines connecting the two sides, which saves much time compared to the buses, which use the two bridges Ponte Vasco da Gama in the east and Ponte 25 de

Abril in the south. The ferries are integrated into the public transport system as well. Public transport is operating in the whole city area of Lisbon and the adjacent municipalities (Municipal Mobility Expert - TML, Personal Communication, June 30, 2022). The recently created planning and managing institution Transportes Metropolitanos de Lisboa covers the whole metropolitan area.

Multiple suppliers offer the different sharing systems for micro-mobility in economic competition. Standard and electronic bikes, motor scooters, and pedal e-scooter are usable in independent sharing systems. In on-road traffic, mostly pedal scooters and electronically supported bicycles are seen because it is quite comfortable in the hilly terrain of Lisbon. A cable car is installed on the river-side close to the Oceanário de Lisboa but is not integrated into the public transportation system and is mainly used by tourists. Car sharing systems are not present in Lisbon. Due to the very affordable taxi prices and the high percentage of car ownership, the operation of car sharing was not profitable in Lisbon. Before Covid-19, some organisations provided offers but with the challenging aspect of the pandemic, they quit their business in Lisbon. Passenger transportation services (e.g., Uber) are commonly used in Lisbon, but the dominant taxi sector regulates the pricing (Municipal Mobility Expert - TML, Personal Communication, June 30, 2022).

PROJECTS IN LISBON



SWOT ANALYSIS

Strengths

- Share of walking is already very high
- Metropolitan transportation agency
- Integrated ticketing system
- Active civil society
- Successful bike sharing scheme
- Climate facilitates active mobility
- Lively society

Weaknesses

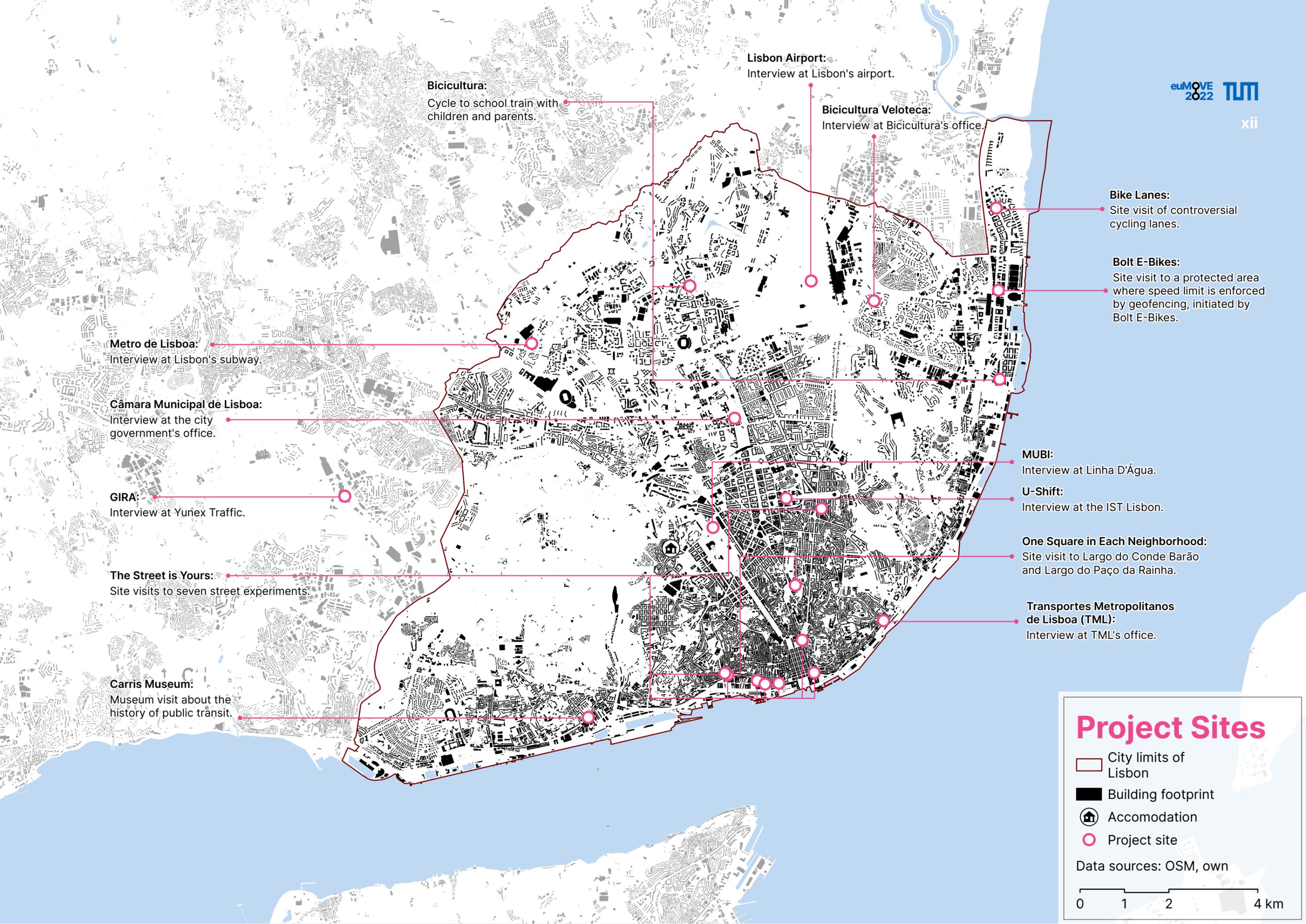
- Traffic-related noise is high
- Rigid mobility patterns
- Hilly topography
- Insufficient integration of transportation and information systems
- Tourists are not integrated into mobility services
- Lack of funding for public transport
- Low level of cooperation between academia and municipality
- A lot of unused open space

- Share of Cycling has been increasing but is still low
- Good planning leading to EU funding
- Openness towards new technology
- Many citizens initiatives
- Comprehensive research projects in the field of mobility

Opportunities

- Increasing costs of living
- Ongoing gentrification
- Recent change in government: backlash of conservative mobility policy
- Low acceptance of population towards alternative mobility modes
- Salaries too low to keep qualified workforce

Threats



Bicultura:
Cycle to school train with children and parents.

Lisbon Airport:
Interview at Lisbon's airport.

Bicultura Veloteca:
Interview at Bicultura's office.

Bike Lanes:
Site visit of controversial cycling lanes.

Bolt E-Bikes:
Site visit to a protected area where speed limit is enforced by geofencing, initiated by Bolt E-Bikes.

Metro de Lisboa:
Interview at Lisbon's subway

Câmara Municipal de Lisboa:
Interview at the city government's office.

GIRA:
Interview at Yunex Traffic.

The Street is Yours:
Site visits to seven street experiments.

Carris Museum:
Museum visit about the history of public transit.

MUBI:
Interview at Linha D'Água.

U-Shift:
Interview at the IST Lisbon.

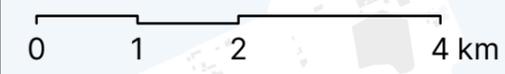
One Square in Each Neighborhood:
Site visit to Largo do Conde Barão and Largo do Paço da Rainha.

Transportes Metropolitanos de Lisboa (TML):
Interview at TML's office.

Project Sites

- City limits of Lisbon
- Building footprint
- Accommodation
- Project site

Data sources: OSM, own



UMA PRAÇA EM CADA BAIRRO

The “[Uma Praça em cada Bairro – intervenções em espaço público](#)” [A Square in every Neighborhood - interventions in public space] program promotes squares as places for exchange socially and culturally for the broad society. It is a conceptual approach to bringing more life to the different neighbourhoods. Within the execution of the program, different locations were identified, analysed, and redesigned. The program was implemented from 2013 to 2017. In collaboration with the 24 Lisbon parish councils, the City Government proposed to continue with this program for the following legislative period (Câmara Municipal de Lisboa, 2022).

Motivation and Goals

The quality of stay in the various parts of the city should be increased to offer the residents a place to stay and not the necessity to “always have to go to the city centre”. In an interview with a representative of the municipality in the field of urban planning, it was mentioned that different centres should be created with the intention of diverting the concentration of the downtown centre. Starting from an already existing square, street, commercial area, or neighbourhood garden, a new public place should be organised that concentrates activities and employment. With the promotion of the active mobility modes and public transport, the whole square should be traffic calmed; car traffic should be restricted. Accessible for all, the new square should become a meeting point for everyone (Câmara Municipal de Lisboa, 2022).

Stakeholders

Lisbon is the “Cidade de Bairros” – the city of neighbourhoods. In general, 230 bairros exist but they don’t have administrative boundaries or a fixed definition. For better organisation, the city area is divided into 24 communities: represented in the 24 Lisbon parish councils. Within these communities, a spatial analysis (in terms of access and links, comfort and appearance, uses and activities, and sociability) and the contributions of the population during the public participation phase defined 30 locations as “squares with priority”. The locations are spread over the entire area of the city. Within online participation phases and public sessions, the citizens were able to hand in suggestions for each neighbourhood and location. Upcoming questions and concerns were answered in an optional second public meeting to clear out ambiguities. The main concerns and proposals from the society are integrated into the concept and related measures are derived from it (Câmara Municipal de Lisboa, 2017).

KEY FACTS

30 planned squares in Lisbon

6 squares are already implemented



LISBON - Project Overview

UMA PRAÇA EM CADA BAIRRO

Implementation

Currently, six squares are implemented, the rest is in the implementation or planning stage. For each square, a SWOT analysis was carried out. Depending on the location, different measures were integrated to use the strengths to reach the opportunities. Besides rearrangement of automobile traffic infrastructure, the improvement of pedestrian accessibility and the enhancement of the tree population as well as the identity of the square within the urban context were observed and inserted (Câmara Municipal de Lisboa, 2022). During the interviews and on the homepage is not mentioned, if all 30 squares will be and till when they will be implemented.

Outcomes and Discussion

The refurbished fundings for every 'location with priority' are written down in a SWOT analysis as well as the main lines of action, the objectives, and the results of the public participation are published in a clear manner on the program homepage and refurbished in a report. Important information can be looked up for every location separately.

Unfortunately, the citizens and the authorities of the different parish councils were not interviewed. Also, not every square was visited on-site but it was noticeable that the quality of the location was improved. A lot of trees and clean pavements left a comfortable feeling. The squares were visited during sunny and warm weather, but it is assumed that the places are as well clean and comfortable during Lisbon's winter.

Applicability to Munich

The project has a high impact on the quality of stay, use, and experiences. The wide distribution over the entire city area promotes equalising neighbourhoods and their locals. Also, the required measure of accessibility positively influences the evaluation.

The program was implemented and carried out by the leading city council. For the same procedure, a leading majority for a similar project/program is needed in the Munich Cities Council. Besides that, the programme would support a uniformly distributed city upgrading.

Outlook

With the launch of this programme, Lisbon is addressing public space as a valuable asset. The various design elements, such as trees, benches and traffic calming, contribute to a pleasant microclimate that invites people to linger. Walkability is improved, public transport is encouraged, and car traffic is restricted. As car use is relatively high in Lisbon, the elimination of parking spaces, as well as the diversion, causes discussions. Still, the lively society will surely appreciate the high quality of stay soon after the implementation. All 30 "locations with priority" should be implemented to support a balanced quality of stay distributed throughout the whole urban area of Lisbon.



Project Transferability



Project Impact



A RUA É SUA

“A Rua É Sua” [“The Street Is Yours”] is a programme that started in 2019 with the project being carried out on Avenida da Liberdade between May and December on the last Sunday of each month. The main idea is to close the street to car traffic and thus was intended to enable the usage of active modes of transport, including but not limited to walking, biking, and driving scooters. Moreover, this project allowed different sales activities for local producers and sellers and made sports or rather leisure activities possible. Today, the project is well established and does nowadays not merely take parts any other Sunday, but has 10 definite and 4 temporary, thus 14 in total, streets which are now an essential part of the programme but will not stay the only ones in the future (Câmara Municipal de Lisboa, 2022a; Researchers IST – University of Lisbon, Personal Communication, July 4, 2022).

Motivation and Goals

The project aims at numerous goals addressing various topics to have a positive impact on people and the environment. First, this concept’s main idea is that safe spots in Lisbon are created to enhance walking and other alternative, active transportation modes possible by reducing car parking. This also influences the well-being of the residents and visitors by enabling an enjoyable place where people come together. Furthermore, the programme boosts local commerce and supports locals by promoting temporary or permanent urban art interventions, which should, in the end, keep the cars from taking up space. Furthermore, even though it started as a temporary programme, it should be carried out permanently. In the end, approximately 100 streets across Lisbon should be included in the project (Câmara Municipal de Lisboa, 2022a).

Stakeholders

The project was initiated by the municipality, whereas now, especially with the adaptation of the programme during the times of COVID-19, e.g., ensuring physical distance or boosting physical activity, and the implementation of the project in new parts of the city, the Parish Councils are more and more involved in the decision processes (Câmara Municipal de Lisboa, 2022a).

Moreover, the project is intended to address not merely the residents of Lisbon and its metropolitan area, even though they are the main target group, but also visitors from around the world are addressed by the project.

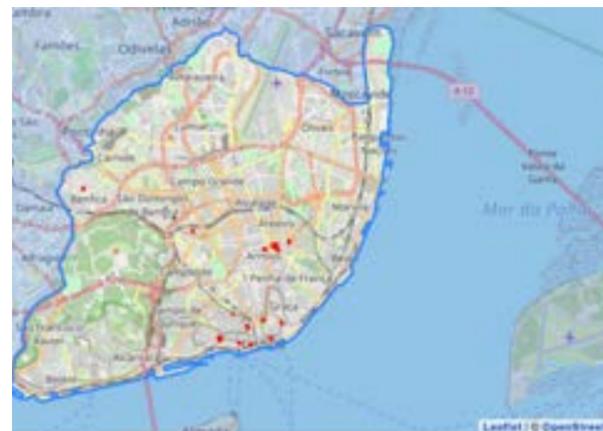


Figure 13. Locations of the “A Rua É Sua”-Project (Câmara Municipal de Lisboa, 2022).

KEY FACTS

The project initiated in **2019** and was adapted during the pandemic

10 permanent streets in Lisbon

4 temporary streets in Lisbon



LISBON - Project Overview

A RUA É SUA

Implementation

Today, the project is implemented in 14 streets across Lisbon. For now, the focus is mainly on the city of Lisbon, but since around 100 streets are intended to be included in the programme, every parish and thus possibly the metropolitan area, as well, should be addressed by these interventions, too (Câmara Municipal de Lisboa, 2022a). Moreover, as seen with the adaptations due to COVID-19, other adjustments might be possible, as well, to make the “A Rua É Sua”-project even more enjoyable for residents and visitors.

Outcomes and Discussion

As the idea started as a temporary event and became permanently implemented in numerous streets all over Lisbon, it seems to be successful to the degree that it is necessary to keep the spots as they are. Moreover, since there is an ambitious goal, there must be from all stakeholder sides to support this project alive and growing, and thus the project looks like it is accepted by the broad public.

However, as the project started in the Avenida da Liberdade and is not continued in this huge street, the project seems to be problematic in large places with more traffic. This conveys the impression as the programme is more suitable for streets that are smaller or rather more frequently used by pedestrians or bikers anyways. Nevertheless, as we have seen during our trip, the streets are indeed used by multiple people, residents as well as visitors. Furthermore, numerous restaurants and stores are using the space for their customers. Ultimately, the streets are also an attraction for many tourists, as they are advertised as such,

too. The information on the streets, however, is in some cases not as easy to find since there is merely one page dedicated to the programme, which is also merely available in Portuguese, which is a language not all visitors are fully familiar with.

Applicability to Munich

The “A Rua É Sua”-the project has had a positive impact on the citizens, merchants as well as visitors of Lisbon. It enables a get-together of all stakeholders and enhances active mobility for them, too. Moreover, it boosts local sales, and in general, it promotes accessibility to different parts of the city for all residents.

When the team visited various locations of this project during our stay, including Rua Nova do Carvalho (Pink Street), Rua da Silva (Green Street), and Rua dos Bacalhoiros (Blue Street), the team also had the impression that these specific streets do enhance the liveability of the city, especially with regards to aspects of walkability and getting together with other people.

The project needs not merely the commitment of the city of Munich but also the spaces to make such a programme feasible. Streets for the implementation of this project need to be identified and re-designed. For this, all stakeholders need to work towards this goal. Possibly, the “Sommerstraßen”-project (see project “Sommerstrassen”, p. 27) is an excellent pioneering project for the implementation of a large-scale programme like the “A Rua É Sua”-project.

Outlook

The project “A Rua É Sua” seems to be a promising programme for the future, as it is not merely implemented permanently today, but also numerous other streets are in planning for this specific project.

Moreover, there are projects dedicated in this sense by the IST Lisbon. U-Shift, a research group dedicated to mobility in Lisbon, has one specific project that deals with new usages of streets – “Street4All”. It is dedicated to finding a solution for different kinds of streets and should enable the usage of the street depending on the demand of the people by allocating road space over the course of the day. However, even though some small ideas are already implemented in a few streets, this project is for now merely focused on research activities. Nevertheless, this project goes hand in hand with the idea of “The Street Is Yours” and might be a useful addition in the future (Researchers IST – University of Lisbon, Personal Communication, July 4, 2022).



Project Transferability



Project Impact



BICICULTURA

Bicicultura is a “non-profit cooperative dedicated to promoting the use of bicycles for transportation, work, leisure, and therapy through sociocultural and other interventions for the well-being of people and sustainable development” (Bicicultura, 2022). It is organised by citizens of Lisbon, who use the advantages coming from different backgrounds. A team of seven supported by several volunteers manages the different projects, the cooperation with stakeholders, the communication, and several other accumulating tasks. The long-term vision is working towards a better city to live and work in, with greener, prosperous, and socially just (Bicicultura, 2022).

The aim should be fulfilled by following different demands and measures. Besides a general promotion of active mobility, the association wants the normalisation of the use of bikes, a modal shift towards cycling, greater qualification and employment in the sector, and a strengthened network of local actors. By concentrating on the health of humans and nature and a sharing and circular economy as well as the high-quality use of and accessibility to public space for all people, the objective should be enabled (Bicicultura, 2022a).

Bicicultura is active in the area of Lisbon. The office itself is located in a residential neighbourhood in the north and offers space for the storage of different equipment just as cargo bikes. With several projects, the aim and vision of the organisation is transported to the broad society. The projects concentrate on different fields and users. In collaboration with technical and institutional partners, different groups of society are addressed. Several projects (“Cycle-to-school”, “Bicycle Heroes”, and “Learn to Play”) deal with the mobility of children and advantageous use of space for their age. The other three active projects (“Veloteca”, “Business with Pedalling”, and “SParqs”) promote the use of cycling for activities in business and daily life as well as the high-quality use of public space. Concentrating on cycling, the organisation promotes active mobility and a modal shift from vehicles to it (Bicicultura, 2022a).

General Outlook

The organisation Bicicultura is an important stakeholder in the field of cycling in Lisbon. With the general focus on cycling, but also with the distinct concentration on the needs of children, the association makes an important contribution to the framework of the mobility culture in Lisbon. As with any other association, it depends on the people behind it. Through the development of cycling in Lisbon in the last years, we guess that the organisation will also in the future have a lot to do.



“Uma cidade mais que sustentável, amável.” (English: A city more than sustainable – loveable.)

- Bicicultura, 2022



KEY FACTS

6 projects are carried out currently, **3** projects concentrating on the needs of children

The Podcast “Conversas da Bicicultura” is carried out to “learn a little more about topics that influence the quality of our daily life”



BICICULTURA: COMBOIOS DE BICICLETAS

The “Comboios de Bicicletas# [Cycle-to-school] project gives school children the opportunity to cycle in a guided group to school. Like a regular train, the Cycle-to-school train has a set route and schedule, and any passenger (child) can join the train if desired. A train leader (a volunteering adult) leads the train through a fixed route, looks after the children, and makes sure that the train arrives on time at the different stops and the final destination. The train leader is accompanied by volunteer parents, who also look after safety aspects. The number of volunteers depends on the number of registered children: With more children, more parents are needed to keep an eye on every child. Registration of a joining child is needed one day ahead in terms of supervision and organisation.

Motivation and Goals

The aim of the project is to promote sustainable mobility for children through a fun and safe travel alternative and to contribute to children’s autonomy and health. On a broader base, the project aims to change the local culture of mobility through awareness of active and sustainable mobility habits. Following the goal to become a climate-neutral city, which Lisbon declared to be by 2030 (European Commission, 2022), increasing the modal split percentage of cycling helps to reduce the emissions of the transportation sector. As the percentage of cyclists in Lisbon’s modal split was less than 1 % in 2017 (Câmara Municipal de Lisboa, 2020), the city of Lisbon needs to promote projects supporting and establishing cycling as a common transport mode for the area of Lisbon. The cycle-to-school project offers a simple and age-appropriate way to create sustainable mobility awareness at an early age. In addition to the positive impact on children, parents also learn about bicycles as an easy and convenient mode of transportation for themselves (Cycle-to-School Volunteers, Experience and Personal Communication on Site, June 29, 2022).

Stakeholders

After the successful implementation of the first cycle-to-school train on the initiative of a father, Bicultura proposed to the Municipality of Lisbon a pilot project, which would include several cycle-to-school trains within the city area. The pilot project was successful and therefore the cycle-to-school project got part of the official mobility program for municipal schools in 2020. Bicultura is the leading organisation and is in charge of the development of the operations (project manager at Bicultura, personal communication, 2022).



“My child would rather ride the bike within the cycle-to-school train to school than walk – even though walking is shorter and twice as fast.”

- Parent of a participating child.



KEY FACTS

1737 passengers joined the cycle-to-school trains in the academic year 2020-2021

881 km are travelled with the cycle-to-school trains in the academic year 2020-2021



LISBON - Project Overview

BICICULTURA: COMBOIOS DE BICICLETAS

Implementation

It all started in 2015 when a father decided to implement a cycle-to-school train for his child's school. In this way, not only his child had the opportunity to go by bike to school, but other children were also able to take part and experience cycling as a fun transportation mode. Nowadays, 16 train lines and 12 cooperations with schools are implemented in Lisbon. The past few years and also the experience on-site have shown that the project is popular among children and adults. The number of participants, as well as cooperating schools and, therefore, trains increased (project manager at Bicicultura, personal communication, 2022).

Outcomes and Discussion

Over the years, the cycle-to-school trains got really popular among the children. The participation and operations work well. Another aspect promoting the cycle-to-school project is the cycling-friendly weather in Lisbon. Of course, during the winter months jacket, hat, and scarf will be needed but only a few trains had to be cancelled due to bad weather habits (e.g., rain). The routes themselves are chosen to be child-friendly and therefore easily doable.

As stated by the annual survey Mãos ao Ar Lisboa (MAA) of the Municipality of Lisbon (Câmara Municipal de Lisboa, 2021), the average percentage of children going to school by active modes is low, but at private schools higher than in public schools. This can also be seen in the participation in the cycle-to-school trains: the number of children varies according to the school type. Another challenging aspect

is building up cooperation with schools in more deprived neighbourhoods because it is difficult to reach them.

Besides covering more neighbourhoods in the area of Lisbon, Bicicultura is currently working on an expansion of the cycle-to-school projects to other cities in the metropolitan area of Lisbon and Portugal.

Applicability to Munich

The project has a quite positive impact on the quality of stay and the quality of experience. For the participation, the children, the project permits a fun, safe and sustainable activity.

For Munich, it is quite easy to implement the project because similar projects already exist. A challenging factor is always the engagement of voluntary locals and the cooperation with schools and the municipality, but through the popularity of cycling, it could be easy.

Outlook

During the City team's participation in the cycle-to-school project, it rained (not much compared to German conditions). Due to that, the experience was realistic because the team experienced the project during "bad weather conditions". Additionally, it was the last cycle-to-school train before the summer holidays. A lot of children participated, and the parents were proud and happy. A lot of pictures were taken. It was really nice to experience the cheerfulness. Probably, the "last train" theme influenced the number of participating children, but it gave a good overview of how many children are aware of the project.

Unfortunately, we were not able to find a fitting appointment with the mobility department of the municipality of Lisbon to talk about this project. Children and parents were not consulted but due to their attendance of them, it showed a clear acceptance of the project. Also, participating schools were not interviewed in person and did not submit a statement after a written request, which results in a lack of information about the cooperation process.



Project Transferability



Project Impact



BICICULTURA: VELOTECA

The easiness of libraries is a globally famous concept. Why not use it for other things as well? The “Veloteca” works like a library – just for bikes. The project gives the population the opportunity to rent different cargo bike models and bike equipment. The first models are bicycles for cargo and/or passengers and include classic cargo bikes as well as tricycles, trailers, and extra equipment just as child seats or helmets.

Motivation and Goals

Through non-binding testing, people can discover cycling and cargo bikes within a sharing system. Within the easy-access principle of the sharing system, costs and barriers should be minimised and the popularity of cycling should be increased (project manager at Bicicultura, personal communication, 2022).

Stakeholders

Bicicultura is the organisator and therefore responsible for the project. The Veloteca is located in the Co-working space Centro de Inovação Social, an area of the development of multi-area projects. It is also the home of Bicicultura’s office. During general events, the bikes have to be removed but during daily business, they do not obstruct (Project Manager at Centro de Inovação Social, Personal Communication, 2022).

Implementation

The basis of the Veloteca lies in other Bicicultura projects: “A Casa da Bicicultura” (English: A house for bicycles) and “Negócios com Pedalada” (English: Business with Pedals). Projects that aimed to transplant the culture

of bicycle use into daily mobility (Bicicultura, 2022). With already seven models of different bicycle types, the basic stock of the library was formed. The project itself is currently in the implementation phase and will probably be ready for use at the end of 2022.

Besides the fact that citizens are able to rent bikes, they can assist the project on a voluntary basis. Through engagement in different project stages and participating in different events, the project is carried out in a good and probably fast way without the support of the engaged citizens.

Outcomes and Discussion

At different roadshows, cargo bike festivals and cargo bike events organised by the municipality of Lisbon, the Veloteca was present to promote the project and the topic itself. The international trend for cargo bikes is also noticeable in Lisbon: The level of interest in the cargo bike sharing system is rising (project manager at Bicicultura, personal communication, 2022).

A limiting factor of the utility of the Veloteca is the location. The office, where the bikes are stored, picked up, and dropped off, is located in a residential neighbourhood in the north, outside of the city centre (approx. 25 minutes

by bike, 17 min by car) (openstreetmap.org, 2022). It seems quite challenging to invite non-neighbourhood people to come and rent a bike there. Also, car ownership is quite high in Lisbon which in general makes it more difficult to promote cycling. The shyness towards the “complicated looking” cargo bikes also initially complicates the use. Compared to the “comfortable and familiar” car, humans choose what is easier. Inside Bicicultura, is the maintenance and repair of the cargo bikes a challenging factor because not everyone is able to repair a broken bike and certainly not a cargo bike.

As the project started in 2022, it is still in its pilot stage. The business will be developed and the team behind will see how the outcomes may be transferred to the real world outside of the pilot stage mode.

Applicability to Munich

The project promotes the sustainable transport mode of cycling for different activities in daily life. Therefore, it maintains all the advantages of cycling in general but puts them into cargo transportation. The safety aspect is influenced

by the challenging handling of a cargo bike, which may disappear with time.

The project is included in the work of Bicicultura. Of course, an association is made by the people, but the topic and the schemes could also work in Munich/Germany. The project requires a sharing system platform that can be implemented in different existing sharing systems in Munich.

Outlook

Of course, it is hard to find an affordable central office with enough storage space for several cargo bikes, but the current location hinders the use of the Veloteca for a broad society (project manager at Bicicultura, personal communication, 2022). It would be conceivable to cooperate with bike shops or similar institutions which promote sustainable business methods. Nevertheless, the concept of the project is quite innovative and offers society access to cargo bikes. Cycling and the transport of goods by bike are promoted. The trend will continue and Bicicultura will be ready to offer a pleasant sharing system.

Project Transferability



Project Impact



MUBI

MUBi – Association for the Urban Mobility on Bicycle is a civil society organisation advocating for cycling as a mode of transport and the rights of cyclists. For MUBi, we talked to one of the co-founders of the organisation.

Motivation and Goals

Originally, the idea for MUBi emerged within a group of people involved in the Critical Mass movement and materialised during a workshop in 2008. Its official constitution in legal terms took place in 2009. Over time, many people joined this collective effort of citizenship, both in terms of active elements and supporters (MUBi, 2022b). Today, MUBi is one of several civil society initiatives engaging in mobility policy in Lisbon. It is one of the most prominent bottom-up initiatives aiming to overcome unsustainable mobility patterns in Lisbon and beyond. Its mission is to help create conditions so that anyone can use the bicycle in an easy, pleasant, efficient, and safe way, and that the benefits of this option are widely recognized (MUBi, 2022a).

Therefore, its vision is a harmonious coexistence between the bicycle and the other sustainable mobility options and contribute to an accessible, pleasant, and safe public space. It aims for an integration of transport in inter-modal systems, the existence of safety conditions, and the defence of those who adopt smooth means of travel. It also argues that the individual option for the use of the bicycle as a means of transport should be legally protected and culturally integrated into Portuguese society (MUBi, 2022a). To this end,

key objectives of MUBi include: Defend and extend the legal rights of bicycle users, the remodelling and strengthening of structural conditions favourable to the use of bicycles, act constructively in the discussion of projects and decision-making of bodies, and informing civil society about the advantages of using the bicycle (MUBi, 2022c).

Stakeholders

Its advocacy approach includes a regular exchange with public officials such as members of the parliament and technical experts from transport departments but also the Mayor of Lisbon or the transportation secretary. Thereby declarations of intent can be a useful tool to achieve policy goals. As soon as the municipality commits to implement a certain idea or project, details for the implementation might be still up in the air but the project itself is likely to be realised.



“We are not cycling lobbyists, we want better cities”

- MUBi Co-founder



KEY FACTS

Founded in Lisbon in **2009**

Strategic approach to communication and advocacy coalitions building

Bottom-up approach includes community listening



MUBI

Implementation

Over the years, MUBi's approach has proven to be very successful. It has become an important player to be taken into account for the planning and execution of mobility projects at the level of the City of Lisbon and beyond. Key achievements of MUBi include: Reducing speed limits for cars and limiting parking, creating additional and well-implemented cycling lanes, and introducing of subsidies for cargo bikes. Moreover, MUBi was involved in the revision of the road code, which for instance included guidelines like cyclists being not allowed to cycle by side or not giving cyclists priority at intersections, even if coming from the right side (Co-founder - MUBi, Personal Communication, June 30, 2022).

Outcomes and Discussion

For all projects, MUBi provides differentiated feedback. With the introduction of cycling lanes, for instance, it criticised the municipality for their implementation, as the lanes would just stop at intersections and safety requirements for cyclists. Because of this, MUBi positioned itself as a group of urban and mobility planning experts publishing not only press releases but also extensive technical reports (compare MUBi Manifesto on Living Cities) (MUBi, 2021).

Organisational design also accounts for certain strengths and weaknesses of the initiative. On the one hand, horizontal structures and reduced hierarchy made it possible that every member could volunteer to become part of the core of the organisation. On the other hand, this produced long decision processes. One thing that is next for MUBi, is to address questions of budgeting and finance of cycling projects.

Applicability to Munich

The success of MUBi shows that well organised bottom-up citizen initiative can have both tremendous impact on the drafting of mobility policy and add a valuable perspective through its embeddedness in the community to the decision-making processes.

Regarding its transferability to Munich, we like to argue that civil society initiatives with similar objectives exist already. The strength of MUBi however, and what stakeholders in Munich can learn from it are the increased efforts to network and build overarching advocacy coalitions among stakeholders with similar interests.

Outlook

It could have been demonstrated that MUBi shaped, shapes, and will continue to shape mobility policy in Lisbon. However, as a limitation to our findings, it is important to note that MUBi is only one out of many civil society actors in Lisbon. Due to this, it is fair to say that other actors might define different goals and adopt a diverging strategy to achieve them and at the same time be equally successful.

In terms of social inclusiveness, MUBi particularly focuses on gender issues in mobility and cooperates with 11 other organisations on this behalf. Nevertheless, cycling is still elitist as cyclists often have a higher income than car drivers do (Co-founder - MUBi, Personal Communication, June 30, 2022). This might change as delivering by cycling is becoming more popular. Of course, this is not the fault of organisations like MUBi but rather a call to action to improve cycling as a mode of transport among all groups of society and work on a better representation of gender and class in internal structures in the future.

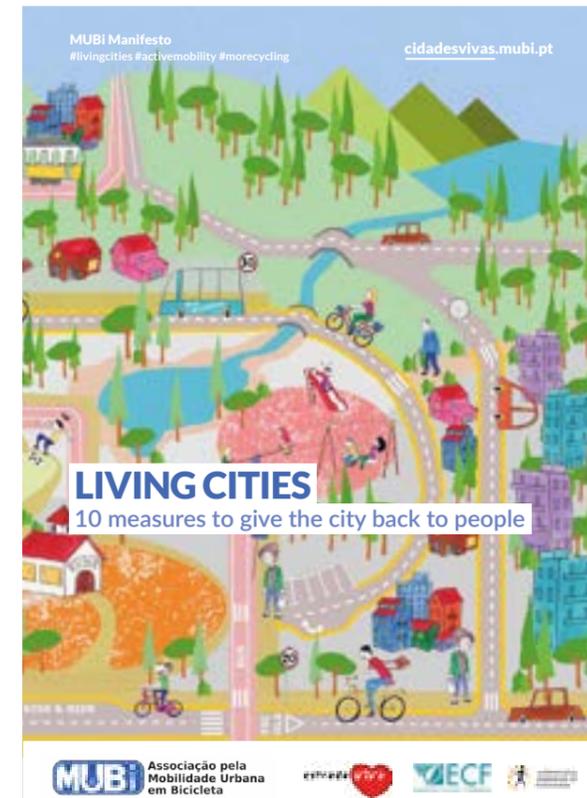


Figure 14. MUBi Manifesto on Living Cities (MUBi 2021)

Project Transferability



Project Impact



PASSE NAVEGANTE

Passe Navegante is the unified public transport ticket system for the entire Lisbon Metropolitan Region. The system came to Lisbon and surrounding municipalities to simplify the previous ticketing system, which was independently managed by each city.

In order to better manage the new system and other responsibilities, the entity of the Área Metropolitana de Lisboa (AML) funded the Transportes Metropolitanos de Lisboa (TML). The TML is responsible for coordinating and planning the efficient integration of the public transport system in the region.

Motivation and Goals

Lisbon has been trying to increase public transport ridership and reduce the number of car trips in the inner city. However, Lisbon has only 545.000 inhabitants, compared to the total of 2.9 Mio in the entire metropolitan region (Municipal Mobility Expert - TML, Personal Communication, June 30, 2022). To achieve the city's goal, only municipal-level measures are not enough, given that more than 60% of the car traffic in Lisbon comes from the surrounding cities (Lisboa para Pessoas, 2020).

Additionally, the public transport ticket system that was in place previously, was managed individually by each city. There were 694 ticket options in the region that resulted in more than 400,000 ticket possible combinations for those who had inter-municipal commuting (Municipal Mobility Expert - TML, Personal Communication, June 30, 2022).

With that in mind, a public transport ticket price reduction is the most effective way of increasing public transportation attractiveness. The Área Metropolitana de Lisboa [Lisbon Metropolitan Area] (AML) made efforts to implement in 2019 an unified metropolitan-wide ticketing system in order to reduce costs for the citizens of the region and simplify the complex ticketing scheme that was previously in place (Público, 2018).

Stakeholders

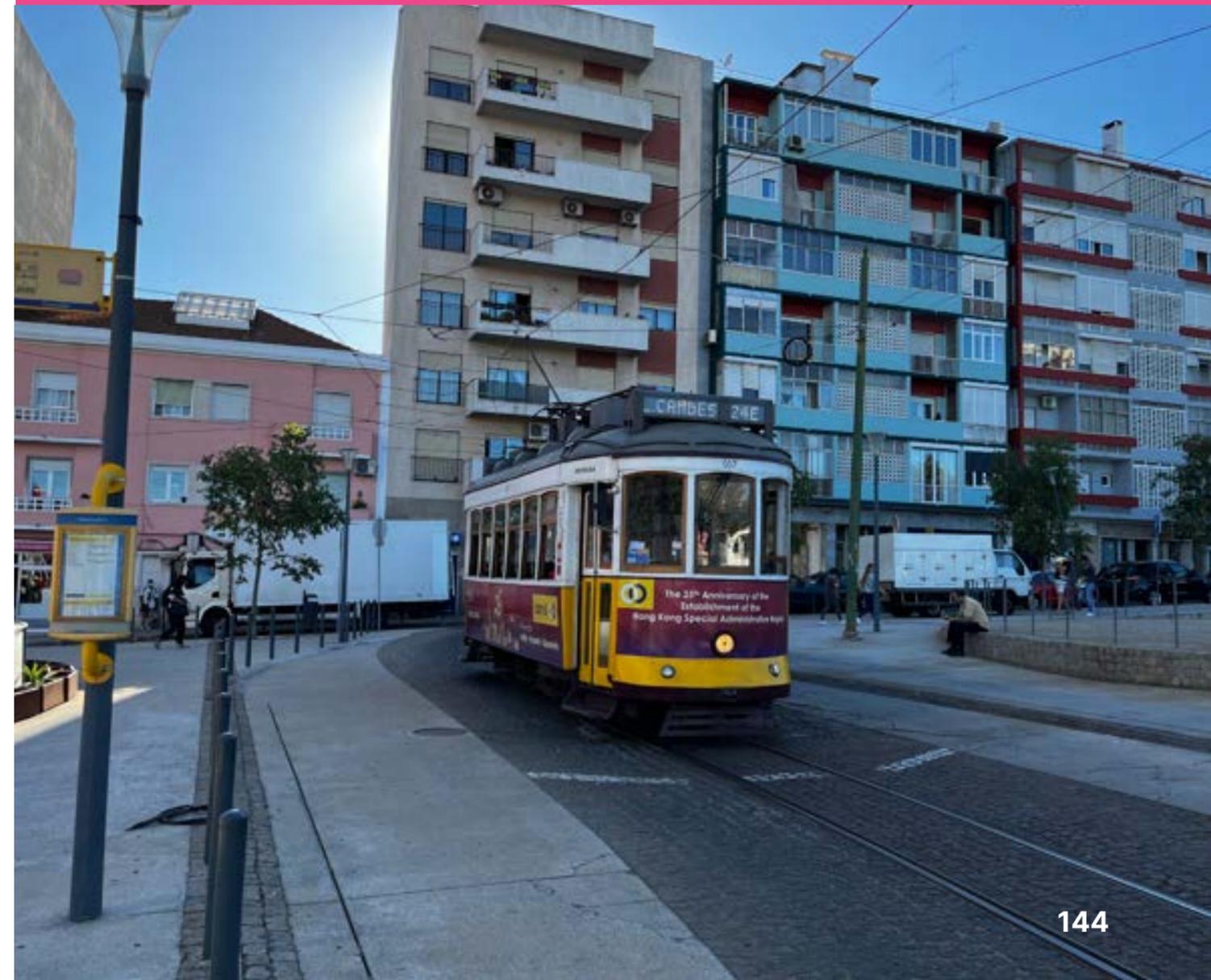
The project is complex and deals with many stakeholders, combining actors from the national government and actors from the Lisbon Metropolitan Area. Namely, the Passe Navegante concerns the prime minister, the ministry of environment and energy transition, the ministry of infrastructure and housing, all the 18 mayors from the cities within the metropolitan region, and the TML. Additionally, there are all the public transport operators such as CARRIS, CARRIS Metropolitana, Metro, private bus operators, boat operators, regional train operators, and others. Finally, the system deals with the daily trips of all inhabitants in the region.

“The goals are not easy to reach, but having a goal makes it easier to get things done”
- Municipal Mobility Expert -TML

KEY FACTS

150.000 new passengers after 6 months of implementation

85% of the passengers are spending less **40€** for a monthly ticket for the entire region



PASSE NAVEGANTE

Implementation

The Passe Navegante is heavily dependent on subsidies. For its implementation in 2019, the national government invested 74,8 Mio€, the municipalities combined invested 31,6 Mio€ and the AML invested 1,8 Mio€ (Dias, 2019; Diário de Notícias, 2019).

The system reduced the 694 public transport ticket types to only 45 and it can be used for all regional public transport modes. Intermunicipal monthly tickets cost 40€ and municipal tickets cost 30€ (the prices have not been increased since 2019). Additionally, members of the same family can share a family ticket that costs 80€ (inter-municipal) and 60€ (municipal) regardless of the number of members. On top of that, elderly citizens (65+) have discounts and young ones (13-) have free rides (Área Metropolitana de Lisboa, 2019).

The region did not have a metropolitan transport authority until recently. To manage the complexity of the public transit system in the metropolitan region, as well as other mobility-related topics, the Transportes Metropolitanos de Lisboa (TML) was created in 2021. They are now responsible for the platform dealing with money division between the public transit service providers. (Municipal Mobility Expert - TML, Personal Communication, June 30, 2022).

Outcomes and Discussion

The introduction of the Passe Navegante in the Área Metropolitana de Lisboa brought immediate effects to the public transit system. In the first 6 months of the project, there were 150.000 new passengers in the system. The

number of frequent passes increased by 25,3% and the number of short-term passes decreased by 17,2% when comparing the first year of the new ticket system in 2019 with 2018 (Dinheiro Vivo, 2020). Between 2019 and 2020, the public transport demand increased in Lisbon by 30% (Câmara Municipal de Lisboa, 2020). Finally, the Passe Navegante helped 85% of its users to reduce their spending with public transport tariffs, with some families sparing up to 100€ (Idealista, 2019).

Besides having a unified public transport ticket system, each city has the autonomy to legislate within its areas. With that in mind, the city of Lisbon has approved in 2022 free public transport for senior citizens (65+) and for young ones (18- or 23- if they're still students). (Finance and Planning Expert – TML, Personal Communication, June 30, 2022). Additionally, the city of Cascais has free public transport for all since 2020, which brought 10% more passengers (Diário de Notícias, 2022).

The efforts toward public transport ticketing integration had positive results, however, until recently there were no measures that tackled timetable coordination across modes and service providers. During the group visit, the delays were frequent, and combining modes was hard and led to long waiting times and transfers. TML is now dealing with the tender of a unified public transport operation in the Lisbon metropolitan region under a new company called Carris Metropolitana.

Applicability to Munich

In terms of the attractiveness of public transport, the Passe Navegante has proved to be a solid approach to be taken by mobility poli-

cymakers. Lisbon based their decision on the data indicating that the majority of cars in the inner city come from outside and simplified the system and made it cheaper, especially for those outside commuters. Munich already has a unified system within the city and the metropolitan region, however, the pricing is not attractive to the further away areas. It would be beneficial to simplify the tickets in the MVV area, in order to reduce congestion, traffic-related emission, noise, and parking issues.

Outlook

The use of the Passe Navegante is open to all those who live in Lisbon. For that reason, it was not possible to try the system, once a fixed address is necessary. Tourists are still bound to buy a relatively expensive daily ticket or individual trips. During the observations within public transport vehicles, most of the passengers carried a monthly ticket. However, to further enhance the reduction of car usage in the city, the ticketing system should include all users in the city, tourists or not.

Regarding the timetable coordination and punctuality, the small talks with other passengers indicate that there is general disbelief in the system, especially because the majority of the public transport stops are not equipped with displays indicating arrival times. It is possible to send a SMS with the stop identification, however, the number does not recognize foreign numbers.

“Imagine how funny it would be if the Portuguese buses were on time”
- Waiting passenger at bus stop

Project Transferability



Project Impact



CARRIS: ON DEMAND BUSES

“CARRIS” is Lisbon’s main bus and tram service provider, including the metropolitan area. Besides implementing several technology-driven projects, e.g., the usage of electric or hydrogen vehicles, which is indeed tied to a few difficulties due to the city’s topography, Carris also works on the implementation of projects which are mostly related to social and accessibility issues. Two examples that go hand in hand, which is why they are summarised in one project, are the on-demand and the Parabuses. These should enable door-to-door pick-up for on one hand everyone, but also scheduled pick-ups for people living with disabilities that restrict them from comfortably accessing public transport (Innovation Expert - Carris, July 5, 2022).

Motivation and Goals

The projects aim to make public transport as accessible and safe as possible for vulnerable and/or disabled citizens. Especially in a hilly city like Lisbon, getting around with a disability is not as easy, which is why the public transport providers of Lisbon must find a solution that is not merely feasible but also includes all stakeholders of the public transport system. Furthermore, even though there are multiple bus and tram stations, there are still some that are merely reachable by a considerably long walking distance, which is not feasible for accessibility and/or safety issues. Ultimately, this is what CARRIS is trying to address with these specific projects to make the life of the disabled and/or vulnerable people easier to a certain extent (Innovation Expert - Carris, July 5, 2022).

Stakeholders

The project is mostly carried out by the public transport provider CARRIS. The project addresses vulnerable groups and mostly disabled people. Even though the goal is to enable access to these services for everyone, not everyone who needs the service can take part in these projects, since not enough spots are open for full coverage usage all over Lisbon and the metropolitan area (Innovation Expert - Carris, July 5, 2022).



“Our users dependent on the reliability of our services. Many of them do not have other options”

- Innovation Expert -Carris



KEY FACTS

The On-Demand buses were a trial project from June to July 2021, even though it was intended for 6 months, it had to be stopped due to COVID-19



LISBON - Project Overview

CARRIS: ON DEMAND BUSES

Implementation

Whereas the Parabuses are an essential part of Carris' offerings to the public, the on-demand buses were only available for a short trial in 2021. The on-demand buses were planned to be designed like UBER Pool but by a public transport provider. However, unfortunately, due to COVID-19 the trial had to be cancelled before it was finished in the mid of 2021. The implementation of the Parabuses was already successful, but the supply for the number of potential users is still low (Innovation Expert - Carris, July 5, 2022).

Outcomes and Discussion

Overall, the trial of the on-demand buses seemed to be successful, but, unfortunately, there is no current data available for any further outcomes of the trial (Innovation Expert - Carris, July 5, 2022).

The Parabus offer is one that is high in demand, but supply is too low and thus there is a long waiting list for potential users of this specific service. Furthermore, there is no further technology used to enhance the service provision, e.g., on-demand Parabus service. Lastly, the communication of the project to the public is weak, but to the existing customers it is indeed better and thus these can be reached and included more easily (Innovation Expert - Carris, July 5, 2022).

Applicability to Munich

Overall, the Parabus project in specific has a great impact on the lives of the people with reduced mobility and thus enhances the accessibility to many daily locations all over Lisbon.

In general, there would be possibilities to offer such services by MVV / MVG all over Munich. However, more resources, i.e., staff, money, and buses, are needed to make this project feasible. Furthermore, MVV / MVG needs to fully fund this project, and if this is not possible, get support from the city of Munich to make Munich safer and more accessible for everyone. In the end, the demand would most likely be there from numerous different stakeholders.

Outlook

Overall, the projects have a high potential to make Lisbon safer and more accessible. However, there are still some points that might need to be tested, revised and / or digitalized.

Nevertheless, there are innovative ideas being developed during the times of COVID-19, which could be implemented in further steps. These should not be dismissed in the future and might deliver solutions for numerous problems of people with reduced mobility and/or vulnerable citizens.



Project Transferability



Project Impact



LISBON - Project Overview

GIRA: BICICLETAS DE LISBOA

GIRA is Lisbon's public bike-sharing service. The project was deployed in 2017 and has been supporting cycling growth in the city. Since its implementation, the bike-sharing system has been increasing in terms of the number of bicycles, stations, and users and consequently, has been breaking records of trips and driven kilometres year by year.

Motivation and Goals

GIRA was developed in Lisbon to offer an alternative to private motorized mobility. The project aligns with the city's approach towards sustainable mobility and with the demands of years of political activism from civil organizations such as Mubi and Bicicultura (hyperlink). The official goals of the project are the following, as stated in GIRA's official website:

- Increase cycling mode share;
- Offer a flexible transport alternative;
- Promote intermodality;
- Promote active mobility;
- Reduce road traffic and associated externalities (congestion, gas emissions, noise and accidents);
- Improve public health.

Stakeholders

The GIRA system was developed and is managed by EMEL and the Lisbon City Council. The maintenance and operation of the system are supported by Yunex Traffic (former Siemens ITS). Between 2017 and 2021, Órbita was the official supplier of GIRA bikes, however, after successive delays and breach of contractual clauses, the company lost the contract and, posteriorly, filed for bankruptcy. To re-establish the supply of new bikes, EMEL hired the

companies MEO and Soltráfego (Lisboa para Pessoas, 2021).

The citizens of Lisbon can contact GIRA through the app, website, or phone in case of problems, malfunctioning bikes, and questions. Additionally, all users are insured against personal and third-party damages caused by eventual accidents, increasing the reliability of the system.

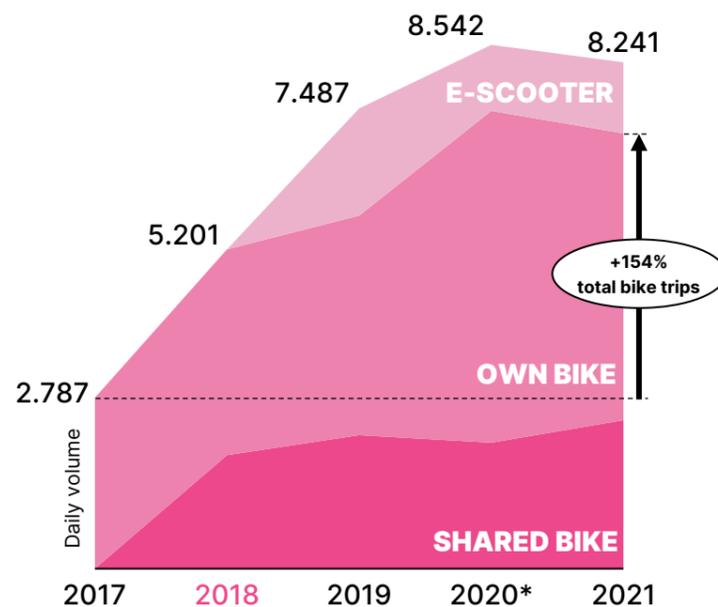


Figure 15. Volume of cyclists before and after implementation of GIRA bikes (U-Shift, 2022)

KEY FACTS

1.600 bicycles, both electric and conventional

10Mio km ridden between Sep 17 and Mar 22

23.000 active annual passes in 2022

10.000 daily trips registered in Feb 22



"Portugal is the largest bike exporter in the EU, but still the cycling shares here are among the lowest"

- Mobility Expert - Private Company



GIRA: BICICLETAS DE LISBOA

Implementation

The discussions about the GIRA bike-sharing system started back in 2015. Since the beginning, the project was treated as a public transportation service, therefore, the KPIs during the tender process were very strict. The service is limited to the municipality of Lisbon and has been implemented in steps.

The bike-sharing scheme deployment in 2017 cost 23 million € and started with 1.410 electric and conventional bikes and 140 docking stations. The second implementation phase aims to increase the figures to 3.000 bikes and 300 GIRA stations (Automóvel Club de Portugal, n.d.; GIRA, n.d.)

GIRA operates with automated docking stations integrated into a mobile app. In the app, the registered users can locate all stations, including the availability of electric and conventional bikes and free docks for returning rented bikes. The GIRA stations are also equipped with free public wi-fi so the users are not dependent on their own mobile data. Additionally, the contract defines clear requirements for free-dock and bike availability, to assume no user should have problems with returning or renting bikes.

The pricing system is simple and encourages the users to adhere to a yearly pass. As of the publication of this report, an annual pass costs 25€, a monthly pass 15€, and a daily 2€. All tariffs allow up to 45 free rental minutes a day, and an additional 1€ to 2€ for daily usage between 45 and 90 minutes. However, it is worth mentioning that non-Portuguese residents are offered exclusively the daily pass, which includes a deposit of 300€ for eventual damages to GIRA equipment.

Outcomes and Discussion

GIRA has been a key project for increasing and promoting cycling in Lisbon. The research group U-Shift publishes standardised yearly reports with bike counting and types of cyclists, which supports the impact analysis of micro-mobility measures. According to U-Shift, between the implementation of the bike-sharing system in 2017 and 2021, Lisbon has gone through an increase in the total number of bike trips of approx. 154%. It could also be observed that 34% of all counted bike trips were performed with a GIRA bike.

The low renting prices and high coverage of the services in Lisbon can be identified as important factors for the positive impacts of the scheme. According to a doctoral candidate from U-Shift interview during the site visit, Lisbon has diversified land use, therefore, trip distances are generally short, contributing to the use of GIRA bike-sharing. The information is corroborated by official government data, which indicates that 68% of trips in Lisbon are less than 5 km (Lisboa para Pessoas, 2020).

The high usage of the system did not come, however, without challenges. The first company hired to provide the system with bikes could not keep up with the contract clauses, delaying the goal of reaching 3.000 bikes and 300 stations. Yunex Traffic, who took additional responsibilities after Órbita left the contract, informed that the COVID-19 pandemic impacted the supply chain and that waiting times for new bicycles can reach up to 2 years.

GIRA proved itself as a successful venture for micro-mobility alternatives in Lisbon. The next steps are being taken by EMEL to continue expanding the services and improving the user experience and satisfaction.

Applicability to Munich

Munich has its own bike-sharing system – MVG Rad. However, the effects of bike-sharing implementation between Munich and Lisbon have not been following the same pattern. While GIRA has been seeing its ridership increasing yearly, the MVD Rad has had its usage peak in 2019. Between 2019 and 2021, the total number of trips with Munich's public bike-sharing system decreased by 18% (MVG, 2018).

There are barely any differences between the systems of GIRA and MVG Rad, with Munich's system having the advantage of not requiring rented bikes to be returned at a dock (within the central areas). Therefore, the difference in success between the two cities can either be attributed to operation, quality of equipment, or external factors.

Firstly, the MVG does not offer electric bikes, limiting the system's attractiveness. Additionally, it is not rare to encounter defective or vandalised bikes that are not promptly repaired. Lastly, the renting and returning of MVG bikes

frequently does not occur without facing technical problems or recognition in the app.

On the other side, Munich has been improving its cycling network at a fast pace. Bicycle ownership in the city is more common than in Lisbon, therefore daily bike users do not rely on the system.

Finally, Lisbon has been making efforts to transform GIRA into an attractive option to last-mile associated with public transportation trips. Munich and the MVG should evaluate the possibility of following a similar approach, given that last-mile would align relatively more to its current mobility patterns.

Outlook

As perceived in other projects and during our visit, Lisbon City Council limits most of its mobility measures and offers to citizens. For that reason, it was not possible to rent a GIRA bike due to the 300€ deposit asked beforehand from daily rentals, which was the only option available to foreigners.

Project Transferability



Project Impact



MICRO-MOBILITY GOVERNANCE

Micro mobility governance is an umbrella term and subsumes two projects or aspects that illustrate Lisbon's approach to governing micro-mobility as there are – by enabling open competition and arranging public-private-partnerships.

For the governance of micro-mobility in Lisbon we talked to a former manager at the Câmara Municipal de Lisboa and now a mobility expert at TML – the public company that is managing transport in the metropolitan area of Lisbon.

Motivation and Goals

The term micro-mobility is sometimes also used to describe small car-like vehicles and some private micro-mobility providers also offer car sharing combined with the usage of other vehicles. In the context of this paper, however, micro-mobility refers to e-scooters and (e-)bikes. As for many other cities, Lisbon wanted to introduce micro-mobility offers as they can help to complement the existing public transport offer and support it in terms of last-mile connectivity (Municipal Mobility Expert - TML, Personal Communication, June 30, 2022).

Stakeholders

Stakeholders involved in the rollout process were the public authorities, respective departments of the City of Lisbon as well as public mobility operators and managing companies such as EMEL the municipal company for parking. Stakeholders on the private side included numerous micro-mobility companies. Especially in the beginning, the situation was very dynamic and in the first months of the pandemic, some like Drive-Now left the market or went bankrupt, which is why we will focus on Bolt-Bikes and Bird in the following (Municipal Mobility Experts - City of Lisbon, Personal Communication, July 5, 2022).



KEY FACTS



“Our vision is to create “a people-centered mobility ecosystem that is (...) built on an integrated public transport network”

- MOVE LISBOA. Strategic Vision for Mobility 2030



MICRO-MOBILITY GOVERNANCE

Implementation

As mentioned above the City of Lisbon pursued an approach of open competition regarding the integration of private micro-mobility into the overall mobility system. But what does this mean for the implementation process?

Although Portugal is one of the largest bike exporters in the EU, there was not much public discussion on micro-mobility and bike sharing before 2015. Especially in the beginning of 2020, the topic gained momentum. The private operator Bolt for instance started its business of sharing electric vehicles in Lisbon in February 2020 (Europe Cities, 2022). During this time, Lisbon and Porto pursued different strategies. While Porto allowed only very few private companies to operate in the city, Lisbon gave green light to private initiatives, letting everyone into the city. As a result, Lisbon became, especially before the pandemic, almost overcrowded with e-scooters and shared bikes, whereas in Porto micro-mobility did not really take off.

During the Covid-19 pandemic, however, many providers went out of business and a phase of consolidation of the market started. After the air has cleared, the municipality made efforts to establish corporations (public-private partnerships) with the private providers in order to integrate different transport modes into one platform and thereby improve intermodality and customer convenience. During the negotiations, certain decisive moments had to be overcome. Gira – the public bike sharing scheme of EMEL had very strict KPIs during the tendering process. For one thing, it was decided to exclude car sharing for reasons of lack of profitability and lack of use cases that can contribute to more sustainable mobility.

For another thing, issues around marketing such as branding, and technical details such as location and design of the docking stations had to be agreed on (Municipal Mobility Experts - City of Lisbon, Personal Communication, July 5, 2022, July 5, 2022; Municipal Mobility Expert - TML, Personal Communication, June 30, 2022).

Outcomes and Discussion

Eventually, Gira partnered up with Bird. Bird scooters and Gira bikes could now be accessed via the Gira-app and vice versa – further strengthening multimodal transportation (Intelligent Transport, 2022). Gira bike stations and the number of bikes available are visible alongside Bird scooters, helping to promote even more sustainable and affordable transportation in the city (Intelligent Transport, 2022). The approach of open competition and public-private partnerships worked well in terms of the technical implementation from the user side. From the business point of view, it created synergies for docking stations for scooters and bicycles, which also improved the service to the customers (Intelligent Transport, 2022).

As for all public-private partnerships, valid critique certainly includes that it provides for one private company exclusive access and brings it into a privileged position. Moreover, the open competition created certain drawbacks at the beginning, such as e-scooters blocking sideways. With this in mind, one could think whether the expansion of the partnership and inclusion of other companies into the platform could be the logical next step to deal with the shortcomings and make the project even more successful.

Applicability to Munich

As the phase of private micro-mobility providers entering Munich has already passed. This section will spare open competition. Instead, it will focus on the opportunities of public-private partnerships and governance of digitalisation and technology.

With the MVGO-app, such cooperation between private micro-mobility & public bike sharing exists already in Munich. However, there is room for improvement. As of now, there are many sharing services like ShareNow, Sixt-Share, Flinkster, Miles that are offering different but similar mobility solutions and which are not integrated with one another yet. An extension of existing platforms or the creation of a new platform is therefore possible and desirable. This applies especially to the integration of car sharing. It is clear that the creation of a “one-stop-shop” for mobility solutions that integrates e-scooters, (e-)bike and car sharing, and ride-hailing in one platform would be extremely attractive to users and has high potential due to the element of sharing.

Concerning the governance of digitalisation and technology, the latest regulation for the parking of e-scooters within Munich’s Altstadt shows that there are also non-digital ways to avoid trade-offs of micro-mobility. However, this is no reason to not embrace digital governance (Sueddeutsche Zeitung, 2022).

Outlook

With the public-private partnership, Lisbon joins a growing list of cities across Europe that offer local bike and e-moped integrations directly from one app (Intelligent Transport, 2022). More recently in July 2022, the Portuguese Federation of Cycling Tourism and Bicycle Users (FPCUB) defended that the Navegante public transport pass in the Lisbon Metropolitan Area should include GIRA shared bicycles. This includes “the possibility of making trips of up to 45 minutes for free and the cost of the annual pass is 25 euros” (The Portugal News, 2022a). Additionally, Navegante users are now eligible for a special Bolt pass, allowing them to use Bolt’s electric scooters and bikes for 20 minutes each day for just €15 per month (Bolt, 2022).

Project Transferability



Project Impact



CITY BIKE LANES

This project is about the rollout of bike lanes by the City of Lisbon.

To understand the implementation process, we interviewed the Advisor to the Deputy Mayor for the mobility of the City of Lisbon and the Head of the Division for Interventions in the Public Space at the Lisbon Municipality as well as other stakeholders like the public mobility companies in charge of the implementation process and from civil society.

Motivation and Goals

As for numerous other cities, the pandemic seemed to be an appropriate moment to restructure urban space to make it more resilient to crisis. Comprehensive and safe cycling infrastructures contribute to this goal and was discussed and wanted by some actors within the city for a long time.

However, in many cases, the creation of cycling lanes goes along with the reduction of parking spaces. Both, parking spaces and cycling lanes were the most contentious political issues for Lisbon in recent times.

As mentioned above, especially during the 2021 local elections bike lanes also were a highly polarised issue and became the hot topic of the election. Whereas cycling became a priority under the previous mayor, the political change in the municipal government and the current mayor emphasised the importance of parking for residents over cycling lanes (Municipal Mobility Experts - City of Lisbon, Personal Communication, July 5, 2022).

Stakeholders

On the one side, relevant stakeholders for the introduction of additional cycling lanes included the municipality, meaning the political majority in the city council and the municipal administration as well as mobility operators in charge of the actual rollout process. On the other side of the conflict line, there was the opposition in the city council among them the social-democratic party of Lisbon's current mayor Carlos Moedas (PSD).

For civil society, cycling activists are also engaged in the process, although the focus is on citizens in the sense of residents and local shop owners. While cycling activists generally welcomed the installation of cycling infrastructure but citizen the process, many residents, who feared losing their parking spots as well as local shop owners who were afraid of losing customers, generally opposed the policy (Co-founder - MUBi, Personal Communication, June 30, 2022).

KEY FACTS



"We start a new cycle today... which I believe begins in Lisbon but will not end in Lisbon"

- Moedas after 2021 election (Reuters, 2021)



CITY BIKE LANES

Implementation

As mentioned above, the bike lanes were decided on by the previous socialist government under the leadership of Fernando Medina (PS) and carried out by different departments and companies of the municipality.

Several interview partners described the communication for bike lanes as poorly and the implementation process as not well thought out. For an already very contentious and politicised project, this led to significant resistance pushback from residents as well as overall low acceptance by citizens (Co-founder - MUBi, Personal Communication, June 30, 2022).

Outcomes and Discussion

For now, the bike lanes are now implemented and can be and are used for cycling.

However, the situation was not used to the extent that it could have been used during this time from a researcher's point of view (Researcher IST – University of Lisbon, Interview, July 6, 2022).

Concerning what worked well one could argue that the implementation occurred and is beneficial to the city's climate friendliness, crisis resilience as well as accessibility by bike.

According to a study conducted by U-Shift, the usage of bikes increased. The bikes were used for various reasons, but the usage decreased after the high times of the pandemic as well, since other possibilities opened up again. That the city of Lisbon took advantage of the situation was indeed already a good start, but should be used to a larger extent as long as the situation is still present (Researcher IST – University of Lisbon, Interview, July 6, 2022).

However, there are different aspects, which need to be improved. The most important two of them are communication measures as well as citizen participation and involvement.

Furthermore, the perceived safety, according to a study conducted by the research group U-Shift, is not as high as it could be, since there are several dangerous situations, which make the cycling experience difficult for some people (Researcher IST – University of Lisbon, Interview, July 6, 2022). This is also the impression we had, when we took advantage of the bike lanes during our stay, since the bike lanes end up in large streets, which make it difficult to navigate through the city, particularly when you are not familiar with a place.

Applicability to Munich

The project has great applicability to Munich in the sense that more cycling lanes have a positive impact on the city's friendliness, crisis resilience as well as accessibility by bike. For this reason, bike lanes play a huge role in Munich too whereby safety for some of the ones installed needs to be improved.

Projects transferability to Munich we assess overall as low for the reason the shortcomings in the communication strategy as well as during the implementation process.

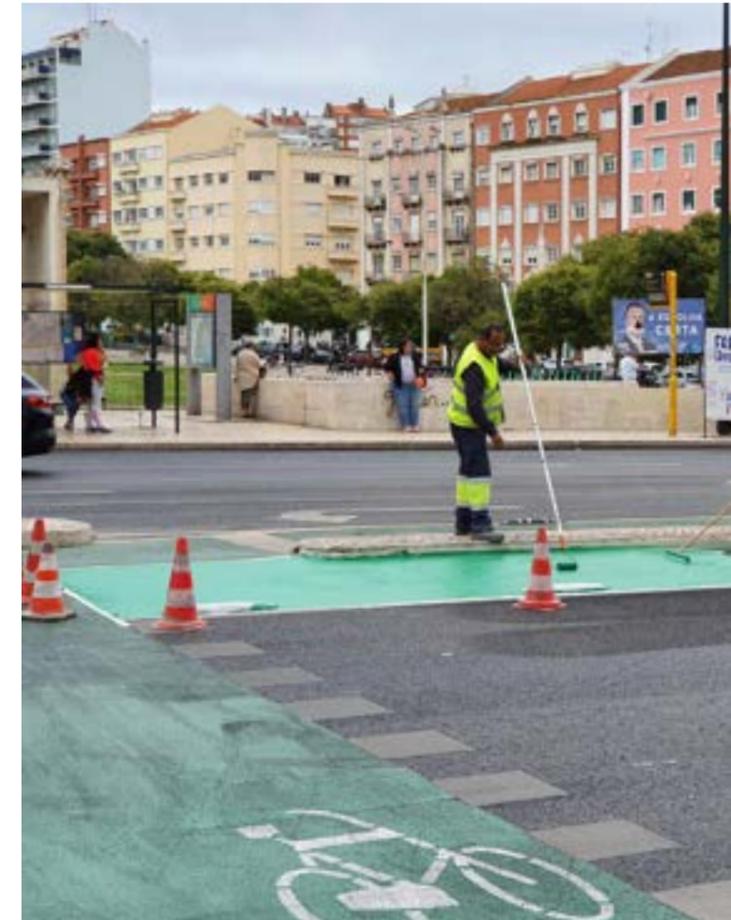
Outlook

In the future, better involvement and engagement of citizens is required when it comes to the implementation of cycling infrastructure, especially when this is linked to the redistribution of urban space.

Moreover, important learning from the rollout of bike lanes by the City of Lisbon was that higher levels of citizen engagement reduce the risk of failure for infrastructure projects.

The city is working on a sustainable urban development plan which offers the chance to strategically and systemically think about mobility challenges with the result of having communication and citizen dialogue about new infrastructure projects upfront as well as avoiding the pitfalls during the implementation process.

Lastly, the university group U-Shift is also researching the topic of biking and specifically safety in Lisbon city with the project "Urban Cycling". This should help figure out how safety is perceived subjectively, by examining how people feel when biking, and objectively, by looking at the number of crashes. This data is used for risk evaluations and could be used by the city for enhancements of the bike lanes in the future (Researcher IST – University of Lisbon, Interview, July 6, 2022).



Project Transferability



Project Impact



CONCLUSION

Lisbon is a lively city with diverse land use, diversity of activity opportunities and a high potential for the development of sustainable urban mobility. The city had high usage of public transport in the 1980s but slowly transitioned into a car-dependent region. The many years of transport policies favouring individualised mobility left their marks on the urban development and the effects are perceived in the daily lives of Lisbon's citizens. During the visit to the city, the high levels of noise, congestion and pollution were quickly perceived, and they seemed to ease only in the evenings. In contrast to the local reality, Lisbon's image is quickly associated by the tourists with the yellow trams and cable cars that run up and down the many hills in the city.

Despite the past car-oriented development, Lisbon's public administration has been taking significant steps toward sustainable transport. In that direction, one of the most outstanding achievements was the introduction of the ["Passe Navegante"](#). The unified metropolitan ticketing system for all public transport incentives its usage and has increased the attractiveness of the system. It is also worth highlighting that pricing reduction was not enough in this case since the different public transport modes are not yet fully integrated regarding their time schedule. Therefore, there is general disbelief in the system that will hopefully be solved with the Carris Metropolitana.

Lisbon's public administration has a clear goal, as defined in the MOVE 2030. Part of finding its way into sustainable urban mobility is providing a liveable and enjoyable city. In this sense, there are several projects in the city, with two being worth mentioning. The ["A Rua É Sua"](#) claims back the urban space previously destined for parked cars and traffic, allowing people to perform leisure activities in spaces that would otherwise be utilised. Another project that incentivises the usage of public spaces is called ["Uma Praça em cada Bairro"](#), which renovates squares in the city to be more enjoyable and supports building a community atmosphere.

Before visiting Lisbon, the background research indicated that cycling and walking would be the least important of the topics due to the local topography. However, with great surprise, Lisbon revealed itself as an excellent example of how to approach mobility solutions with a focus on active modes. Cycling rates have been increasing yearly since 2017 due to the implementation of ["City Bike Lanes"](#) and the ["Gira: Bicicletas de Lisboa"](#). This effort must be also accredited to several civil society organizations that have been for years advocating for a cyclable Lisbon. ["MUBi"](#), as one of the pioneers, has been publishing guides and reaching out to policymakers. Additionally, ["Bicicultura"](#) has been acting on local communities with the Comboios de Bicicleta and Veloteca.

Lastly, Lisbon and its people portray themselves as being ready for the future. There is an influx of innovation and technology that benefit many areas, including urban mobility, and the city has accepted many micro-mobility providers in the region. Lisbon is open to new ideas, however, the first signs that attention is required have been appearing, such as real estate prices increasing quickly, and sidewalks taken by e-scooters in the way of pedestrians. But mostly, the most remarkable perception during the visit to Lisbon is the number of actors (public, private and individuals) who are willing to dedicate themselves to developing new and innovative mobility solutions, sustainability, accessibility, equity and building a community spirit.





OUR TEAM	168
INTRODUCTION	169
LOCATION ANALYSIS	173
URBAN MOBILITY ANALYSIS	177
SWOT ANALYSIS	180
PROJECTS IN MILAN	182
PIAZZE APERTE	185
AREA B AND C	189
CAMBIO	193
CICLOBBY	197
TRANSFORM TRANSPORT	201
RAISE UB	203
GOVOLT	206
BIKEMI	209
CITYFLOWS	213
NUMIDAS	215
IPA2X	219
A-ROUND CORVETTO	223
STRADE APERTE	227
CONCLUSION	231



Tranviaria di Milano

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INTRODUCTION

The city of Milan is the third city chosen by this year's euMOVE teams. A group of four students from three different study backgrounds, Politics and Technology, Responsibility in Science Engineering and Technology and Transportation Systems, visited Italy's second largest city between 3rd and 14th of July 2022. During the days spent in Milan, our team conducted 16 interviews with multiple stakeholders acting in the mobility sector, from startups to research, local lobby groups and the authorities. Hence, 19 projects were researched all related to the five different clusters of this euMOVE report.

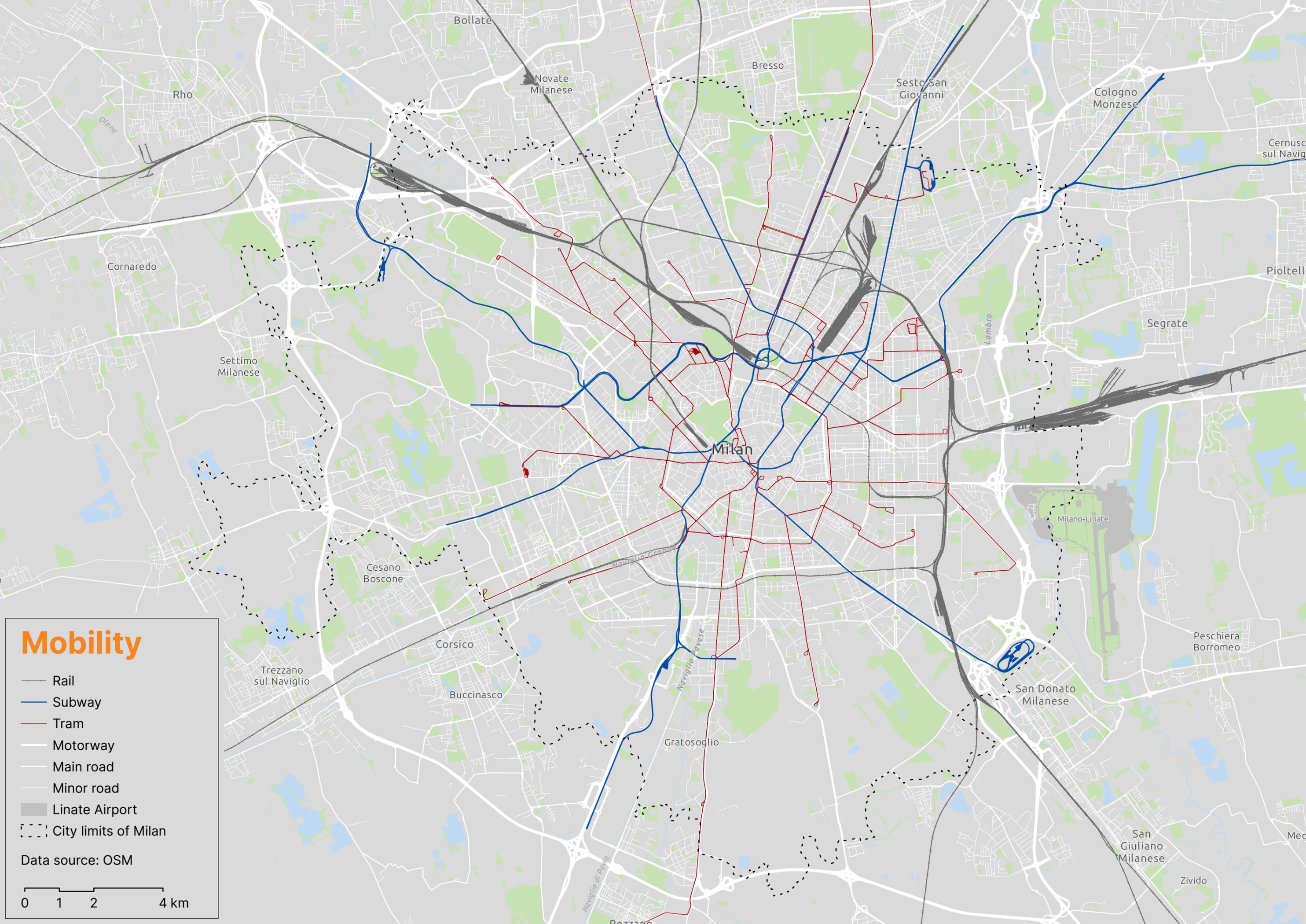
Why was Milan chosen? The Città Metropolitana di Milano is size-wise comparable to Munich. Furthermore, it is an internationally well-recognized economic hub and a booster for the entire region of Lombardi as well as Italy. Munich has a similar role in Germany. Both cities are frequent hosts of international events such as fair trades, concerts, and football games of Europe's best teams. This leads to comparable impacts on the cities: housing costs are radically increasing, and gentrification takes place in the most central and popular neighbourhoods, especially during the last two decades. On a mobility perspective, both cities have experienced a dramatic rise in car ownership with no stop of it anywhere in the near future even though ideal conditions for alternative mobility modes exist thanks to the flatness within both city limits and their city structures developed along ring roads. In addition, rising housing costs in the urban perimeters have led to an increase of suburbanization in the surrounding regions and a boom of the metropolitan regions of Milan and Munich. The result is a large day population in both cities due to daily commuters, affecting the cities' daily traffic quality.

Milan feels bigger with many vibrant neighbourhoods all over the city. The city is alive all day and night but especially during summer evenings, piazze (public squares) and outside dining gets crowded until late night. It is multicultural and leaves the impression of a global megacity. In respect

to architecture, it consists of many different styles and sometimes even feels unorganised when skyscrapers rise to the sky next to traditional apartment buildings. Urban mobility is also different with more motor scooters on Milanese streets than bicycles, 100-year-old tramway vehicles, and endless and uncontrolled parking all over the city. On a first glance, mobility in Milan seems to be behind Munich's especially in terms of sustainability.

However, the visited projects speak another language. Very ambitious people work in various fields of urban planning, transportation and mobility and work towards more sustainable mobility in Milan. Some of the projects are very innovative and show best practice examples for other cities and Munich. Especially Milan's ambitions in creating space for people rather than private vehicles is noteworthy. "[Piazze Aperte](#)" and the subsequent "[StradE aperte](#)" program changed Milan's streetscape strongly by implementing street experiments and redistributing space from cars to cyclists and pedestrians. The number of Piazze Aperte's created since the initiative started in 2018 is incredible and far beyond what Munich has reached with its street experiments and pop-up bike lanes. The connection of the metropolitan region with the city by new cycle paths, under the umbrella of "[CAMBIO](#)", is developed with high speeds while Munich debates over new cycle highways for years. Bike sharing in Milan tries to implement very innovative methods for balancing the fleet of bicycles, Milanese startups plan to improve last mile operations and traffic safety, the authorities want to improve participatory processes and research projects tackle all kinds of topics and focus on tactical urbanism. Among research initiatives, "[Transform transport](#)" with their approach of "urban informatics" needs to be pointed out as they work on providing high-end quantitative data for argumentation in favour of (not only) street experiments and tactical urbanism.

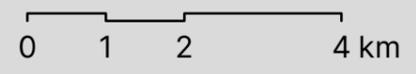
Overall, Milan is a city which is worth being compared with Munich. The mobility projects in the city are worth drawing attention to and transferring knowledge and ideas to Munich can help the Bavarian city to succeed in its mobility strategies. The next chapters will analyse the city of Milan and its transportation systems. Then, the visited and interviewed projects are described in more detail and the impacts and transferability of each project is determined.



Mobility

- Rail
- Subway
- Tram
- Motorway
- Main road
- Minor road
- Linate Airport
- - - City limits of Milan

Data source: OSM



LOCATION ANALYSIS

History & Demographics

The Celts founded Milan more than 2,500 years ago, in 600 BC. Mediolanon, which means “in the middle of the plain,” was the city’s original name (Marc, 2021). Milan is quite a metropolitan & capital city of the region of Lombardy, in addition to being home to Italy’s most prosperous manufacturing and financial sectors. The city of Milan is known for its historical, architectural, and cultural landmarks, as well as its world-class fashion, tourism and culinary sectors. There are a great number of unique landmarks to refer to, from the Duomo Cathedral, the opera La Scala, the Sforza Castle, the Vittorio Emanuele II shopping arcade, to the environmentally friendly residential tower Bosco Verticale.

As mentioned, the city of Milan is home to 1.37 million people, compared to the 8.2 million people that live in the entire metropolitan area (Geo demo istat, 2022), including Milan, Bergamo, Varese, Monza, Como, Pavia, Novara, Lecco, and Lodi provinces. With 3.14 million residents, its continuously populated urban area is the fourth largest in the EU, and its outer suburbs reach far beyond the limits of the administrative metropolitan city. The population of the Greater Milan Metropolitan Area, commonly known as Milan as a whole, is reportedly between 8.2 million and 12.5 million people, making it the largest metropolitan area in both Italy and the EU (Wikipedia contributors, 2022).

After World War II, there was an increase in Milan’s population of around 400,000 people. The surge was mostly caused by the influx of immigrants from the poor regions of Italy’s south and northeast. Population hype led to the expansion of Milan and growth of self-

built urban villages in the countryside around the city (Foot & Lecco, 2021, pp.13-14). These conditions eased in the 1970s when Milan’s population began to decline. Then the city’s population began to age. There was a migration movement from different countries on the latter years. At the end of the 1990s, Milan and its province had more than 150,000 non-Italian immigrants, and one in ten new schoolchildren in Milan was non-Italian (Foot & Lecco, 2021, p.15). As per the 2021 statistics, of the population, 20.1% are foreign migrants in which 8.21% are of Asian origin ((Milan Population, n.d.).

Transportation

The metropolitan transportation service runs a well-connected bus, tram, and subway network in the urban region. The city’s first subway line was launched in 1964. In the latter half of the 20th century, work on a light rail system started (Wikipedia contributors, 2022). Nevertheless, despite the accessibility of mass transit, Milan has a high rate of private car ownership, which since the early 1980s has led to traffic and parking issues along with significant increases in pollution. In order to reduce pollution levels, local government officials occasionally imposed strict regulations on all private driving (Giuliano et al, 2004).

ATM (Azienda Trasporti Milanese) - the Milan Public Transport Operator’s “Full Electric 2030” plan aims to convert the entire public transportation network to electric power by 2030 (Editorial, 2019). In 8 years, the entire fleet of transportation vehicles will be composed of electric vehicles, including 1,200 electric buses that will serve both the city and the metropolitan area. These will be supplemented by 83 electric service cars to assist transportation,

monitor operations, and maintain subway and tram centres. In addition, 3 full electric hubs will be built, and 4 main bus depots will be gradually transformed to house the new buses by installing smart electric recharge points. ATM has also switched to a new electricity provider that only provides certified renewable energy to ensure that the system will be 100% electric (Baccelli et al., 2019).

Geography & Climate

Milan is located in Northern Italy’s low-lying Po Valley and is encircled by mountains. The city is vulnerable to dense fog due to its geography and the summer heat (Geography of Milan, 2021). Milan has a humid subtropical climate with hot, humid summers and some rainfall and cool, soggy winters. The average maximum temperature in July is around 82°F (28°C), while it hits a low of 43°F (6°C) in January. Snowfalls are fairly common in the winter. The average annual precipitation is 40 inches (1000mm) (Milan, n.d.).

The city is “going green” to tackle climate change and improve the quality of life for its residents. Local governments have announced plans to plant 3 million trees by 2030 (Girardi, 2019), believing that increased greenery will improve air quality and, as a result, people’s health.

Governance

Three distinct authorities exist within the Lombardy region: municipal, provincial, and regional; all three are under the jurisdiction of the Republic of Italy. First one is the city (comune) of Milan, which is led by a directly elected mayor and council. The City Council is chosen for terms of five years. This body is in charge of monitoring the activities of the city, along with the public education, traffic control, road maintenance, and transportation services (Foot & Lecco, 2021, p.25).

Second, the Milano province (provincia) governs the surrounding area of the city and has powers related to infrastructure development and cultural policies. Milano province has also been scaling down in operations as some cities, including Lodi and Lecco have become provinces with their own rights (Foot & Lecco, 2021, p.26).

Third, Lombardy has an elected regional government (regione), headquartered in Milan and which was established under national statutes in 1970. It has expanded its power as the Italian state has delegated more authority, including public health administration (Foot & Lecco, 2021, p.27).

Economy

Italy has a highly advanced market economy. The national economy ranks third in the European Union, 8th globally by nominal GDP, and 12th globally by GDP (PPP) (IMF, n.d.). Italy possesses the third-largest gold reserve in the world, and it stands among the wealthiest considering the private wealth (Reuters, 2019).

Hosting some of the biggest metal and textile production facilities in Europe in addition to having a highly developed service industry, the Lombardy region’s per capita GDP of EUR38,000 is at least 20% greater than the national average for Italy (The GDP per capita in Italy was last recorded in 2021 at 31511.79 US dollars) (Babali, 2021). Milan’s GDP per capita, which is approximately €49,500 (US\$55,600), is among the highest in the nation. The unemployment rate in Milan is 5.8% as against the national average of 9% (WikiMili, 2022).

Milan is home to the largest commercial markets in Italy. Markets’ geographic positioning have a vital role in Milan’s position as Italy’s most important economic hub. With a whopping GDP of EUR381 billion, Lombardy owns Italy’s top regional economy. Milan, the Lombardy region’s capital, is the wealthiest city of Italy.

Milan serves as the headquarters for a number of well-known fashion companies, including Versace, Gucci, Armani, Valentino, Prada, Dolce & Gabbana, Moschino, Luxottica, OVS, Tod's, Trussardi, and Missoni and the city is regarded as one of the world's fashion capitals, along with New York, Paris, and London. Milan Fashion Week, a significant fashion event that influences trends, is held twice a year in the city. Milan's Porta Nuova is one of the most significant business districts, and organisations with their corporate headquarters include AXA, Bank of America, BNP Paribas, China Construction Bank, FinecoBank, Finanza & Futuro Banca, FM Global, HSBC, KPMG, Mitsubishi UFJ Financial Group, UniCredit & UnipolSai. Milan's service sector has benefited from the performance of the city's banks and the stock exchange, the Borsa Italiana, that's also located in Piazza degli Affari in the city centre.

Milan also ranks first in economic stability and sustainable mobility, second in social quality, and third in digital transformation. The city has grown in significance in terms of environmental and energy issues (The Mayor, 2021) and is home to approximately 350 businesses involved in water, energy efficiency, and air quality activities .

Milan is also a national focus for mobility & transportation. Two airports serve the city, and a vast network of roads and rail connections reaches out to the surrounding territories, especially in the north. There are many businesses and startups in mobility, such as BeMobility (road logistics), GoVolt (last-mile logistics), SeaWe (electric water taxis), and Ocioo.ai (AI to ensure road safety).

Education & Research

When compared to other Italian cities, Milan has a lot to offer in terms of research and education. There are about 32 universities/higher education institutions (Universities, Academies

& Schools in Milano, n.d.). Some of the leading universities are the University of Milan, the University of Milan-Bicocca, the Polytechnic University of Milan, and the Catholic University of the Sacred Heart. International students make up 20.638 of the 214.537 total students enrolled in Milan's universities and (art and music) academies, which is nearly 10% of all students(Yes Milano, n.d.).

The Politecnico di Milano is the highest-ranked university in Italy, ranking 139th in the world in the QS World University Rankings® 2023 (Alumni Polimi, 2021).

Major research areas in mobility include the following: Integrated mobility systems, Mobility and urban development scenarios, Business and financial analytics, Evolution of vehicle technology, Asset management and maintenance, Infomobility, and support for integrated mobility. The following are some of the innovative projects that we have come across.

I. Multiple projects by different PhD candidates in polimi focusing on Future Mobility Solutions

1. Hybrid Choice Models for analysing users' perceptions, attitudes and willingness-to-adopt Future Mobility Solutions (Fulvio Silvestri): The project focused on Assessment of the impacts of future mobility solutions on travel demand, through the design of psycho-attitudinal surveys and the estimation of advanced behavioural models. Research was carried out in Milan & the Lombardy Region.

2. Machine learning techniques for the analysis of people mobility (Luca Barbierato): Using new data sources (mobile phone data, i.e., GPS data) for estimating trip purposes. Several high-potential sources of big data for mobility are available, including MNO (Mobile Network Operators) and app records. Travellers' segmentation has been tested with the data, within Milan

3. Metro Benchmarking (Luigi Castagna): Collection, data integration and develop a method

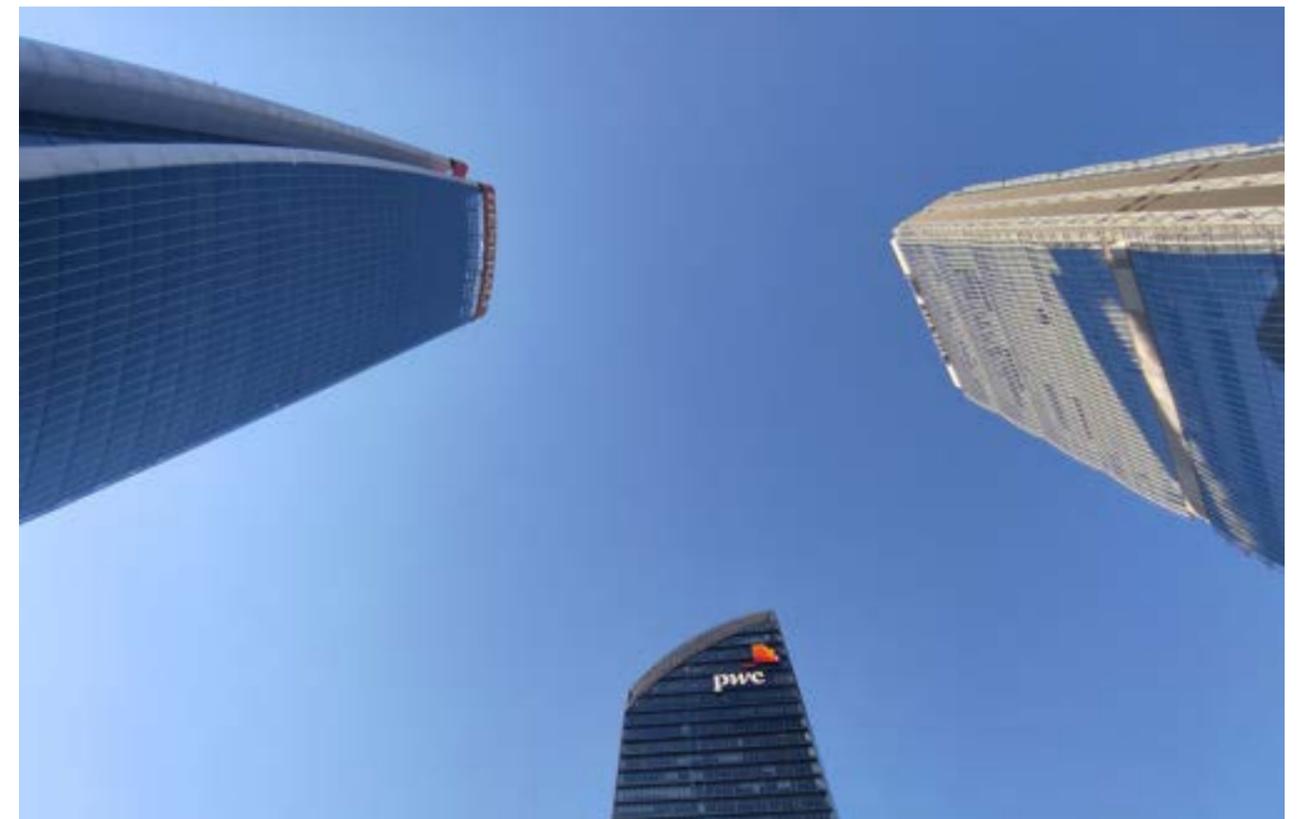
for the benchmarking analysis of the technical efficiency of the main European metro systems & accessing the technical efficiency of long term- socio economic factor impacts. The project intends to measure the productive efficiency of the subway systems of major cities in the world. It also compares productive efficiency across cities and over time, considering system differences, transit users, and the city, as well as other significant factors beyond the current management's control.

4. Innovative approaches to Transportation Planning(Francesco De Fabiis): Understand people's reaction to urban experiments via Living labs. Understand users' needs of accessibility, security, comfort & quality & services to calculate what variable to be improved. Bottoms up approach of living lab in Milan which include citizens, universities, administration & industry. Conducted urban experiments to measure people's perceptions. The project partners included Politecnico di Milano,

Municipality of Milan, City of Ljubljana, City of Maribor, City of Zagreb, Municipality of Patras, City of Novi Sad, City of Sarajevo, Capital City of Podgorica.

II The digital start-up dirm: Ocioo.AI

The mission of Ocioo.AI, the digital startup which is established in 2021 is to "make zero accidents real". The company came up with a creative AI solution,a camera device that they create intelligent sensors that can spot danger signs and human error before they turn tragic. While being implemented on the driver's front, the software alerts drivers when they begin to become distracted while driving and wakes them up when they fall asleep. The target segment of the company is transportation & logistic Industry and, in particular, companies that have more than 10 trucks within their fleet.



URBAN MOBILITY ANALYSIS

Commuting Patterns & Costs

Overall, in Italy, employees commute more than students and cars are still the most common means of transportation. Students use public and shared transportation much more frequently. Bus, metro and trams are the second most popular way to commute. The reasons why many people still prefer to take the car can be different. To lead people to use public transportation more frequently instead of private vehicles, municipalities, in particular larger ones, should offer commuters attractive solutions, fast services, on time and affordable.

Some Quick Facts:

1. Milan and Lombardy Commute Times Statistics: In Milan and Lombardy, the average amount of time people spend riding public transit is 43 minutes. Over 44% of those riders spend more than 2 hours on public transportation every day.
2. Milan and Lombardy Waiting Time Statistics: How long do people usually wait at a stop or station in Milan and Lombardy each day? Commuters wait on average 9 minutes, but over 26% wait longer than 20 minutes.
3. Milan and Lombardy Travel Distance Statistics: The average distance people ride in a single trip within Milan and Lombardy is 7.1 km. Yet 39% of riders travel over 12 km in a single direction.
4. Milan and Lombardy Transfers Statistics: The percentage of public transit riders who transfer lines at least once in Milan and Lombardy is 31%. On average, 43% of riders transfer at least twice during a single trip.

5. Milan and Lombardy Walking Distance Statistics: Did you know that in Milan and Lombardy, the average distance people walk to work or home is 0.74 km? Approximately, 23% walk more than 1 km to reach their destination.

Type of ticket	Price (€)
Single ticket	2
24-hour card	4.50
48-hour travel card	8.25
Weekly travel card	1.50
Monthly travel card	35

Accessibility for People with Disabilities

Urban bus lines in Milan are all equipped with vehicles with low floors, accessible to people in wheelchairs; some tram lines are entirely equipped with low floors, while others only partially; trolleybuses lines are in part equipped with low floor automobiles. Public transportation which can transport wheelchair users has a blue sign on the outside. In some vehicles it is possible to find visible and acoustic signs of indications such as destinations and stops. However, only some of the platforms and bus, tram and trolleybus stops are accessible for disabled people.

The following stations are fitted with LOGES pathways (which stands for Orientation, Guidance and Safety Line in Italian), a guidance system on the ground to help direct people with visual disabilities inside the stations from above ground down to the platforms and back again. Tactile stations maps written in Braille and raised characters can also be found on

the mezzanine floors, which direct passengers to the stairs and the lifts. The lift buttons are written in Braille and raised characters.

- M1 Line: Rho Fiera Milano, Pero and Duomo
- M2 Line: Abbiategrasso, Assago Nord and Assago Forum
- M3 Line: Maciachini, Dergano, Affori Centro, Affori FN and Comasina
- M5 Line: All stations

Best Aspects of Milan Disabled Access

1. Flat terrain –The city centre of Milan is fairly flat.
2. Easy train connections.
3. Several attractions are within walking/rolling distance of each other.

Most Challenging Aspects of Milan Disabled Access

1. Cobblestone abundance – In Milan, cobblestones can be found on many streets and crosswalks. Wheelchair users and other travellers with disabilities should take care when walking/rolling over the cobblestones.
2. Missing sidewalk ramps – Some sidewalks, especially near tram tracks, do not have sidewalk ramps at the crosswalks.
3. Tram tracks – Many tram tracks are present in the streets of central Milan. Wheelchair users should be careful when rolling over the train tracks.

Different Modes of Transport

METRO

The Milan metro is made up of four lines and is the most extensive in Italy. Its construction was completed in the 1960s. Despite the Milan metro only having four lines and 111 stations, it is currently the longest metro line in Italy -

measuring 94.5 km.

The four metro lines in Milan are numbered and have various colours:

- Line M1 (red): This line is useful, especially if one is travelling to Milan on business and wants to reach the Fiera Milano. The line also stops at the Duomo and San Babila.
- Line M2 (green): The M2 stops at Milano Centrale.
- Line M3 (yellow): The M3 is probably the most convenient line for tourists. It stops at the Duomo, in Via Montenapoleone (the most important commercial area in Milan) and Milano Centrale.
- Line M5 (purple): The M5 is integrated with the regional trains. Visitors will find the following stops interesting: Garibaldi station and Stadio Giuseppe Meazza.

The Milan Metro is currently working on the fifth line (blue line).

TRAM

Milan's trams have been present since 1876, although at that time they were horse-drawn. Even today some of the trams in circulation are relics, more than 80 years old. The Milan tram network system consists of 18 lines that run until past midnight. The trams in Milan have longer schedules compared to the Milan metro and the city's local buses. The trams are numbered from 1 to 33. Trams from several periods run in Milan, from the most modern and "psychedelic" to the most classic or historic. The most peculiar are the 1500 series trams, which date back to 1928-1930.

BUS

More than 80 local bus and trolleybus lines pass through the Milan streets every day. At night, and on the weekend, night buses take over. Since 2015, Milan's night buses have run every day of the week. There are fifteen routes that travel from midnight until 6 am. These depart every 30 minutes. The buses depart

MILAN - City Overview

from various neighbourhoods in Milan, most of them are the city's most famous nightlife areas (Valtellina with Stelvio, Milton with Pagano, Sturzo with Como, Piazza XXIV Maggio, Umbria with Tito Livio, Umbria with XXII Marzo, Castelbarco with Tantardini and Ripamonti with Pietrasanta).

BICYCLE

Bicycles are environmentally friendly and practical when moving in the city. Milano offers cycling fans about 144 kilometres of cycling routes and lanes on a completely flat territory. Adults do not need to wear a helmet. Bike sharing is present with fixed pick-up and drop-off points as well as free floating that can be booked via app.

E-SCOOTER

There are 40,000 shared e-scooters available for hire on the streets of Italy according to the latest research. This tally means that the country has the second largest rental e-scooter market in Europe. E-scooters have been legally equivalent to bicycles in Italy since early 2020, although some e-scooter sharing fleets had already launched before this. In the summer of 2019, some cities adopted an experimental law, including Milan, to introduce e-scooters although the very first was Bit Mobility in Catolina on 27 July 2019.

TAXI

The first thing to know about taking taxis in Milan is that one cannot hail a cab the way one would somewhere else. Taxis are not allowed to stop for passengers just anywhere – there are specific taxi stands all over Milan, and one has to go there to get a cab. Also, in not-so-busy areas or off-hours, there won't be a queue of taxis waiting at the stand – there will just be a phone that connects directly to a taxi dispatch service. While Uber is legal in Milan, it is not the same and only Uber Black is available.



SWOT ANALYSIS

Strengths

- The city is flat, perfect for cycling.
- The city is actually very compact and dense, which means you can cycle across in 25-30min.
- The public transit network reaches every corner of the city.
- The city is economically thriving.

Weaknesses

- New infrastructure being built is delayed by the cultural heritage ministry and archaeological sites being found (this happens a lot in Italy in general). The process of overcoming that is not very efficient.
- Old-fashioned street design code that is very car-oriented.
- High car ownership in Milan (even if it is lower compared to the rest of Italy).
- Cars are parked everywhere.

- As a reaction to COVID-19, awareness of the importance of public space increased everywhere in Italy. As a result, the Comune di Milano revised the city's mobility strategy.
- Since 2010, and especially since the Expo in 2015, Milan has become more and more international and progressive in terms of urban planning.

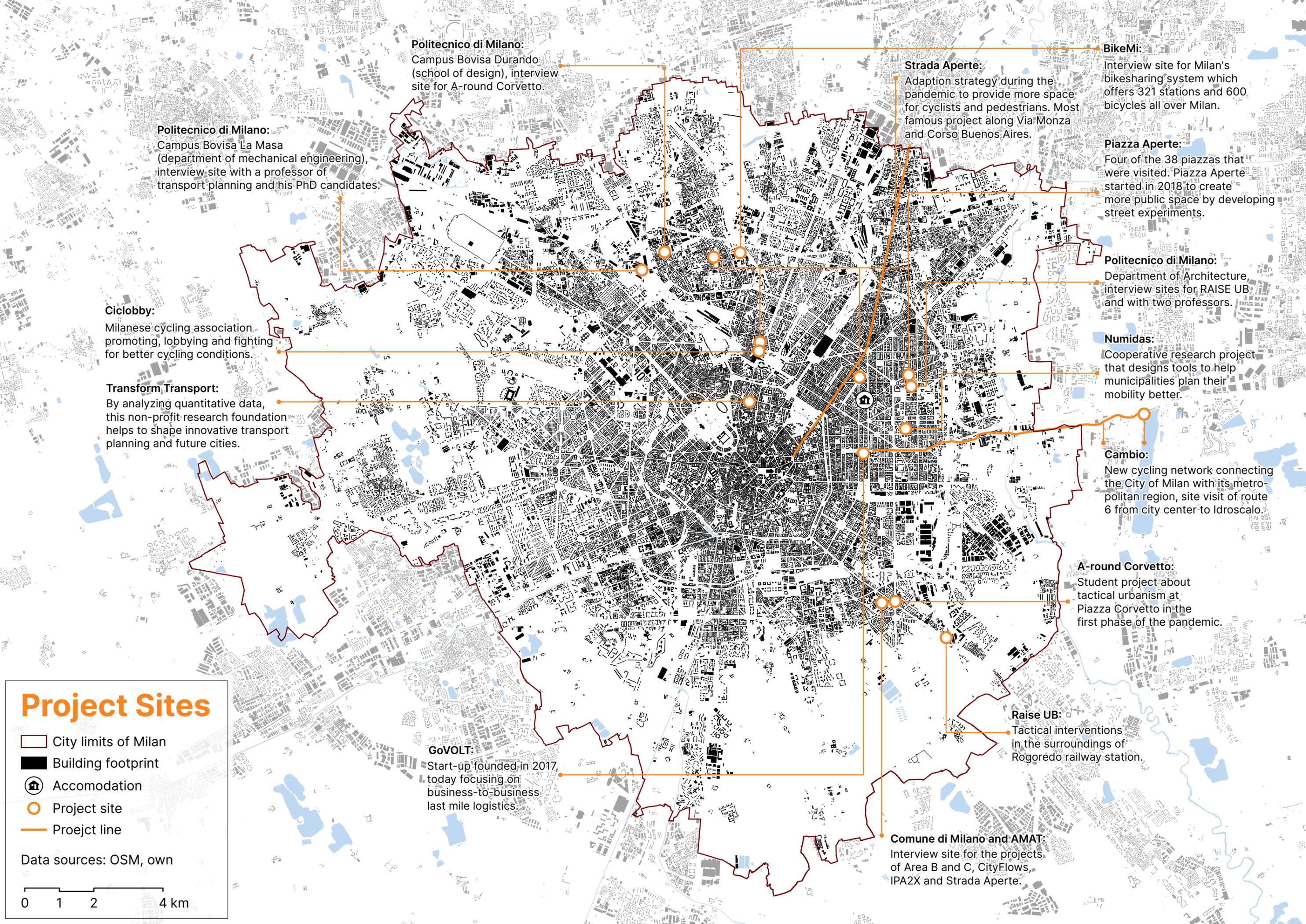
- Increasing rental prices.
- Rising temperatures during summer.
- Compliance – even after the introduction of Zone 30 and the introduction of cycle lanes, there is no urban police control to make sure cars don't park on cycle lanes, etc.

Opportunities

Threats



PROJECTS IN MILAN



Politecnico di Milano:
 Campus Bovisa Durando
 (school of design), interview
 site for A-round Corvetto.

Politecnico di Milano:
 Campus Bovisa La Masa
 (department of mechanical engineering),
 interview site with a professor of
 transport planning and his PhD candidates.

Strada Aperte:
 Adaption strategy during the
 pandemic to provide more space
 for cyclists and pedestrians. Most
 famous project along Via Monza
 and Corso Buenos Aires.

BikeMi:
 Interview site for Milan's
 bikesharing system which
 offers 321 stations and 600
 bicycles all over Milan.

Piazza Aperte:
 Four of the 38 piazzas that
 were visited. Piazza Aperte
 started in 2018 to create
 more public space by developing
 street experiments.

Politecnico di Milano:
 Department of Architecture,
 interview sites for RAISE UB
 and with two professors.

Ciclobby:
 Milanese cycling association
 promoting, lobbying and fighting
 for better cycling conditions.

Numidas:
 Cooperative research project
 that designs tools to help
 municipalities plan their
 mobility better.

Transform, Transport:
 By analyzing quantitative data,
 this non-profit research foundation
 helps to shape innovative transport
 planning and future cities.

Cambio:
 New cycling network connecting
 the City of Milan with its metro-
 politan region, site visit of route
 6 from city center to Idroscalo.

A-round Corvetto:
 Student project about
 tactical urbanism at
 Piazza Corvetto in the
 first phase of the pandemic.

GoVOLT:
 Start-up founded in 2017,
 today focusing on
 business-to-business
 last mile logistics.

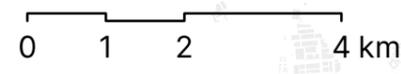
Raise UB:
 Tactical interventions
 in the surroundings of
 Rogoredo railway station.

Comune di Milano and AMAT:
 Interview site for the projects
 of Area B and C, CityFlows,
 IPA2X and Strada Aperte.

Project Sites

- City limits of Milan
- Building footprint
- H Accomodation
- Project site
- Proeject line

Data sources: OSM, own



PIAZZE APERTE

The project is about temporary interventions on the streets of Milan.

The Comune di Milano (municipality) launched the project to turn squares, streets and parking areas for cars into spaces dedicated to people.

Motivation and Goals

This project aims to create more public space in Milan for its residents. Street experiments can help to provide accessibility to different social groups and locations in Milan. The project is an easy and cost-effective way to solve urgent mobility issues at intersections in the city. The city needs it to innovate on outdated regulations and transformation processes. Therefore, by inviting citizens to participate in improving the public spaces in their neighbourhoods, the city hopes to reduce inequalities in access to urban opportunities.

Implementation

The project has been implemented at complex intersections outside the historical centre. As the older city centre already has many public squares, the city decided to focus on the city's periphery with less public space when choosing locations for open squares. To facilitate pedestrian safety, the most complex intersections are chosen as locations for open squares. The cost of the interventions is mostly covered by public funds.

Stakeholders

Citizens and other stakeholders are asked to propose locations and designs for street experiments. Initially, in 2018, residents, shops, and public buildings (e.g., schools and churches) in the vicinity of a potential street experiment are approached directly by the city. In the city centre, there is also a greater interest from private developers to become

involved and help fund street experiments. Since 2019, the city has changed its approach by launching open calls to Milan's neighbourhoods to propose locations and designs for street experiments.

Outcomes and Discussion

The initial three squares that were part of the pilot project in 2018 inspired similar squares elsewhere in the city. The street experiments typically last a year before the city and the residents near the square decide if and how they want to transform the project into a more permanent version. Benches, parked cars on the side of the street and poles are used to demarcate the street experiments and to prevent people from parking their cars there.

The acceptance of the street experiments by residents was one major thing that worked well. Other things include:

- Involving residents: With every street experiment, the city has many informal conversations with residents to understand if the project is working for them, and if not, why. In general, the projects were well accepted by residents, because high quality public space is rare in Milan.
- Improving accessibility: Allocating more



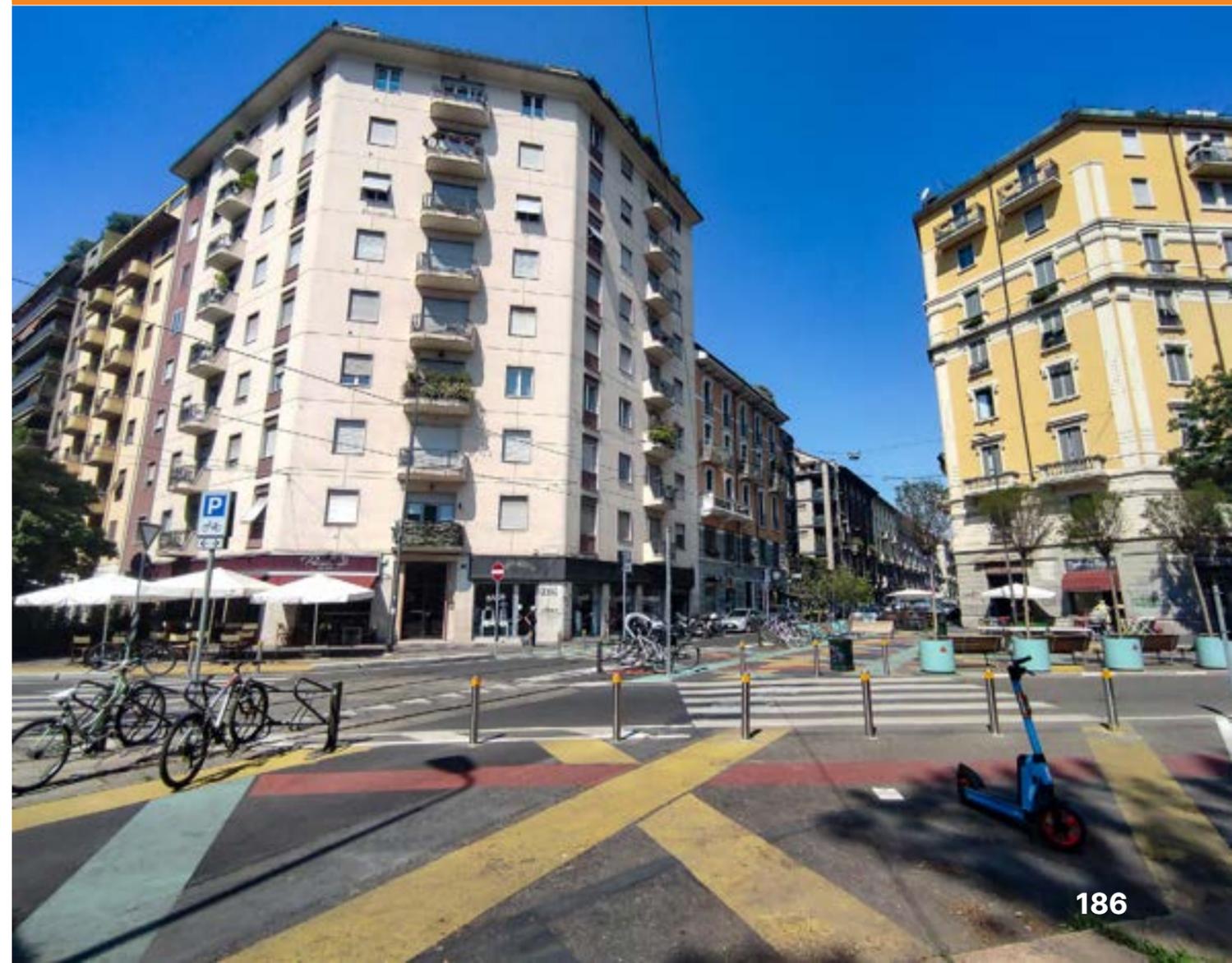
“Public space is for conflict”,
researcher at Politecnico di
Milano



KEY FACTS

36 temporary street experiments implemented since 2018

6 new permanent public spaces created out of street experiments



MILAN - Project Overview

space for pedestrians results in a greater sense of safety and improves accessibility for people with disabilities.

- Reducing parking: The space for street experiments is typically taken from space previously dedicated to parking or at least unofficially used for parking. Even though residents initially complain about this parking space reduction, once the street experiment is implemented, the fewer parking spaces don't seem to pose a problem.
- Improving licensing: During Covid-19, the awareness for the need for high quality public space rose all over Italy. Thanks to this, permits for street experiments and outdoor seating for restaurants were granted faster.

It is necessary to discuss what did not work well—documenting the projects and maintaining them. The challenges were:

- Monitoring the street experiments: There was no clear process with a defined methodology followed to choose locations for street experiments or to evaluate their success. As a result, comprehensive and transparent documentation of the street experiments is not available to the public. However, it must be said that each street experiment is unique in terms of its challenges and its stakeholders. This in turn makes it difficult to develop a replicable process for implementing street experiments.
- Maintaining the paint: While there is no official colour code, the city typically works with colours where they already have suppliers for other road markings (e.g., yellow, white, blue and red). This is a largely practical reason, but probably works out cheaper for the city as they can order the paint in bulk. Nonetheless, the paint weathers quicker than road markings because people walk on it and, in the case of the Mercate dell'Isola, the

square is washed with chemicals after the bi-weekly market. Similarly, painting the squares is more difficult in winter due to the bad weather.

The project is going to focus on the following further:

- Transforming street experiments into permanent public spaces: Instead of paint, more durable materials (e.g., cobblestones) are used and trees are planted (and not just potted). Interestingly, in the six experiments that were already transformed permanently, residents preferred a more traditional look with benches and cobblestone pavement than colourful squares. Especially older residents fear that very modern-looking squares could invite sketchy young people to spend time there.
- Focusing on schools: Headmasters and parents' associations are particularly proactive when it comes to proposing and implementing new street experiments, as the improved traffic safety is in their interest for the schoolchildren. The additional public space near schools also gives children more space to play during breaks. Due to the success of street experiments near schools, the city has decided to focus on these in the future.
- Creating a permanent office for urban experiments at the Comune di Milano: The street experiments have shown that there is a need for a direct contact point between the city's urban planners and residents. The idea is that with an official bureaucratic structure in place, it will become easier and faster for residents to propose new locations for street experiments.
- Studying the durability of the paint: New types of paint products are being tested to come up with longer-lasting alternatives to the current colours in use.

Applicability to Munich

Since Munich, like Milan, struggles with dividing space in cities between parking and public space, there is a need to implement such a project. Since it is easy and cost-effective, it could be done quickly to improve the accessibility of neighbourhoods as well as the quality of stay and experience by providing more greenery, outdoor benches, and additional seating space for bars and restaurants.

The project is transferable to Munich, but governance is the only obstacle. The project fits into the Munich and MCube mobility strategies. Pop-up outdoor seating of restaurants and bars during COVID-19 has shown that Munich's residents appreciate more public space where there was once parking. Despite this, the biggest issue would be the legal framework and political determination to compile the appropriate mix of politicians, planners, and residents to successfully implement street experiments in Munich on a large scale.

Outlook

We visited Milan in the first two weeks of July 2022, which meant that many people, especially schoolchildren, were already on vacation. We were on a guided tour of four open squares in Milan with two Politecnico di Milano researchers. There were fewer people than usual on the squares due to the summer heat. The trees at many street experiments are still too small to provide shade, which means that people avoid the squares in the peak summer heat. According to the interview partners, the street experiments would normally be busier with people. Residents and representatives of the city could have been interviewed. A dedicated interview with both could have provided additional insights on the co-creation process of the street experiments. Monitoring the interventions could be done better. This way, their impact can be evaluated and serve as proof to sceptical individuals that the street experiments do benefit the residents of Munich.

Project Transferability



Project Impact



AREA B AND C

The project is about congestion charging in the city centre.

Milan is the only city to have implemented two types of access charging to its inner city. Ecopass was launched in 2008 and then transformed into what is known today as the Area B and C congestion charging model in 2012.

Motivation and Goals

The predecessor system, Ecopass, was not effective anymore. The need for the change was the increasing efficiency of vehicles on the market: as they became more environmentally friendly, the more of them were allowed to enter the previously restricted city centre. Hence, ironically, the more environmentally friendly vehicles reversed the initial achievements in overall pollution and traffic reduction.

The project aims at achieving carbon neutrality and reducing congestion. The City Council of Milan has approved a plan to become carbon-neutral by 2050. It also has established a set of reference criteria for Carbon Neutral Areas and has developed a baseline report, "Guideline for GHG calculation and offsetting in Carbon Neutral Areas", with requirements for the permitting process and monitoring plan that the City of Milan will use to quantify GHG emissions in the context of carbon neutral areas.

Implementation

The congestion charge applies only to the city center. Zone C is the actual congestion charging zone in the city center (8.2km² or 4.5% of Milan's surface). Access to this zone

costs 5€ per day and this charge is active from 07:30 to 19:30. Zone B covers most of the remainder of the city (132km² or 70% of Milan's surface). Access to this zone is free, but the type of vehicle allowed to enter is regulated. Entry and exit to both zones are controlled by cameras at the respective access points.

Stakeholders

Citizens were asked to give their opinion on the congestion charging scheme in a referendum. 79% of voters that participated in the referendum were in favor of the congestion charge. The referendum was held shortly after the mayor was elected to office. According to our interview partners, the congestion charge would not have been possible without the strong political commitment demonstrated by the mayor.

“Any innovation brings with it some kind of resistance”, mobility planner at AMAT

KEY FACTS

18 gates for accessing Area B

5€ per day for accessing Area C

43 access points monitored by cameras for central Area C



Figure 16. The outline of Area C (source: <https://www.areacmilano.it/mappa>).

Outcomes and Discussion

The introduction of Area B and C has led to a rapid decrease of pollution. In the first four years, PM10 emissions have been reduced by half. For NOx, the values have been steadily decreasing by about 11% per year. The share of Euro 6 vehicles (i.e., the least polluting vehicle class) has increased from 6% to 54% in the same time span. Additionally, the monetary incentives by the government to swap out old, polluting cars incited people to buy newer, less polluting ones.

Adapting the charge to meet the needs of locals worked really well. Along with:

- Being less strict with residents and service companies: Locals in Zone C are granted 40 accesses for free per year. For them, any access on top of that costs only 2€. Similarly, service vehicles only pay 3€ per access. In being flexible to adapt the congestion charge to meet the needs of locals, the acceptance of it is high.
- Being stricter with delivery vehicles: There is a special window from 08:00 to 10:00 (morning peak) where only electrical delivery vehicles are allowed to enter Zone C. On the one hand, this led to less vehicles in Zone C overall, and more electric vehicles in Zone C itself. This way, the reduction of pollution was spurred further, and delivery companies have boosted their productivity by 10% since they can make more and faster deliveries when there is less traffic.
- Reinvesting the revenue: A share of the revenue is reinvested into funding new mobility projects in Milan, most prominently the city's bike sharing system.
- Reducing the need for parking: The congestion charge has led to less cars circulating in the city centre. This not only means that there is less traffic, but also less of a need for parking. For example,

this scheme has freed up 15.000m² of public space in front of the Castello Sforzesco that is currently being transformed into a public park.

The real challenge was cooperation with other European countries:

- Recognizing foreign licence plates: French licence plate numbers follow the same structure as Italian ones. Initially, this led to the cameras detecting French licence plates as Italian ones and erroneously sending the bill for the congestion charge to Italian citizens. However, the cooperation and data exchange between European authorities has since improved and therefore the problem is not a common occurrence anymore.

The transition to carbon neutral mobility is what drives the project. The next phase of the project includes:

- Phasing out polluting vehicles: Starting in October 2022, all vehicles considered particularly polluting will gradually be banned (starting with Euro0 and Euro1 up to Euro5 in 2030) in selected areas of the city. This goal also applies to the city's public transport, i.e., the diesel buses still circulating in the city. This "Air and Climate Plan" also includes greening actions to reduce urban heat islands through de-paving, increasing urban green spaces and forestation.
- Supporting street vendors: Typically, street vendors use old, polluting cars to transport their goods to the city centre. For equity purposes, the city allows the street vendors to use on-board units monitoring their mileage. They are granted 500km free a year and only have to pay once they exceed this threshold. A similar project, Move-In, is being launched for regular Milanese residents.

Applicability to Munich

By improving the quality of air and space in Milan, the project has shifted locals' attitude towards car ownership. The congestion charge helps the city reach its emission targets as fewer vehicles circulate in the city centre. On a global scale, the project contributes to climate protection. On an individual level, the project improves the traffic quality and the accessibility to the city and therefore makes people realise that fewer cars in the city centre mean a better day for them: less time spent in traffic, less time spent searching for parking.

Congestion charging requires strong political commitment. For that, the right legal framework and sufficient political determination have to be in place, otherwise the project is a high risk to implement in Munich. Munich is also similar to Milan in the sense that car ownership is almost cultural. While this can pose a threat to implementing a congestion charge, as seen in Milan, it can also be an effective push away from high car usage, at least in the city centre.

Outlook

Residents of Zone C should have been interviewed. It would have been interesting to talk to residents of Zone C directly to learn first-hand how they view the development of Zone C over the years. Also, it would have been interesting to know what they think of the access prices and the phasing out of old cars. It would have been interesting to know if they would buy a new car once it becomes inevitable or if they would rather stop using one altogether.

Project Transferability



Project Impact



CAMBIO

Cambio is an initiative to build a network of cycle paths in the Milan metropolitan region that connects greenways, "super-cycleways", and municipal lanes.

The Metropolitan Council of Milan has started implementing the Biciplan "Cambio" project, a new transportation system that introduces "super-cycle" corridors across the urban area, prioritising cycling, environmental protection, safety, and wellbeing. This project is part of Milan's ongoing vision of bicycle-friendly highways & a coherent network.

Motivation and Goals

The project aims to create an extensive sustainable network exclusively for cycling that will promote sustainable mobility.

24 cycle lines are part of the project: 4 circular, 16 radial, and 4 "greenways," super-fast lines allow people to travel across the country from North to South and from East to West. The rest of the network will be connected to some already-existing routes, like the cycle paths along the Villoresi canal and Navigli, while new routes will be constructed from the scratch. The basic idea is to focus more on sustainable mobility, in addition an urban development that integrates with environmental protection, safety, economic development and general well-being.

Cambio hopes to make cycling the "obvious choice" of residents by making it fast, healthy, safe, and affordable for all. Milan is a flat city that is perfect for cycling. However, it is difficult and unsafe for cyclists due to parking and traffic issues and the excessive number of cars. Therefore, it is necessary to increase road safety for both motorists and cyclists, as they will no longer need to use the same routes after the plan is implemented. Additionally, connecting high school students is a goal because they frequently lack travel options (no

drivers' licence, inadequate public transportation).

Implementation

By constructing new infrastructure, the project targets to increase bicycle trips by at least 20% overall and by 10% on intermunicipal routes, complementing existing cycle lanes with 750 kilometres of new corridors that will link the city's 133 municipalities within the metropolitan area. Cambio has a projected year of completion in 2035. There will be 24 bike lanes, including 4 circular lines, 16 radial routes, and 4 greenways, high-speed routes that cover the country overall. To ensure extensive territorial coverage, the project also calculates that 80% of the services of interest will be situated within 1 km of at least one line. Precisely, the planning of the routes had already incorporated notable traffic observation data. Where

“Milano does a lot of cycling”, project manager of Cambio

KEY FACTS

2.5 million Euro costs for route 6

2 years of planning and construction for route 6

2.5m of path width on route 6

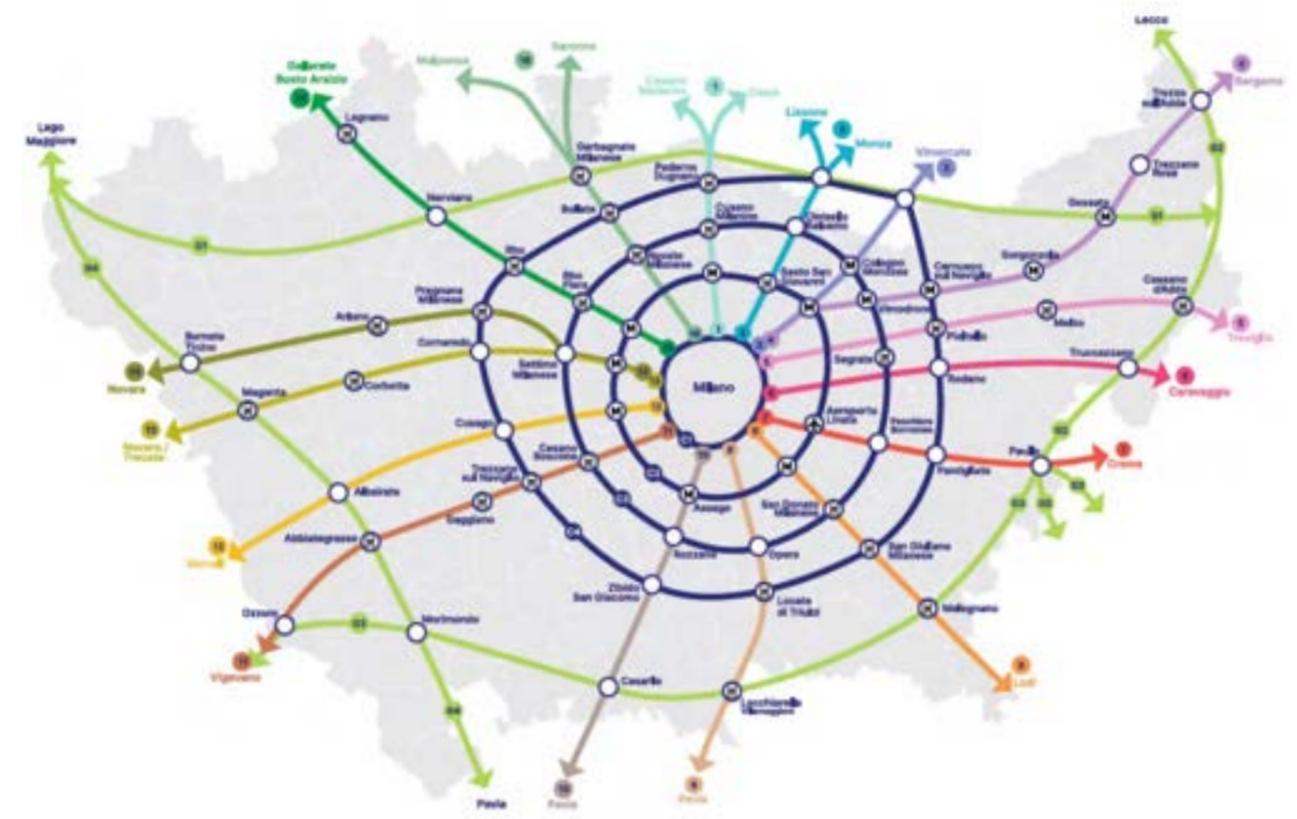


Figure 17. Cambio includes a total of four ring express routes and 16 radials (source: <https://www.cittametropolitana.mi.it/portale/news/Cambio-il-Progetto-Biciplan/>).

MILAN - Project Overview

do people want to travel from? The city chose the following locations as its top priorities: schools, hospitals, train stations, commercial districts, and workplaces. 86 percent of residential areas, 77 percent of businesses, 78 percent of workplaces, 79 percent of schools, 83 percent of train stations, and 74 percent of healthcare facilities must all be within one kilometre of the express cycle lanes.

The cycle path that we have visited, route 6 will connect Milan with Segrate and the Idroscalo.

Stakeholders

Citizens were encouraged to participate throughout the project. There are approximately ten round tables with various associations depending on the specific issues, such as public participation.

Outcomes and Discussion

So far, the project has been well planned, with sufficient funds and quick implementation. EU funds have accelerated the project. Route 6 took two years for planning and construction, with a cost of 2.5 million euros.

The cycle expressways are also intended to be visible at a glance, according to the colour code and a different color code is assigned to each lane. Graffiti arts are also there in the underpass. The authorities have collaborated with the artists in order to discourage others from creating new graffiti in the underpass, where there was previously a lot of it.

Teamwork and quick implementation worked well. The successful factors of the project so far include:

- Faster implementation: Route 6 took two years for planning & construction, which is faster than most of the projects
- Teamwork: Had a motivated & committed team

- Communication with Govt Authorities: During the tendering procedure, one construction company was assigned, and they hired subcontractors. They found working with the government to be rather simple, as they knew whom to contact.

The major challenges were:

- Coordination: So many things to do within two years was not easy. The entire coordination was hectic.
- The challenging part of communication was if you don't know the correct person or contact, it takes a long time.

In the future, the project's focus will be on its subsequent routes. Routes 5, 7, 12, and 15 will be developed and implemented. High school students are prioritised because they frequently have no other means of transportation (no driver's licence, poor public transportation).

Applicability to Munich

The project's impact includes less road congestion, smoother traffic, fewer accidents, improved health, and less environmental harm. The development of bicycle connectivity reduces greenhouse gas emissions, creates greenways to preserve biodiversity, increases cyclist safety, and enhances public health. The impacts are: less congestion, smoother traffic, fewer accidents, better health, and less environmental harm.

The project could set an ambitious target for Munich. To have green corridors connecting the city to the suburbs are undoubtedly a great step toward promoting sustainable mobility.

A similar cycling infrastructure strategy has also been proposed by the local Government in Munich following a citizen-led petition in 2019 and a feasibility study from the previous year. The project involves the construction of six cycle expressways in the city, as well

as a bicycle ring road around the centre. The first route will connect the city centre to the town of Markt Schwaben (Balgaranov, 2022). Munich's bike lanes are more efficient, secure, and well-organised than those in Milan, so the integration is unlikely to have been as chaotic as it was in Milan. However, Milan's project implementation moved extra quickly.

Outlook

We interviewed and visited Route 6 of Project Cambio with the project manager and worksite director to learn about the entire planning process, challenges, and future plans, which was insightful. One of the places most severely impacted by the COVID outbreak was Milan. That is why the project has been delayed. Perhaps more time will help to reduce the rush.



Project Transferability



Project Impact



CICLOBBY

Cicloobby is the Milanese subdivision of FIAB (Federazione Italiana Ambiente e Bicicletta), Italy's cycling association.

Cicloobby is not a project of soft or hard infrastructure and measures, but rather an association promoting and lobbying for cycling in Milan. 1,000 members contribute to the common aim of improving cycling conditions in the city. In addition, different activities and courses are organised by Cicloobby, for example, free cycling trainings.

Motivation and Goals

Cycling in Italy and especially Milan is under the radar of politicians, cities and people. The modal share of cycling has been around 5% in Milan for a long time. Hence, little improvements into the cycling infrastructure were taken, and there was no promotion of cycling at all. However, Milan has realised that cycling is an important pillar of sustainable mobility. Many plans are developed, but the voice of the people using the cyclist infrastructure in the end is rarely heard. Cicloobby lobbies for better cycling and raises the voice of the public.

The goal of Cicloobby is to make Milan a cycling-friendly city. As it is very flat, Milan has perfect conditions for cycling. Only by increasing the share of cycling and reducing the number of cars in the city, Milan can reach its goals of the Sustainable Urban Mobility Plan. Hence, cycling is a key factor to make Milan a more livable and sustainable city.

Implementation and Stakeholders

Besides activities for members and the public, Cicloobby keeps close contact with stakeholders of the city, from AMAT to council members.

As a voice for cyclists in entire Milan, the lobby group does not have one specific focus area but generally fights for the improvement of cycling conditions all over the city. Contacts with politicians and AMAT, Milan's office for mobility planning, exist and are good, especially with AMAT and one council member.

All citizens can participate and politicians as well as other people in charge of cycling are met at events or specific meetings. The former Milanese mobility councillor regularly met with Cicloobby. They cycled together, he confronted Cicloobby with sympathy, and many improvements for cycling were started during his time as a councillor, for example the new regulations in 2020. However, the current mobility councillor of the city shifted the focus on public transit, and to data has rarely convened with Cicloobby.



“FIAT wants to sell cars, this is why one cannot do a lot [for cycling]”,
Cicloobby member



KEY FACTS

1000 members
in Milan

5% cycling modal split in Città
Metropolitana di Milano in 2020



Outcomes and Discussion

New regulation since 2020 and improvements on some roads, but it was not enough. The city creates new plans again and again, but apparently nothing changes and not too many improvements are implemented to make cycling a safe and sound alternative. Developments such as the one on Corso Buenos Aires are not sufficient for the amount of cyclists anymore.

Milan has a few good examples that show what can be done for cycling.

- Free bicycles on public transit: Taking the bicycle onto the metro lines and two specific tram lines has been free for two years, but due to the poor accessibility of the system, usually no cyclists use this option. In the case of regional railways, it got better and only a small fee of 3€ is to be paid, but usually only delivery drivers use this service.
- Massa Marmocci: A “bike bus” where kids are accompanied by parents or supervisors for a safe trip to school.

Ciclobby criticises many topics on cycling in Milan.

- Poor cycling infrastructure: Cycle lanes often stop a few metres before intersections, merging into car traffic. This increases safety issues and conflicts with cars. The reason for this is that redesigning all intersections takes much more resources than adding cycle paths between intersections. This leads to the next problem that no continuous cycling network exists in Milan (yet).
- Car dominance: There are too many cars on Milanese roads without regulation nor regular control (such as policing illegally parked cars on sidewalks, cycle paths, in intersections or the use of bus-only lanes).
- Overregulation: Apparently, technicians

and planners in Italy are responsible for accidents and any occurring conflicts that happen on roads and cycle paths they planned. Hence, they over-secure the design of cycle paths which is time- and money-consuming. On the other side, cyclists just want to get from A to B and do not always follow the safest route if it is not convenient.

- Communication with administration: In the case of Corso Buenos Aires and many other projects, the city plans and realises new cycling infrastructure but consults the public only after the inauguration. There is no or only little chance for Ciclobby or other advocating groups to affect the planning and design of new cycling infrastructure. Hence, the dialogue with the administration is difficult and time-consuming.
- No obligation to consult the public: In the case of cycling infrastructure, there is no legal obligation to consult the public or any interest groups. It was explained that in Italy, so far only the public must be consulted only during the planning procedure of bigger projects.

The future of the project emphasises “Survive”. It seems that all the currently discussed projects were already discussed five years ago.

On the initiative of a city council member, an official consultancy group consisting of 17 associations will be formed in September. This consulting team will deal with mobility and cycling topics in Milan. Similar initiatives existed before but were never successful due to their informal format. There is new hope that

“What’s next? The same projects as twenty years ago”,
Ciclobby member

this new Consulta will be more successful, and the public finally becomes a voice throughout the planning processes of mobility projects.

Applicability to Munich

Due to the nature of the cycling association and not being one specific project, the impact on time, air and space cannot be distinguished. However, what Ciclobby stands for, is important in any governance process. The aim of Ciclobby’s work and their ideas eventually impact time, air and space due to the sustainable nature of cycling.

There is no need to take Ciclobby to Munich. As explained before the interview, German’s governance system and the collaboration with ADFC (Germany’s counterpart to FIAB) is working better than in Milan. Instead, Germany’s approach with cycling and the work of German cycling associations should be taken to Milan instead. However, similarities can be taken away mostly dealing with governance issues in Munich and local context.

For example, the mobility culture in Munich and the dominance of the car is comparable to Milan. On the other side, there are few local challenges as resources for good public participation are comparably little.

Outlook

Talking to politicians could have broadened the content. During the visit in Milan, we talked to researchers, the public administration and a local cycling association about Milanese cycling infrastructure. However, for a full understanding of what is going on in the city, an interview with one or multiple local politicians, the people that eventually decide about projects, could have been very insightful.

Cycling conditions in Milan entirely could be done better. In Ciclobby’s point of view, everything concerning cycling in Milan needs to be improved. Munich, which is for sure not the best example for cycling in Germany or Europe, is considered to be a paradise for cyclists according to Ciclobby.

Project Transferability



No project impact determined.

“I hope our planners go to Munich to take their ideas”,
Ciclobby member

“[Today] cycle lanes are designed to be as safe as possible and therefore they become as complicated as possible”,
Ciclobby member

TRANSFORM TRANSPORT

Transform Transport is a non-profit research foundation based in Milan and focused on innovation in mobility and transport planning. It provides innovative, inclusive, and sustainable mobility solutions for shaping the future of society and cities worldwide in line with the UN's SDG 11 (Sustainable cities and communities).

It is based on 30 years of Systematica's work and explores how disruptive technologies, increasingly and rapidly influencing urban mobility, can have a positive impact on cities, neighbourhoods, and buildings, collaborating closely with municipalities and companies, and using Big Data for greater insights.

Transform Transport actively participates in lectures, talks, and hackathons in partnership with universities, mentoring and sharing methodologies with students. It also promotes and develops research studies, disseminating them through books, publications, conferences, public talks, and events. They have multiple projects like 15-minute City (including the Stories app) and Wher.

Motivation and Goals

The motivation to carry out this project stems from the transformation of Milan as a result of events such as Expo 2015. Milan has grown into a large city. The atmosphere is unique and exclusive. Many investments were made in infrastructure. This project's goal is to improve commuting across Milan; the city needs its residents to save time and feel safer.

Implementation

The project is implemented in the regions around the centre of Milan. They are focusing on the places most frequented surrounded by people.

The project has now been tested with women and children. They want to improve walkability for children with 15-minute city (which is based on a radical approach to urban planning that evaluates the neighbourhood scale and prioritises accessibility to daily services based on walking and cycling) because they have different needs, and they want to improve women's safety. Wher is a collaborative app that allows

women to show other women what the best routes to walk on are by providing feedback.

Outcomes and Discussion

The projects are being researched. And they are being received well. Testing with and acceptance from the public has worked well. It helped them get better insight.

The major challenge was that COVID-19 slowed everything down. Many people were not available. The future plan of the project includes qualitative analysis. They want to focus on sensor-based crowd management and street experiments.



"The 15-minute city is a sexy name for an already existing concept", head of research at Transform Transport



Data driven approach, called "urban informatics"

Project Transferability



Project Impact



Applicability to Munich

The project has a great impact. They are researching much-needed ideas, but we will know more once they are actually implemented. The project is transferable to Munich as well, as Munich is also expanding, with people living on the outskirts now and safety is always important.

The major challenge was that COVID-19 slowed everything down. Many people were not available. The future plan of the project includes qualitative analysis. They want to focus on

sensor-based crowd management and street experiments.

Outlook

The project is going well without particularly being affected by the weather and events. We already got great insights during the interview with the head of research of transform transport. However, better communication with the partners could be done as external factors influence the administrative aspects.

RAISE UB

Creating design criteria for multimodal railway stations is the focus of the project.

RAISE UB, funded by EIT Urban Mobility, takes place as a project of tactical interventions at two similar train stations in Milan and Madrid. Both stations have a low quality of space and the railway acts as a barrier. During a monitoring process, the impacts of the interventions will be evaluated.

Motivation and Goals

Multimodal travelling increases but transport hubs do not keep up to the changes in services. More railway stations become a hub for multiple modes of transport but designing the space in a high quality often lacks behind. RAISE UB is supposed to develop design criteria and standards for such nodes of transportation.

Setting standards of designing multimodal hubs is the goal of this project. It aims at defining upgraded criteria for designing railway stations as multiservice hubs. The criteria include accessibility, security, service, comfort and quality. Furthermore, the plan is to create a space for the local community and not only users of the train station. The outcome shall be a roadmap for classifying different features of multimodal railway hubs.

Implementation

The project has a one-year time frame and is located at Rogoredo station in the Southeast of Milan. Through close collaboration with authorities and the users of the train station, many helpful insights were collected which helped to come up with small interventions inside and outside Rogoredo station. Inter-

ventions mainly consist of additional furniture as well as signage and colouring of space for wayfinding.

Stakeholders

Multiple stakeholders as well as local users are involved in the project. On a municipal and technical level, AMAT, Comune di Milano, RFI and Polimi are involved by regular meetings. On a local level, ex-ante assessment used to find out about the needs of users and local citizens. A pre-intervention survey (on-site and online) with 500 participants was undertaken asking about service quality and accessibility, while it is planned to have focus groups for testing the interventions.

“Bureaucrats are not focused on solving the problem by simplification”, professor at Politecnico di Milano

KEY FACTS

500 participants were surveyed at Rogoredo station

6 months took the discussion with the company in charge of the railway station

Project Transferability



Project Impact



Outcomes and Discussion

Planning of the interventions thanks to public participation and the coordination between responsible stakeholders took place. Since it is a one-year project, the time frame is limited and long discussions with stakeholders can interrupt the entire schedule. However, local citizens and users of the train station already provided advice, and the responsibility of interventions is clarified by now.

Discussing what worked well, the Interventions are already underway. It is planned to start with short-term interventions at Rogoredo station in September. Also, finding out about failures helps to improve further processes and future projects.

The challenges faced include miscommunication and unclarity about responsibilities. It was previously planned to install additional benches for seating inside the railway station. However, it took six months and long discussions with all stakeholders until it became clear that benches installed by the municipality on the ground of the infrastructure owner are not covered by insurance. This was a big surprise for some involved stakeholders while others are used to the long processes due to bureaucracy at the side of the public administration.

Talking about future plans, interventions and their monitoring will start in September. Once the interventions are installed, multiple monitoring tools will be in use: A platform to collect information about the involvement of stakeholders, a second survey about the usage of new equipment, as well as cameras and sensors that will process the movement of people and the kind of activities that take place at the new interventions.

Applicability to Munich

The project mostly impacts on time and space. As the project aims at creating small-scale interventions in the surroundings of a railway

station, an enhanced quality of space can be reached and the time-spent at the site is highly improved too.

Regarding if the project is transferable to Munich, local challenges are small and the local context asks for improvement on this matter. The involved stakeholders match. In Munich, the governance process could be similarly difficult due to many stakeholders, and especially the involvement of Deutsche Bahn. However, the local context clearly shows that a project like RAISE UB follows Munich's mobility strategy. Furthermore, the local challenges are rather small due to the small-scale nature of the interventions. However, unforeseen problems due to the amount of stakeholders may take time and involve additional personal resources.

Outlook

Stakeholders from outside the research field, as well as local users, should have been interviewed. Talking to users of Rogoredo station and experiencing the railway station could have helped to better understand the need for change around the station. Other stakeholders, such as the railway company or the municipality, could have shown the side of the public administration and their involvement in the project. The strength of such a project stems from involving all stakeholders from the start, so issues will arise in the early stage.

(This project description partly refers to Fondazione Politecnico di Milano 2022)

GOVOLT

The company focuses on business-to-business last mile logistics.

GoVolt acts as a business providing delivery, maintenance and to other businesses and provides micromobility as a delivery service or e-moped rental to restaurants, retailers and other stores in Milan. micromobility operators in Milan. This asymmetrical business model is beneficial, because the e-scooter usage peaks in the summer, while the delivery revenue peaks in the winter.

Motivation and Goals

Bringing micromobility to Milan was the motivation of the initiative. At the time GoVolt was founded in 2017, the start-up was the first e-moped sharing service in Italy. Milan, in particular, initially seems like a city struggling with traffic, and even more with parking. According to the interview partners, as everywhere else in Europe, Italy aims to decrease vehicle ownership, electrify mobility and create more pedestrian areas.

Implementation

The service is available all over Milan. Clients simply request e-mopeds and drivers via the app. The initial sharing service was launched on 25 Oct. 2018 with a fleet of 20 e-mopeds.

Stakeholders

GoVolt initially relied on private investors. The founder was able to secure his first round of funding (190.000€) solely from his personal and professional network. The launch event of the service in October 2018 generated another (550.000€) of funding.

Outcomes and Discussion

Reimagining the business model was one significant incident that has happened during the pandemic. In the beginning, GoVolt was an e-moped sharing service. The business

however struggled to take off, the small fleet size and strict regulation being contributing factors. When the pandemic hit Italy in February 2020, GoVolt pivoted completely and turned from a micromobility service into a delivery service. The start-up seized the opportunity that presented itself during lockdown: people were only allowed to leave their houses to buy groceries. So, little by little, GoVolt started doing deliveries for businesses that did not do that at all before the pandemic: pharmacies, Michelin star restaurants, local fashion retailers, and more. At the same time, GoVolt contracted many riders. Many were people working white collar jobs from home, but desperate to get out of the house during the strict lockdown.

Relying on three different pillars to sustain the cash flow throughout the year has worked well.

- Maintaining other micromobility operators' fleets: Repairing, charging and swapping the batteries of Voi's and Bolt's e-scooter fleets has become GoVolt's second revenue stream. The e-scooter operators pay GoVolt on a task-basis for

“All shared mobility providers should be public services, but [in reality that is not the case]”, founder of GoVOLT

MILAN - Project Overview

their services. This pillar of the business is very successful as it requires no intervention of public administration, but is strictly business-to-business.

- Obtaining new scooters: The first batch of e-mopeds GoVolt bought from another startup were faulty. After two years, the legal issue was resolved and GoVolt was given a brand new fleet of e-scooters for the price of 1€ in total.

Launching a shared mobility service in a constrained Italian market did not work well for the company. The other challenges were:

- Collaborating with public administration: According to our interview partners, the strict regulation, high taxes and slow service delivery in Italy leave little room for innovation and entrepreneurship.
- Launching the service without preparation: Only after a big launch event with a lot of media attention, GoVolt found out that the android version of the GoVolt application did not work properly – almost luckily, it rained for 21 days after the launch event and no one was using the application anyways. On top of that, after an incident where a woman fell off an e-scooter and broke her hip, e-scooters were temporarily banned from Italy altogether.
- Overtaking existing mobility options: In Italy, there is a strong lobby to protect the roughly 40.000 taxi drivers in the country. This makes it difficult for new shared mobility services to flourish.

GoVolt aims to evolve from an Italian start-up to a European company. The future plans are:

- Automating the service: GoVolt is working on becoming increasingly tech-based, rather than tech-enabled. They are currently building their own last mile logistics marketplace. Such an online platform would enable the direct connection between clients and riders without GoVolt

having to be physically present in every city the service is available. This would allow the company to grow faster.

Applicability to Munich

The impact of the project mainly about air and space. Enabling other shared mobility operators to provide a better service to their customers makes micromobility more efficient as a mode overall and therefore more attractive. This in turn spurs people to use the service, which can reduce car usage and therefore improve the quality of air and space in the city.

The project is transferable to Munich. Contrary to Italy, there is regulation in place facilitating shared micromobility (Elektrokleinstfahrzeuggesetz). However, for this reason, there is also more competition on the market.

Outlook

We have interviewed the founder and the sales manager of GoVOLT. Therefore we had the perfect source from the business side.

We could have interviewed the taxi drivers, GoVOLT customers and drivers to obtain a broader perspective on shared micromobility in Milan.

GoVOLT could have done better in terms of fleet rebalancing. Currently, hybrid vehicles are being used to rebalance e-mopeds and e-scooters throughout the city.

“There is a fight against innovation [in Italy]” and “a good idea can still fail if it is carried out by bad people. A bad idea can still be turned around into a good one by good people”, founder of GoVOLT

KEY FACTS

300 e-mopeds in Milan

8.2 million Euro evaluation

2 to 2.5 km average delivery trip length

Project Transferability



Project Impact



BIKEMI

BikeMi is Milan's bike sharing program.

It is an actual mode of public service that can be used to go around the city and integrates with the ATM network (the public mobility system).

Motivation and Goals

BikeMi is a convenient alternative to both public transportation and private cars. Milan is very flat & the weather is rarely extreme. These two facts make the city ideal for bike sharing systems. The initiative is effective in promoting cycling as a sustainable mode of transportation.

There is a significant pollution issue in the city centre due to traffic and overuse of cars. The project focus to transform the "bicycle trend" into a passion and make cycling a common tool for everyone.

Implementation

The project has been implemented since 2008 & started with mechanical bikes. BikeMi is contracted to and operated by Clear Channel based on its SmartBike system. The company won a public tender in Milan organised by ATM, Milan's transport authority. In Milan there are 321 stations with 12-49 docks per station and around 13.000 trips per day. Three virtual ones are being tested. Clients can book bikes via the BikeMi app.

Stakeholders

The company, Clear Channel won a public tender held by ATM, the city's transportation authority. So now Clear Channel manages and operates BikeMi. It has got a wide public customer base as well.

Outcomes and Discussion

BikeMi has already been developed as a popular bike sharing system since started in 2008 with mechanical bikes. In 2018, e-bikes with child seats have been introduced. 1000 e-bikes were available during the Expo, and 150 e-bikes with child seats were later added (paid for by the EU Sharing Cities project). Previously, only the BikeMi card was required to use the app and card. New bikes were introduced in 2019, which are more flexible, modular, and compatible with the software. In 2021, 3 temporary virtual stations have been set up.

There has been an increase in trips ever since e-bikes were introduced. As the service was open-air, the pandemic had less of an impact than other modes of transport. It revealed a mixed trend, with fewer trips in 2020 but more in 2021 than in 2019. Pandemic-related station sanitation (cleaning saddles, handlebars, and brake levers) was implemented; it was discon-

6000 bikes in Milan

KEY FACTS

1150 e-bikes

25 vans continuously rebalance bikes among stations



MILAN - Project Overview

tinued again around April 2022. Since 2022, a partnership with Google has provided real-time analytics that display nearby stations and the number of bicycles and e-bikes when you type "bikemi."

However BikeMi has a few significant problems to mention: Rebalancing the stations, managing vandalism & shortage of customer care employees. Only 50 to 70 employees are managing the maintenance warehouse, which adds to the chaos besides managing repairs and battery swaps. With 25 vans, rebalancing the stations is cluttered (full in the morning, empty in the afternoons). Financial hardships are caused by the high cost of salaries, fuel, van rentals, and bike parts replacement. The station-based model is not as appealing to tourists because the metro is less expensive and they are not familiar with station locations. Also, since the introduction of Milan's free-floating service in 2017, BikeMi service usage has declined. 13000 trips per day now, compared to 25000 trips per day in 2015. The free-floating model creates chaos, congestion, and clutter in the city; therefore, it is best to improve the station-based service. Vandalism at stations remains a problem (e.g., the station at Central train station is broken once a week). Customer service is handled by 5 employees who respond to emails. Most complaints are about issues arising when bikes are released at stations, and phone calls are diverted to an ATM hotline. This problem has happened to us during our stay, and it took them two days to respond and resolve it.

BikeMi's future plans could be summarised as: understanding travel patterns and building flexible virtual stations

- Virtual stations that are flexible! Add more virtual bike stops at current stations or at other locations as needed and equip all bikes with the necessary smart locks. For e-bikes, it is straightforward; for mechanical cycles, it is more challenging. An idea is to use a dynamo or a solar

panel in a basket. The issue of rebalancing is resolved by virtual stations, but the issue of recharging e-bikes is not.

- Implementing Google's Lucre - the business intelligence tool to forecast how the upcoming year will go, import all historical data from the last 12 years to comprehend daily peaks and travel patterns.
- Ideas for cargo bikes and customised bikes for the elderly are also being considered.

Applicability to Munich

By encouraging sustainable mobility, the initiative aids in climate protection. Many people are drawn to cycling by Bikemi's convenience, accessibility to stations and since they offer special rates to students, it's also advantageous. It makes the city more accessible, lowers emissions, and offers an alternative to increasing the number of cars on the road.

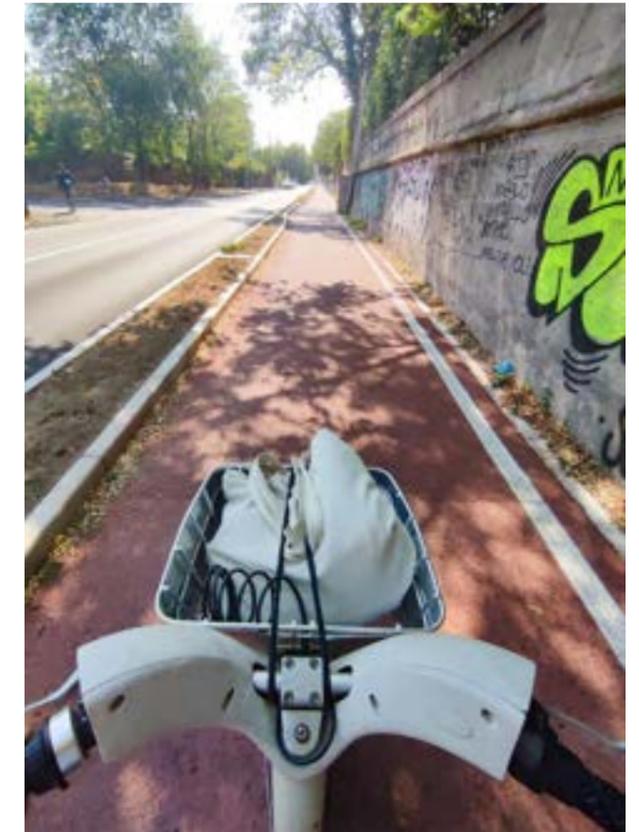
Munich has a similar service called MVGO, but it is not as large as BikeMi. For instance, the partnership with Google makes it simple for BikeMi to access the location of stations and see how many bikes are available. Thus, it makes things easier for people and tourists. Munich suffers from the free-floating problem as well ; there are a lot of providers & options to choose from, which congests the paths. It is important to improve the station-based service. Upgrading virtual stations and deriving insights in Munich would be beneficial. Also student special tariffs offered by BikeMi was attractive.

Outlook

So far the initiative is running fine even though pandemic made a mixed impact in the service. The number of rides were decreased in 2020 & increased in 2021, them more than 2019. We interviewed the bikesharing manager, for BikeMi (Milan) & VeronaBike (Verona) at

ClearChannel and then visited one of the stations near the headquarters. The interview was very insightful, also, we could have interviewed the regular users of the service to derive some non-organisational perspectives.

One of us has encountered a problem since we began using the service. The system does not show that the bike was returned after use due to a technical error. Because there were not enough people to address the issue, BikeMi continued to charge her until customer service resolved it, which took 2 days. Therefore, one suggestion is to hire more people and improve customer service.



Project Transferability



Project Impact



CITYFLOWS

The project is about crowd monitoring in Milan Central Station.

Using pedestrian monitoring and tracking, computer vision techniques, speed and density heat-maps, and real-time video streaming, the crowd has been monitored.

Motivation and Goals

Events in Milan like Salon di Mobilia is the motivation to carry out this project. Milan has hosted & managed big events and they are interested in such projects because many people visit the city. They measure the speed, density and direction of the pedestrians.

The city need it to recognize patterns in the movement of people. By using AI they are better prepared to react immediately.

Implementation

Three sensors have been installed near the gates. Because they use a solar battery, they were designed as stand-alone instruments (sensor setups). They've also tried it in Amsterdam (AJAX Arena) and Barcelona (Parc Guel). They shared information in order to standardise the process.

Stakeholders

Stakeholders include the City of Milan, EIT Urban Mobility, AMAT, AMS, TU Delft, ENEA, and Capgemini Engineering.

Outcomes and Discussion

It was a short-term project that had already completed. They are now using the instrument that was designed for other purposes, such as traffic flows. During COVID-19, the project was put to unexpected use: it was used to control people and keep them at a safe distance.

However, there was less data collected during COVID-19 because people moved around less, but enough to draw conclusions.

The program's findings will be useful for future projects, while ensuring data protection.

Applicability to Munich

The impact of the project: knowing and understanding people's behaviour It is important and helpful to know how people act in the busy parts of major cities.

The project is transferable to Munich. Munich also has many similar events. Therefore, there is a high applicability index.

Outlook

More time would have been needed to evaluate the project's impact. Our interviewee worked in AMAT's Development of Innovative Mobility Projects department. Other stakeholders should have been interviewed as well to get their perspectives. More time could have been allotted to the project. More data that could have been analysed for more solid understanding.

“While the project was planned before COVID 19, it helped in social distancing during the pandemic”, mobility planner at AMAT

KEY FACTS

2 years duration instead of 1 year due to the pandemic

Project Transferability



Project Impact



NUMIDAS

Numidas is about a new mobility data and solutions toolkit.

Numidas is a cooperative research project between Italy, Czech Republic, Greece, Belgium, the Netherlands and Spain. It started January 2021 and will be completed December 2022. In these two years, the Numidas consortium wants to design tools to help municipalities plan mobility in their cities better. Concretely, four cities were chosen: Milan, Leuven, Barcelona and Thessaloniki.

Motivation and Goals

The innovative use of mobility data is the motivation to carry out this project. The idea behind Numidas is to identify new ways of collecting mobility data and subsequently using it to solve mobility challenges in European cities. The tools should be designed with simple and clear input parameters, keeping in mind that the final user does not have to be an expert on shared mobility.

The tools will help Milan regulate shared mobility. In the case of Milan, two tools are being developed to assist the city in specifying the conditions to enter the city as a sharing operator, be it car-, bike-, moped- or e-scooter-sharing. Previously, the sharing market in Milan was “free” – anyone could enter without having to prove the economic sustainability of their business model. In one example, an e-scooter operator placed many e-scooters in the city, only to go bankrupt one year later and leaving the city to get rid of all the e-scooters scattered across the streets. In the future, with the help of the Numidas tool, sharing operators will have to adhere to a given fleet size, service area and additional requirements such as electric vehicles. This will not only help Milan regulate shared mobility better, but ensure that all operators survive economically.

Implementation

Numidas is being implemented in Milan, Leuven, Barcelona and Thessaloniki. In every

city, the project is divided into three phases. First, the state of the art is reviewed: urgent needs, main issues and data were discussed in workshops with city representatives and public transport authorities. Based on that, solutions using mobility data were developed. Lastly, the project team will assess how the tools (tailored for one specific city) can be generalised so they can be transferred to other cities, while maintaining an acceptable level of accuracy.

Stakeholders

The outline for the tools were developed in workshops. The development of mobility planning web tools relies on the cooperation between the universities and municipalities in each city. In the case of Milan, Poliedra acts as the intermediary between AMAT, Milan’s mobility agency, and the larger European project consortium. Citizens are not directly involved in this project.

Outcomes and Discussion

Designing mobility planning tools according to the needs of every participating city has happened so far. Solutions are almost completely developed for every location. In Barcelona, the tool will help cities improve origin-destination matrices based on road-side video footage and help forecast air pollution. In Leuven, the tool will help measure the traffic impacts of reduced parking. In Thessaloniki, the tool aims to measure travel demand, such as the

KEY FACTS

6 mobility planning web tools for Milan, Barcelona, Leuven and Thessaloniki

2 sharing tools created specifically for sharing operators in Milan



Figure 18. User interface of one of the tools (source: kindly provided by Numidas).

“Tools to help cities regulate fleet sizes and service areas guarantee sharing operators economic sustainability”, engineer from Numidas

MILAN - Project Overview

estimated effect of lane direction changes. In Milan, two tools are being developed to estimate the service area and fleet size of sharing operators, respectively. The tools will be available for all kinds of sharing operators (car-, bike-, moped- and e-scooter-sharing) and operating models (station-based or free-floating).

Cooperating with local partners and the project management has worked well. Along with:

- Sharing data and experience: AMAT (the Municipality of Milan's in-house mobility agency), is very interested in the project and therefore readily shares data that can serve as input for the tool. The project management team in Leuven organises two meetings a week. According to our interview partners, this regular and intense exchange of everyone's progress contributes to the project's overall success.
- The Milan tool was split in two (one for the service area estimation, another for the fleet size estimation). This was done so the estimation of each variable can be done independently from the other, depending on which data is available and what the exact use case in a given city is.

The real challenge was balancing optional data with the accuracy of the tools.

- Developing open tools: Initially, the idea was to develop tools that are free and open to use to anyone – other cities, researchers and sharing operators. However, in the course of the project it was decided that in-house solutions are preferable as the tools require sensitive information. For example, sharing operators are reluctant to share their data on fleet sizes and vehicle movements.
- Aggregating data for the tools: In line with the previous point, it was difficult to acquire and aggregate input data for the tools. On the one hand, precise data for one location (in this case, Milan) would

improve the accuracy of the tool. On the other hand, aggregated data must be used to circumvent the sensitivity of the information. On top of that, data that is readily available in one city might not be available in another. Deciding which input parameters are optional and which are required is therefore an intricate balancing act on the way to creating generalised, but still useful tools.

- Sharing data and experience: While the cooperation worked well with AMAT and Leuven, cities where there is no smooth connection between the municipality and research institutions were slow in providing the right data. Our interview partners explain that they come across this problem often: people working at municipalities are very busy with their day-to-day tasks, while research projects are an add-on whose benefits can only be seen in the very long-term, if they are tangible at all.

Through the future plans Numidas are being taken to the next level.

- Cross-testing the developed solutions: Currently, the respective tools are customised to the city they are being developed for. In the last phase before the project's completion at the end of the year, Leuven, Milan, Barcelona and Thessaloniki will cross-test each other's tools to see what has to be adapted to make the tools more generalised and usable by different cities. For example, an input parameter such as the city's neighbourhood boundaries (i.e. a shapefile) will be required, but an expected demand curve for the sharing service could be approximated from Milan's data.
- Deciding on a business model: Currently, the project team has to decide if they want to turn the developed solutions into businesses or if they want to apply for European funding again and continue funding the project this way. Since Poliedra is a non-profit institution attached to the Politecnico

di Milano, they are more interested in the second option. This is an important decision to make as the tools are hosted on Amazon Web Services, which costs approximately 100€ - 200€ per month in addition to the maintenance of the web tools.

- Addressing the relocation issue: For this project, the tools are all designed as planning tools, not operations tools. This means that the relocation issue all sharing operators have – too many vehicles in one area, too little in another – are not handled by the designed tools as is. In future, the tool could include a functionality calculating relocation-based tariffs. This way, cities could specify where sharing vehicles may park, where parking is cheaper etc. Especially increasing demand in periurban areas would benefit from this.

Applicability to Munich

Time reflects the major impact. Improving the distribution of e-scooters across cities by bal-

ancing their fleet sizes and service areas will not only improve the accessibility of clients to the services, but also improve the quality of experience in the city (if the city is not cluttered with e-scooters). At the same time, improving the process will save cities time.

The project is transferable to Munich. The project does not contain any major risks in terms of governance, local context or local challenge. The only challenge would be the availability of data for using the tool.

Outlook

The Municipality of Milan and AMAT delegates could have been interviewed. Understanding the project from the perspective of the other partners could have provided further insights.

The project could be done better by creating an open-access tool. It is understood that the tool deals with sensitive data. However, providing it in a manner that does not require this data could make it useful for many cities rather than a select few.

Project Transferability



Project Impact



IPA2X

IPA2X aims to create safer street crossing for children, the elderly and people with disabilities.

The project is a result of an alliance between European living labs, research institutes, and OEMs on improving pedestrian crossings and accessing the user acceptance of robots. The project is supported by EIT Urban mobility, an initiative of European Institute of Innovation and Technology (EIT), a body of the European Union.

Motivation and Goals

Innovative solutions to contribute to traffic safety is the motivation to carry out IPA2X.

The project's main goals are to develop a human-centric, user-friendly autonomous zebra pedestrian assistant and to increase pedestrian safety, particularly for children, people with disabilities, and the elderly. Other objectives include encouraging active mobility, focusing on new urban spaces, and reducing the costs and efforts of local police forces.

The city of Milan needs it to reduce dependency on the police force. Parking issues are particularly challenging for school children. In Milan, there are 150 schools, and 50-60 police officers work two-hour shifts to assist children crossing the street. The project's goal is to reduce reliance on police forces to cross roads during peak hours. IPA2X will send signals to cars that detect people from a distance of 50-60 metres.

Implementation

The project has a one-year time frame and it is planning to be implemented in three pilot and living lab sites: Milan, Ljubljana, and Modena. The project began with the idea that modifying Lifetouch Srl's delivery robots could be used

for safe road crossing. The modified robot can alert car drivers when an object is in front of them. Because the goal is to alleviate the chaos of road crossings caused by car traffic and parking issues, the mode of transportation is primarily being developed to communicate messages with car drivers. Along with ensuring safe road crossing, the robot can also detect cyclists.

TUM, AMAT, CVUT, Evidence Srl, Hipert Srl, Lifetouch Srl, and Skoda Auto collaborated closely to design the solution. Considering the living labs, the target group in Milan and Modena is schoolchildren, whereas the AV Living Lab Ljubljana is the elderly. The pilot will be carried out in Milan in collaboration with the police department, teachers, school officials, a mobile operator, and AMAT. The pilot will take place in Modena's Automotive Smart Area, a real urban laboratory equipped with infrastructure and 5G IOT capabilities. The Ljubljana pilot would be organised by AV Living Lab, a living



**“The real challenges are yet to come”,
coordinator of IPA2X**



KEY FACTS

5G allows communicating between zebra crossings and vehicles

Walking is encouraged



Figure 19. IPA2X in action (source: <https://rtsl.cps.mw.tum.de/ipa2x>).

MILAN - Project Overview

ecosystem and SME dedicated to the development of future human-centric mobility solutions.

The developed robot has a shelf life of at least 3-5 years and is priced between 10,000 and 15,000 Euros. Municipalities are the intended buyers, and the police force will be the primary beneficiaries.

Stakeholders

Multiple stakeholders and researchers are involved in this project.

IPA2X is a collaboration between various partners, including Technical University Munich, AMAT-the affiliated partner of the city of Milan, Czech Technical University in Prague (CVUT), Evidence Srl-a company specialised in real-time operating systems (especially on autonomous robotic systems in multi-domain applications), Hipert Srl-UNIMORE's spin-off where more than 40 researchers are developing algorithmic and software solutions, Lifetouch Srl-an AI & UX design automotive SME, focusing on the development of next-gen autonomous robots, and Skoda Auto.

Outcomes and Discussion

The coordination between responsible stakeholders took place and the product is at its final stage. Since it is a one-year project, the time frame is limited and the stakeholders actively participated together to meet the deadlines. The first demo of the full systems will happen by the end of September, 2022 and the demo in Milan is scheduled around October, 2022.

Coordination and communication within the time frame worked really well. Despite the challenges and constraints, coordination with various stakeholders was great. The project also had to face different challenges, including changes in management and hectic work. A major stakeholder dropped out of the project in the middle. Also, there was a massive amount

of work that needed to be done between March and May, and the coordination team had to work nonstop.

The major challenge of implementing any new technology is the unknown & uncertainties. According to IPA2X, one uncertainty that lies ahead is how to scale up the business, as well as how efficient the real demo would be. Also, due to the time frame & other limitations, testing has not been conducted in areas that would normally experience extreme weather, such as foggy, snowy, or hilly terrain. The robot is therefore only appropriate for an urban flat path setting.

The overall impact and outcome is yet to be known as the final demonstrations are scheduled in the real environment for the end of September and October of 2022 for Milan.

Applicability to Munich

To address traffic safety, the project combines top-tier expertise with technological advancements & it is yet to be implemented. School children, elderly & people with vision and/or mobility impairments would benefit from the robotic system that assists them in crossing the streets safely.

There is no chance that the project is immediately applicable in Munich because the commercialisation of the product targets municipalities as their primary buyers. The police force, which assists in road crossings in Milan because of traffic issues, is the main beneficiary. Things are organised in Munich comparatively. Verkehrshilfe, the senior force that assists children in crossing the road, serves in place of the police. Therefore, the idea is optional rather than necessary.

Outlook

An interview was conducted with the coordinator of IPA2X, who is also a research scholar at the chair for Cyber-Physical Systems in

Production Engineering, Technical University of Munich. The interviewee was the overall coordinator of the project, which was very resourceful. What could have been done better is to conduct the interview at the end of the demonstration, which due to the limited time frame of euMOVE, we could not have done either.

At times, IPA2X has been slowed down due to the lockdown, and the team has had to work hard to meet the deadlines. One year was a bit short as this is a fantastic technological concept. Perhaps adding another year to the timeline would not have created such a rush.

Project Transferability



Project Impact



A-ROUND CORVETTO

It is an abstract student project of tactical urbanism which took place during the first phase of the pandemic.

A-round Corvetto was a student project located at Piazza Corvetto in the southeast of Milan. It established ideas to change the Piazza partly towards a more pedestrian-friendly infrastructure, a meeting point for locals as well as a place for local economy and events.

Motivation and Goals

The motivation for carrying out this project is to find ideas for tactical urbanism in Corvetto and

create a profound strategy of public participation. It was part of a seminar at Politecnico di Milano on tactical urbanism during the first phase of the pandemic. Besides addressing the challenges of the COVID 19 outbreak, a better understanding of local conditions was key to realise the project by working closely with local stakeholders.

The goal of this project is creating a collective space that connects people, different realities and varying cultures. The project aimed at providing tactical urbanism interventions on a short-term level to overcome the challenges of the pandemic, e. g. providing more space for pedestrians and allowing social distancing as well as overcoming safety issues in the area. On a long-term level, further interventions changing the street design and hence mobility patterns were contemplated.

Implementation

The project took place in Corvetto, a marginal neighbourhood of Milan, on a small-scale level. As the project was part of a seminar, it was

not part of the course to realise the developed interventions on-site but provide ideas for tactical urbanism to the municipality, but the communication with the city stalled. No idea has been realised since 2020.

Stakeholders

A major part of the project was the co-design session with local stakeholders. The participation process was well-thought-out and included a survey with citizens (distributed through local community associations), expert interviews and two co-design sessions with local stakeholders (e.g., a kiosk owner and representatives of local associations). Due to the pandemic, it took place virtually using Skype and Miro.

“It’s difficult to work with institutions in Italy”, team member of A-round Corvetto

KEY FACTS

1st phase of the COVID 19 pandemic needed immediate action

2 days spent in online workshops with local participants

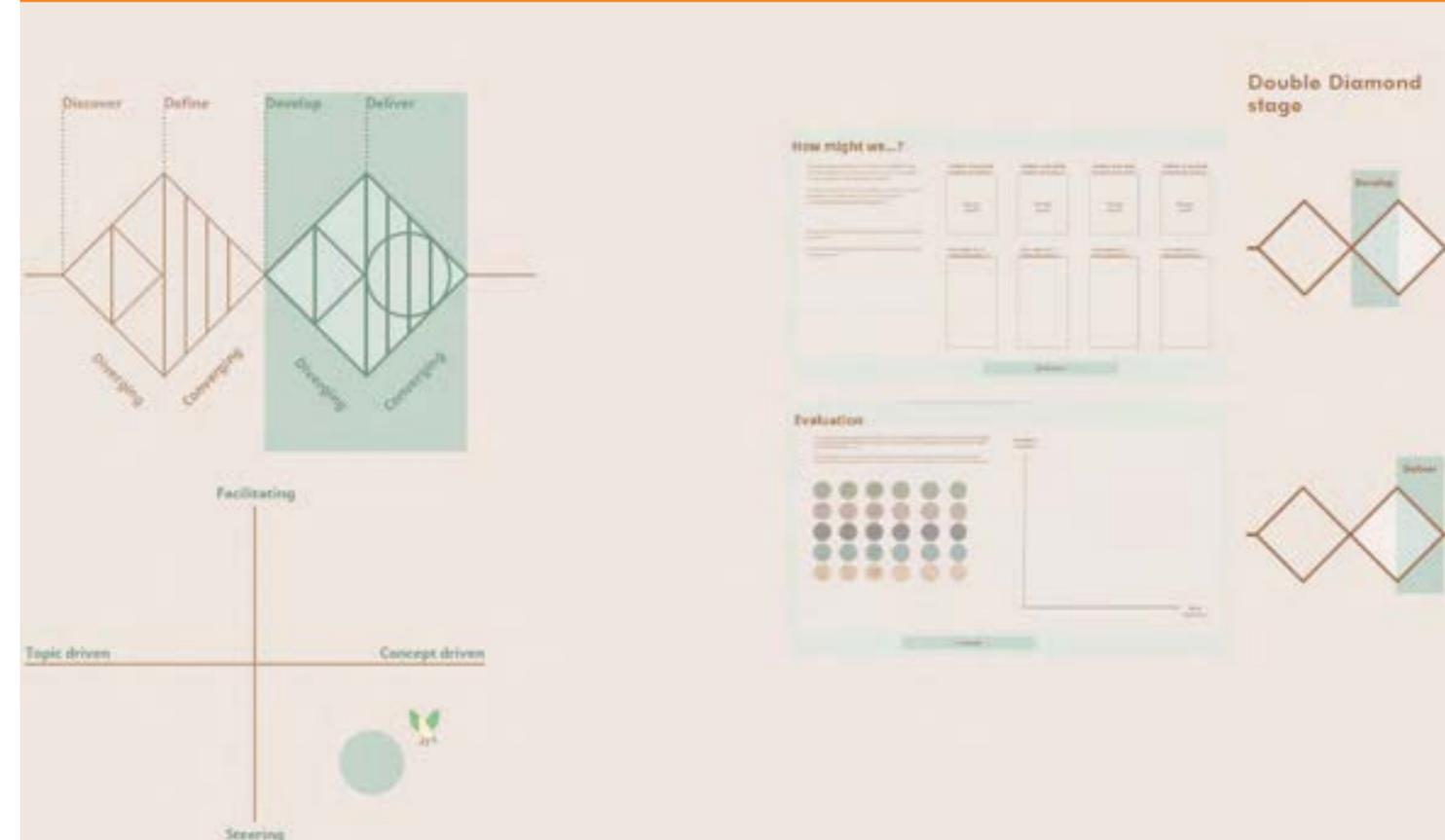


Figure 20. Double diagram, the methodology used during online workshops (source: kindly provided by the team of A-round Corvetto).

MILAN - Project Overview

Outcomes and Discussion

The project went through all phases, from an analysis to final ideas of interventions. The project took place from March to June 2020 and ended with a final report about the spatial and community analysis, the proposals, the codesign session and the final interventions for after 2020 and beyond 2030.

The necessities of the local community were incorporated at every step in the project. Especially the codesign session went well in this project. Despite the pandemic, a close, completely virtual collaboration with local stakeholders was achieved. A survey with 25 participants as well as two sessions with five members of the local community took place during the course of the project. The fruitful interventions were only possible thanks to such close participation, and listening to the needs, wishes and ideas of the locals.

The major challenge was that no further implementation by the municipality took place. Further follow-ups with the municipality were planned but bureaucracy hinders the project from implementation. As for now, no further steps are planned for the project.

Applicability to Munich

The project has a strong impact on time and space. Milan is a best-practice example of street experiments and the redesign of public space, especially public squares. A-round Corvetto directly addresses the redistribution of space and enables communities to grow together; hence, shortening distances for residents to gather, to spend quality time in a livable and safe space, and to do their daily errands and shopping. By incorporating the local economy, businesses as well as residents profit from a stronger local commerce. On a long-term perspective, even air is impacted by decreasing numbers of cars and adding more greenery to the streetscape.

The project is transferable to Munich, but the bottom-up approach of A-round Corvetto could be a limitation to typical processes in Germany. A project developed by local students as well as the local community is an approach right from the "bottom". It incorporates local needs thanks to the participation and uses innovative approaches and out-of-the-box thinking by the students. Transferring this to a project realised by the city of Munich may be restricted by bureaucracy and existing regulations. However, by working closely with students and providing time and space to them as well as a test bed for new design, such a project could be quickly realised in a very cost-effective manner.

Outlook

We have conducted the interview with two former students of MSc Interior and Spatial Design at Politecnico di Milano, also collected additional data from the report (Albano et al., 2020). The local citizens and stakeholders should have been interviewed in addition. So that local users of Piazza Corvetto and their current sensation of the public space could have provided a better understanding of the project and its needs. By talking to the supervising professor or the municipality, one could have brought the actual barriers of implementing A-round Corvetto to light.

The municipality should work in close collaboration with universities and students to develop new strategies and broaden the expertise.

(This project description partly refers to Albano et. al 2020)



Figure 21. A-round Corvetto masterplan (source: kindly provided by the team of A-round Corvetto).

Project Transferability



Project Impact



STRADE APERTE

It improves street designs to a more pedestrian- and cyclist-friendly infrastructure.

After Piazza Aperte, the next project by the municipality was Strade Aperte as immediate answer to the COVID-19 pandemic. It is part of Milan's "Adaption strategy" in 2020 towards a more sustainable mobility, based on planned actions of Milan's Sustainable Urban Mobility Plan (SUMP) from 2018.

Motivation and Goals

The project intended as a quick and immediate answer to new mobility patterns as a result of the pandemic. The Milanese realised the importance of public space in the direct surroundings of their homes during the first lockdown but its limited availability due to cars. The pandemic provoked a mental shift, and the municipality reacted quickly by implementing Strade Aperte. In addition, an amendment of the Highway Code allowed new design methods for cycling paths after September 2020.

Providing more and better cycling infrastructure is a key towards sustainable mobility is the key of the project. The modal shift of cycling in Milan was at around 5% for the last centuries. Already in 2018, the city had envisioned a large push of cycling as part of the SUMP. The pandemic accelerated this process and a year-long debate about changing the regulation of cycling paths came to an end when new design measures became part of Italy's Highway Code. These adaptations of the regulation were a psychological opportunity during the first phase of the pandemic that called for quick reactions of politicians.

Implementation

The project is carried out in the entire city along planned cycling corridors. Since the publication of Milan's new SUMP in 2018, 72km of new cycling lanes were already added to

Milan's cycle network until 2021. Main interventions took place as experiments all over the city while Corso Buenos Aires, Milan's most famous shopping street, and Via Monza was the most famous project. Furthermore, projects such as "Città 30" (30 km/h zones), an improvement of inter-modality, creating public spaces on streets, sidewalk expansions and parklets were part of Strade Aperte.

Stakeholders

The project has a close collaboration with Cambio and the Open Street Maps for public participation has been used. The city's task in improving the cycling network ends at its borders with the region but the need for a comprehensive network does not start here – the project of Cambio continues and stretches out into the metropolitan region. In addition, a citizen-created platform on the base of Open Street Maps (OSM) shall combine all recent mapping initiatives in the city and enable a fast reaction to citizen requests as well as sharing the data with all citizens.



"This can be the lesson for you: a simple rule change can have a deep effect" and "without the pandemic, we would not have [cycle lanes in Milan]", senior specialist at AMAT



5% cycling mode share in 2003 and 2018

16% increase of cycling mode share on Corso Buenos Aires from 5% in 2019 to 21% in 2021

35 additional kilometres of cycle paths thanks to Strade Aperte from 2019 to 2021

KEY FACTS

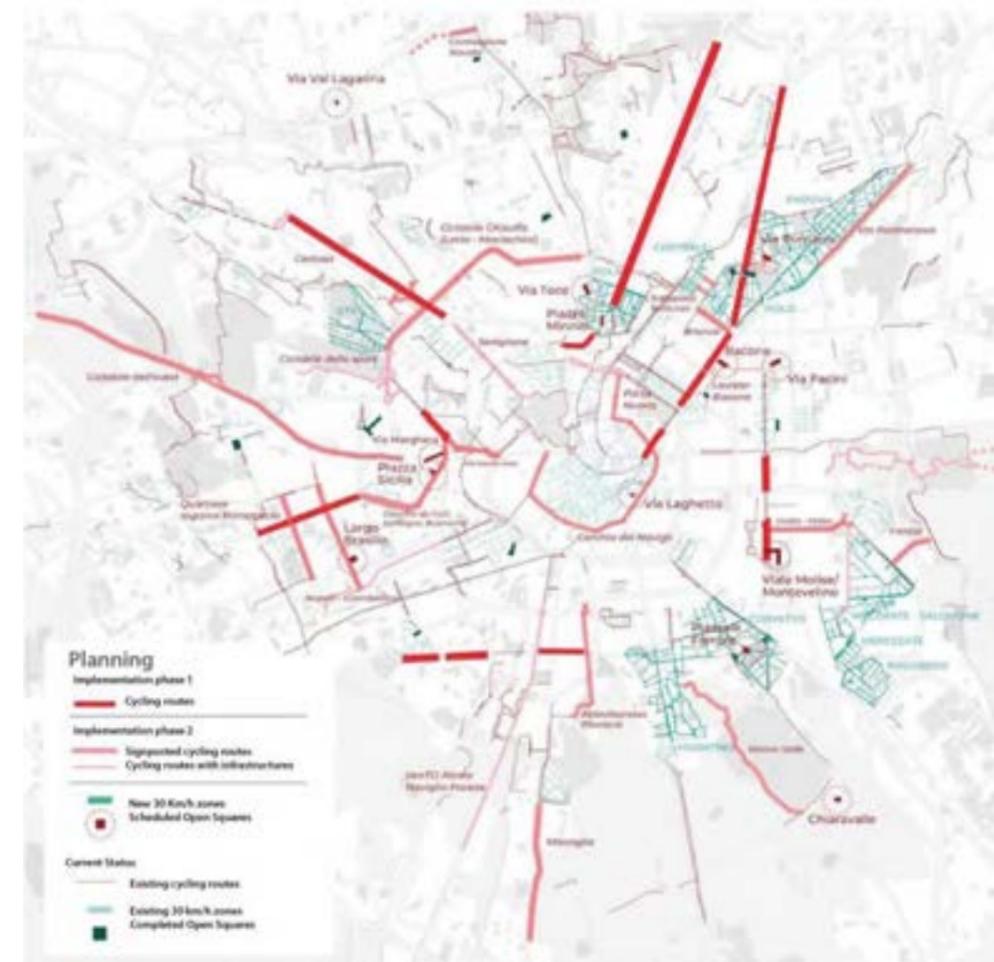


Figure 22. Strade Aperte project locations (source: kindly provided).

Outcomes and Discussion

Many interventions were realised in 2020 and 2021. Additional 35km of cycling paths were created as part of Strade Aperte. The adjusted regulation allowed more interventions such as:

- 1. Improved signage, 2. "parking-protected" signage (parked cars separate moving cars and cyclists), 3. improved street markings, 4. two-way cycle lanes, 5. traffic interventions such as speed bumpers, 6. the introduction of shared streets, 7. sidewalk expansions, 8. pedestrian areas, 9. parklets.

Moreover, some of the interventions were monitored and evaluated showing results of increased bike usage. More monitoring as part of the citizen-created platform by OSM is planned.

The project has many positives including the pandemic accelerated the process of implementing interventions.

- Quick implementation: The additional 35km of cycle path, besides the 72km that was planned already, was implemented very quickly in about one year. The pandemic was used as opportunity to realise a shift in transportation and implement a more sustainable infrastructure.
- Rising numbers of cyclists: The counting station of cyclists on Corso Buenos Aires proved that the new cycling infrastructure is very successful, with a mode shift from 5% up to 23% during certain times. On average weekdays, 6,471 cyclists use Corso Buenos Aires (no comparison number to before although), with peaks of more than 10,000 cyclists.
- Safety: Overall, the entire development of the cycling network increases the safety for vulnerable road users. In some parts, parked cars block cyclists from moving cars.

Still, regulation is lacking some opportunities for intervention and it is unclear how the public was involved in the processes. The challenges are:

- Previous infrastructure construction: In one mentioned example, the renewing of a cycling path took more than eight years since three different companies failed. In addition, there were only a few companies for this task.
- Public participation: When talking to Ciclobby, the cycling lobbyists in Milan, they never heard about the project of "Strade Aperte" which can lead to the conclusion that the public was not involved in the processes.
- Missing regulation: Many interventions, that are standard in Germany, the Netherlands or Denmark, are not allowed in Italy, for example the opening of one-way roads for cyclists.

The future of the project is that Milan wants to become a cycling-friendly city as it has very good conditions.

- Cambio: The creation of a region-wide cycling network, not only for leisure but for all daily moving patterns.
- More interventions allowed by regulation: Urban cycle roads (streets dedicated to cyclists) and school zones (particular precautions of behaviour are in force)
- Data collection: By the citizen-created platform and the use of OSM, more data is collected about the current infrastructure. For example, currently all intersections are evaluated if they still have high curbs at pedestrian crossings.

Applicability to Munich

The project has strong impacts on air and time. The development of a cycling network in Milan affects the modal shift, improves accessibility and the quality of the streetscape. The

example of Corso Buenos Aires and Via Monza shows that people are willing to shift to cycling instead of driving. Hence, a more sustainable mobility is created, emissions are reduced and the health of cyclists, as well as all other city-users, increases.

The project is transferable to Munich, but residents should have the option to participate right from the beginning. Germany's regulation is already more bike-friendly than Italy's. Hence, many of the interventions are already possible in Munich or have been implemented by now due to Munich's Radentscheid. However, both cities can see further improvement for cyclists, and Milan's fast processes during the pandemic should be a motivation for Munich to become as fast or even faster in realising cycling projects. Especially resources limit a faster growth of cycling infrastructure in Munich but also getting all stakeholders on board is sometimes difficult.

Outlook

Cycling in July is rare. As the month, during which the team visited Milan, is one of the hottest of the year in Italy, the number of cyclists seen on streets is lower than in months such as May or September. However, e-bikes and e-scooters were seen more frequently. The interview was with a senior specialist at AMAT, who is responsible for active mobility and accessibility. By talking to Ciclobby and Cambio, as well as researchers, a broad picture on cycling could be developed throughout the stay in Milan.

Close collaboration with the public could have been done better. It was surprising to us that Ciclobby did not know about Strade Aperte. This indicates that the project was top-down, only planned by the municipality but without listening to actual users of the infrastructure. Here, more collaboration is needed to learn about specific local circumstances and to gather more perspectives.

(This project description partly refers to Comune di Milano 2020)

Project Transferability



Project Impact

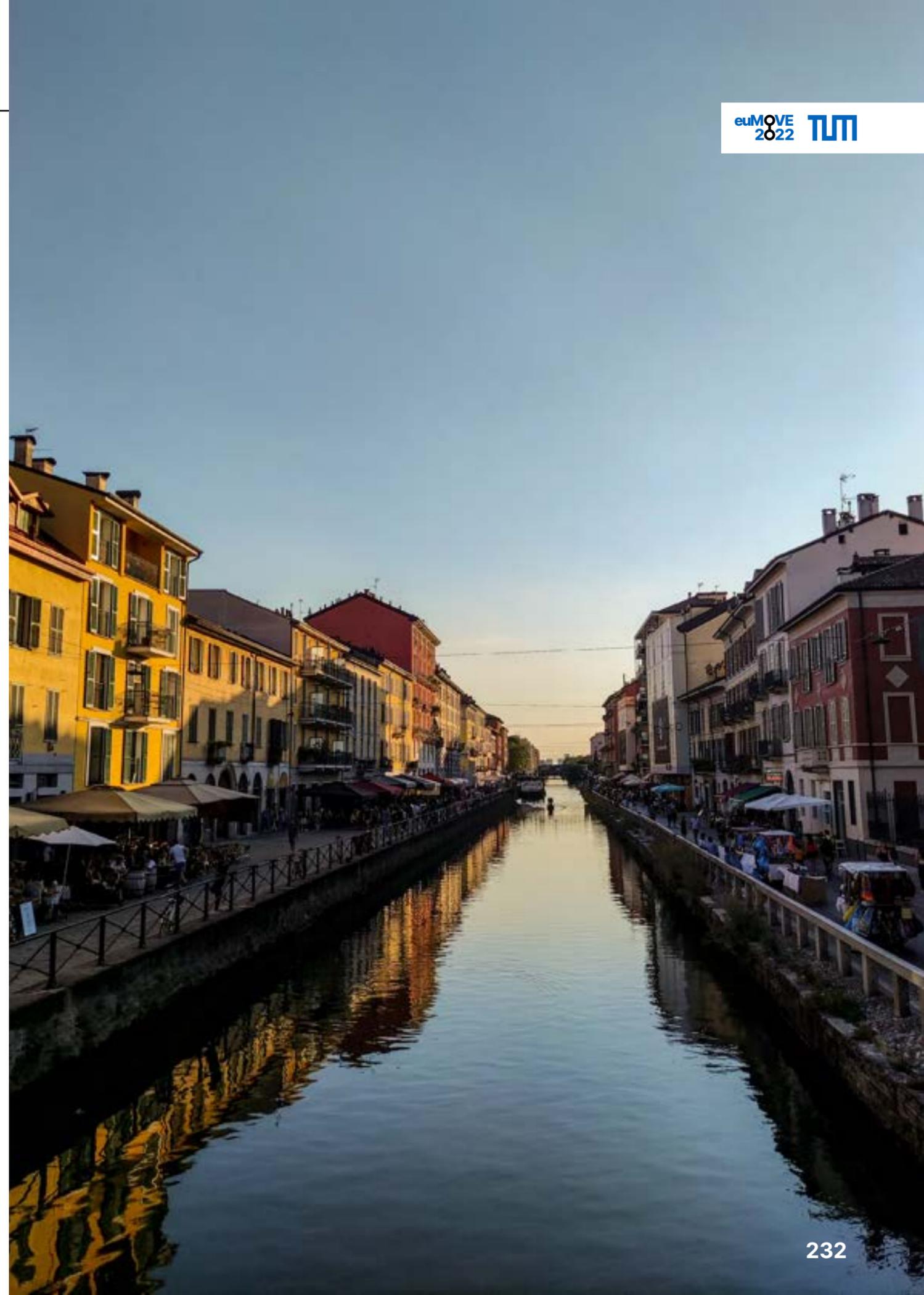


CONCLUSION

Milan is a city where old meets new, where tradition and modernity happily co-exist and where the established and the innovative complement one another. It can be seen on every level, from mobility to housing, to culture and food: in Milan, hundred-year-old trams run alongside autonomous metro lines; in the Isola neighbourhood, vegetation-covered skyscrapers rise next to classic Italian terracotta buildings; the opera at the Scala is as popular as the open-air festivals are busy; and the pizza in the Navigli district is as recommendable as the dumplings in Chinatown are appreciated. In the past twenty years, Italy's fashion and design capital has experienced rapid growth and internationalisation. This development was accelerated by the World Exhibition in 2015 and the annual design and fashion weeks. According to our interview partners, this trend towards becoming an "event city" is solidifying itself, on the one hand challenging the city's transport network, but on the other hand also accelerating progressive urban mobility planning. In a nutshell, Milan is to Lombardy what Munich is to Bavaria: both cities are the bustling economic center of an entire region. Both cities offer a plentitude of job opportunities, education, and entertainment to their citizens. On the downside, increasing rental prices plague both regional capitals, pushing people towards housing on the cities' peripheries, thus rendering equitable access to mobility ever more important.

In Milan, mobility projects rely on early and frequent communication and cooperation among all stakeholders, especially citizens, to be effective. The ["Piazze Aperte"](#) and ["Area B and c"](#) projects show that proactive citizen participation avoids projects missing the mark. Similarly, the ["CAMBIO"](#) project is exemplary in terms of cooperation beyond administrative borders. What Munich can learn from Milan in terms of cooperation is formalising and simplifying the engagement process and targeting specific audiences that have pronounced interest in change. This can spur acceptance and deliver more satisfactory results faster. Milan's approach to mobility innovation centres on harnessing mobility data. ["Transform transport"](#)'s urban informatics approach, ["BikeMI"](#)'s flexible virtual stations, ["CityFlows"](#)'s crowd movement monitoring technology, and ["Numidas"](#)'s shared mobility regulation tool all aim to solve practical problems the city's transportation system is facing. Milan shows that analysing existing mobility data to tackle concrete problems and essentially quantifying the need for change fosters innovation and supports policy makers in their decision-making process. In Milan, overregulation tends to throttle innovation and results in a lack of compliance. Despite being a flat city that is perfect for cycling, the Milanese drive and park their cars everywhere, as the city has no urban police control to enforce speed limits or parking restrictions. On top of that, the strict street design code is outdated and very car oriented. Only recently was it amended as Covid-19 revived Italy's interest in quality public space and cycling infrastructure, as can be seen in the ["StradE aperte"](#) project. ["GoVOLT"](#) initially struggled to obtain permits and to compete with the country's strongly protected taxi industry, making it difficult for the start-up to grow and access funding. All these projects can teach Munich the value of open-mindedness in imposing regulation.

Overall, Milan's mobility projects show that effective cooperation, data-driven and need-based problem solving in combination with a more flexible approach towards regulation enable mobility innovation.





OUR TEAM	236
INTRODUCTION	237
LOCATION ANALYSIS	241
URBAN MOBILITY ANALYSIS	243
SWOT ANALYSIS	245
PROJECTS IN PARIS	246
<u>'ZONE APAISÉE' OR 'QUIET ZONE'</u>	<u>249</u>
<u>PLACE DE LA REPUBLIQUE AND PLACE DE LA BASTILLE</u>	<u>253</u>
<u>PARIS2CONNECT - SMART CITY</u>	<u>257</u>
<u>BIKE EXPERIMENTS BY PARIS&CO</u>	<u>261</u>
<u>GRAND PARIS EXPRESS</u>	<u>265</u>
<u>PLAN VÉLO</u>	<u>269</u>
<u>EZYMOB APP</u>	<u>273</u>
<u>POP-UP BIKE LANES</u>	<u>277</u>
CONCLUSION	281

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INTRODUCTION

Paris is the city of love, but is it also the city of disruptive mobility transformation and experimentation? Since left-wing Anne Hidalgo was elected Paris Mayor, the city has received increased attention for its bold and transformational mobility strategy. The broad effort to make Paris a bicycle-friendly city is gaining traction. The policies underlying such significant changes to the transportation system may not be appealing to everyone. Nonetheless, it is undoubtedly a case study from which we can learn a lot for the euMOVE project and how some of the concepts and elements may be applied to the Metropolitan Area of Munich, Germany and other European cities.

Four TUM students from the disciplines of Urbanism, Transportation Systems, and Responsibility in Science, Engineering, and Technology (RESET) were performing this case study. It involved a ten-day research stay in Paris, which provided an opportunity to investigate the transformational mobility solutions in the French metropolis closely.

We seek to find an answer to the key research question: “What are some of the transformative mobility concepts that are planned, managed, and implemented in Paris?” through substantial literature and media research, as well as interviews with Parisians. To do this, we combine approaches from several disciplines, such as conducting and analysing qualitative interviews, ethnographies, and quantitative assessments of the local mobility behaviour. The stay on site allowed us to experience the city, speak to users of various modes of transport, learn about local initiatives, and conduct individual interviews with experts.

What makes the Parisian mobility landscape so interesting to study?

In response to some pressing local and global challenges such as (mobility) inequalities, gentrification, heavy traffic jams, pandemics, noise and air pollution, and heat waves, various actors in Paris are focusing on a large-scale transformation of the mobility landscape to make the city more liveable and sustainable.

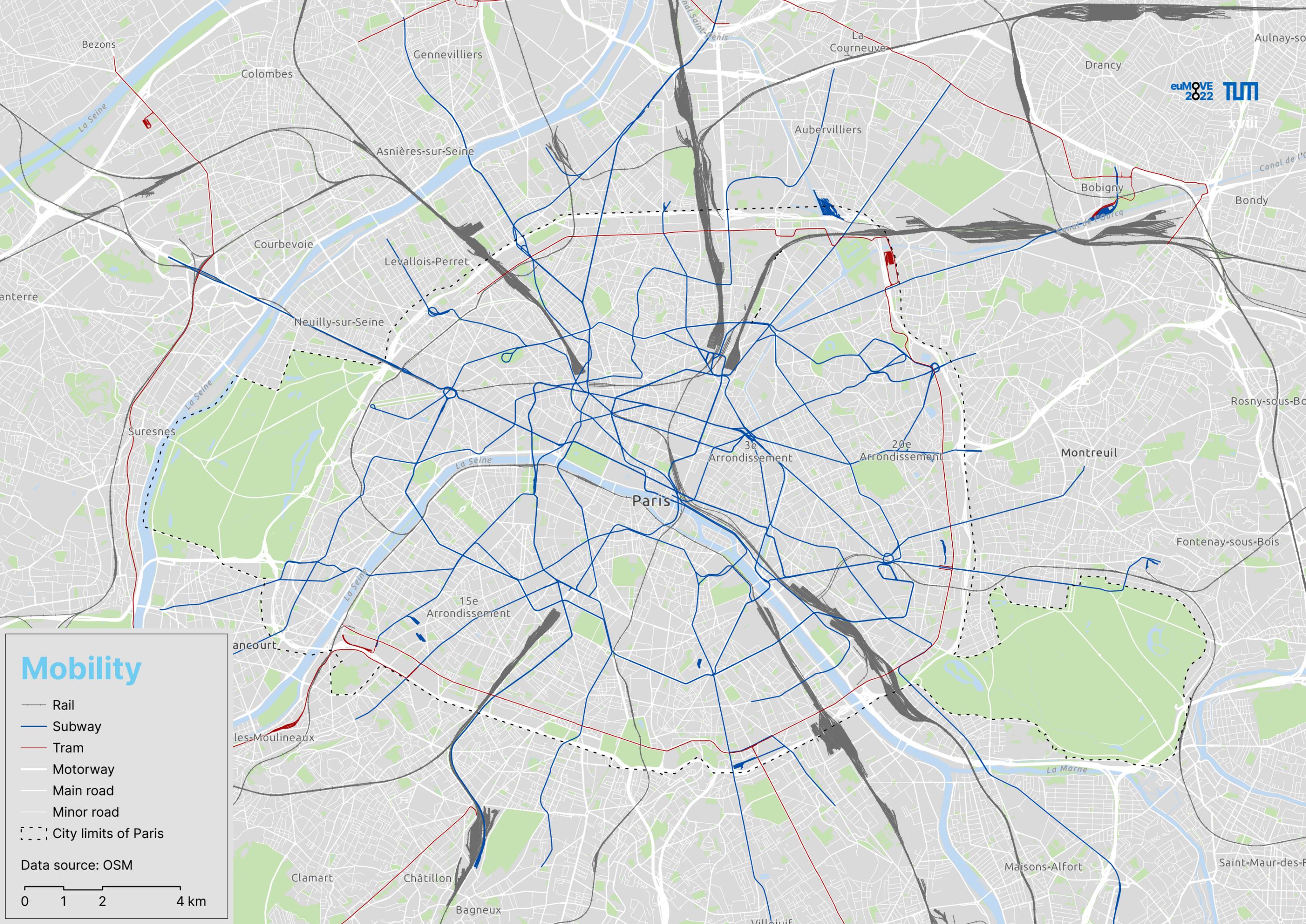
According to Paris J'écoute (2022), roughly half of the city's public space is dedicated to cars. But the city has been fighting to reclaim that space, turning a crowded street along the Seine River into a park and walking path, redesigning intersections to prioritise pedestrians, giving most space on one of the city's busiest streets to bikes, banning cars on some streets near schools and kindergartens, and planning hundreds of kilometres of dedicated bike lanes. This involves the establishment of car-free roads as well as the redesign of seven major city squares and transportation hubs. In addition to the precautions adopted during the Corona pandemic, the Parisian authorities built 50 kilometres of pop-up bike lanes. Along with these pedestrian- and cyclist-friendly urban planning initiatives, Anna Hidalgo promotes the idea of the “15-minute city.” This planning paradigm states that every citizen in the city should be able to reach all the infrastructure of daily life within 15 minutes by foot.

Through interviews and our own observations, we were able to look behind the scenes of the 15-minute city concept. Various actors in the mobility sector, such as Forum Vies Mobiles, criticise the 15-minute concept of “very localised wealth, but also poverty, attractiveness and exclusion” (2022) which fosters, in turn, gentrification, inequalities, and is perceived as too vague. For example, those who can afford to live in the centre of Paris would have access to infrastructural resources even before framing or calling it ‘15-minute city’, whereas the concept is almost not implemented outside the city, which can reinforce social inequalities.



Our approach to find answers to our research questions and its relation to the policymaking process.

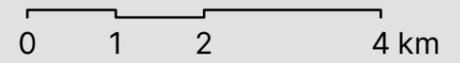
The interviews we conducted and the literature consulted give us some insights into the policymaking process, the political culture, and its recent developments and outcomes. These are further described below. Overall, transformation processes of the mobility system are mainly initiated at the governmental level, which allows for quick implementation and short decision-making processes, but excludes the vital building block of creating socially robust policies through participation of (local) interest groups. For example, shopkeepers would like to be involved more in decisions that suggest reducing the number of cars in front of their shops. Furthermore, cycling initiatives complain about badly planned routes that demonstrate the difference between observing desired versus planned lanes, which could presumably be better solved by involving their expertise (read project on bike infrastructure)



Mobility

- Rail
- Subway
- Tram
- Motorway
- Main road
- Minor road
- - - City limits of Paris

Data source: OSM



LOCATION ANALYSIS

Demographics

- 2.2 million people within its administrative city limits as of 2022 (worldpopulation, 2022)
- Ile de France region has a population of 12.2 million as of January 2021, or 21.4 percent of the population of France (ile de France, 2021).
- French censuses do not ask questions about ethnicity or religion, instead collects information regarding people's country of birth (Bleich, 2016).
- According to the 2011 census, 456,000 residents of the municipality of Paris (20.3%) and 2.2 million residents of the Paris Region (Île-de-France) (17.9%) were born outside France (INSEE, 2011).

Today, in Paris, the average income is slightly higher than the rest of France and Paris has a younger median age compared to the rest of France. Moreover, similar tendency can also be observed for the diversity: the population is much more diverse in Paris rather than the rest of France (worldpopulation, 2022)

Economy

Considering the data in 2011, Paris is awarded the fourth largest metropolitan economy in the world according to the Brookings Institution (Brookingsinstitution, 2013). In Paris, the average household income is nearly 36,085 Euros and that number gives 60% higher income than the national average of France (worldpopulation, 2022). The metropolitan area of Paris produced around \$1.0 trillion GDP which is the largest number in Europe with London and equals to the 1/3 of France's GDP (visualcapitalist, 2018).

According to Fortune magazine, the top ten French companies having their appearance on the Top 500 companies list are located in the Paris region (Fortune, 2015). In terms of the employment areas, INSEE states, the majority of the employment is happening in the commerce, transport and services sector (68.0%) and it is followed by administration, education, health and social services (24.4%). Only 4.4% of the employees are working in the industry sector (INSEE, 2012).

Political System and governance

Anne Hidalgo, a member of the Socialist Party, has been Mayor of Paris since 2014, becoming the first woman to hold the position. She is being described as a champion mayor capable of challenging and disrupting long-standing mayoral traditions. According to a Civitas report, Hidalgo is champion of sustainable transportation in cities. She wishes to improve the city's air quality and reduce its carbon impact. The solution that she pushes forward: more walking, biking, public transportation and less vehicles (CIVITAS, 2021). In an interview Hidalgo stated, "Unparalleled challenges like air pollution require unprecedented action. These policies are based on the urgency of both the health crisis and the climate crisis we are facing" (Peters, 2017).

History

Instead of presenting a full account of the history of Paris, we focus on some key aspects in regard to mobility.

Between 1853 and 1870 Napoleon III and Georges Haussmann conducted an immense effort to transform the city and its look as we know it today

to change Paris from being chaotic and twisty to the boulevard traversed metropolis. This not only changed the look of the city but also created big transportation nodes such as the Arc the Triomphe and the Place de la République. In 1900 the first Metro line of Paris was implemented from Porte Maillot to Porte de Vincennes providing the starting point to the construction of one of the densest suburban networks of the world.

As in the early days of the Metro Parisians were afraid of safety if the Metro reached out to the poorer suburbs this changed in 1930. From 1930-1950 Metro lines were built reaching the first suburbs.

Because of a boom in population, from 1960-1990 a network of RER (Reseau Express Regional) was added to the metro connecting Paris to the Ile de France region. Newly implemented Line A became the most used urban rail line in the world with nearly 300 million journeys a year. Today the public transport system of Paris and the neighbouring metropolitan area Ile-de-France is carrying 4.1 million passengers every day.

Climate and Geography

Paris, the French Capital, is located in the north-central part of France being the centre of the Ile-de-France region. The Seine River cuts through the urban fabric for about 13 km. Two islands, the Ile de la Cite and the Ile Saint-Louis, represent the historic centre of Paris. Elevations within the city vary from 130 metres (Montmartre, north) to 26 metres (southwest). (Ardagh, 2022; Paris City.fr, 2008)

Paris is characterised by a typical Western European oceanic climate. Due to the influence of the Gulf Stream it is fairly temperate. The weather alters throughout the season with mildly cold

winters and warm summers. The annual mean temperature is 12 °C. There is precipitation over the year, slightly less frequent in summer (Ardagh, 2022; climatestotravel.com, n.y.).

Paris is classified as moderately air polluted, being the 2nd most polluted city in France (2019). Whereby air pollution is mostly induced by transportation, industry and heating. Since 2020 measures are being taken to prevent air pollution levels returning to pre pandemic conditions. (IQAir, 2022)

Education and Research

Paris is ranked as Europe's most innovative city with transportation as an area of excellence and many start-ups (CCI Paris IdF, 2022). The innovation and economic development agency Paris&Co of the Paris' metropolitan area provides an acceleration program for mobility startups focusing on logistics and sustainable urban mobility (Paris&Co, n.y.)

Two long established planning associations consult the City of Paris and its metropolitan area (architect and urban planner, personal communication, July 6, 2022). The non-profit Paris Urbanism Agency Apur is engaged in the urban and societal development of Paris and its Metropolitan area (Apur, n.y.). The Institut Paris Region has evolved from a research foundation into a centre for scientific and technical support for the development and evaluation of public policies in the Paris Metropolitan area (Institut Paris Region, n.y.).

Overall, the higher education landscape in the metropolitan area of Paris comprises 16 universities (La Chancellerie des Universités de Paris, n.y.). Various clustering is made to foster connections between higher education institutions and research institutes (Bernard, 2020).

URBAN MOBILITY ANALYSIS

Modal Split

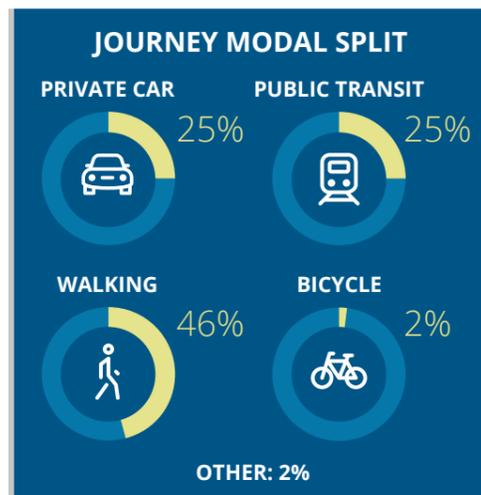


Figure 23. Modal split for Paris (deloitte, 2019)

From all the examined cities Paris is the only one in which walking is the predominant way of mobility. Many day-to-day journeys are made by foot as the city provides a dense network of infrastructure. Journey taken by private cars and public transportation share the same portion of the modal split but through political incentives there's a trend against the usage of private cars. Parking on public streets is nearly everywhere subject to charges and the prices range from four till six Euros per hour (seety, 2022). In comparison a one way Métro ticket only costs 1.75 Euros. To increase the comparably low percentage of bike rides the taken the city of Paris is taking extensive measurements to improve the cycling experience in the city which are elaborated further in the report.

Accessibility

One of the important characteristics for accessibility is how walkable the city is in general. In terms of the walkability aspect of the city, the 15-min-city project is a leading concept of the future of the city. This term was first defined by Carlos Moreno in 2016 and it promises an urban model ensuring that citizens can satisfy their daily requirements (work, housing, food, health, etc.) within 15 min walking or biking distance (Postaria, 2021). The main features of the 15-min-city are introduced as follows by Transformative Urban Mobility Initiative (TUMI, 2021):

“The city should follow the rhythm of people, not cars.”

“Every square metre should serve multiple uses.”

“Urban quarters should be designed in a way that people do not need to commute.”

Hidalgo used the 15-min concept as her political leverage at many points of her political agenda. She took her bicycle out to show her vision for the 2020 elections (Postaria, 2021). Moreover, in alignment with the 15 min city project, Paris put emphasis on developing new services for each district by introducing new bicycle lanes, transforming already existing infrastructure and creating areas for leisure (Postaria, 2021). Despite these developments, as also indicated in the introduction section, 15 min city concept is also seen as a marketing tool for the city to promote itself to the rest of the world and according to some of our interview partners and mobility experts, it increases gentrification and inequalities at the same time.

Another crucial aspect of accessibility is the situation of the people with impairment. During our visit we realised Paris does not provide the best infrastructural conditions for those people in general. When they want to use the subway, it is hard for them to navigate by themselves, as most of the subway infrastructure lacks lifts and escalators. Nevertheless, Paris has been also pushing some measures to make the city more attractive for people in need. Convention and Visitors Bureau states that they implemented some concepts such as adapted taxis, adapted car parks and parking places, rental of adapted cars and personal travel assistance to increase the accessibility of disabled people (Paris Info, 2022).

Multimodality

As the modal split for Paris suggests walking is one of the main modes of transport in Paris. This is caused due to the city's comparable small size and the high density of population and infrastructure (Size explorer, 2022). In comparison Munich is nearly three times as

big as Paris with about 600 thousand inhabitants less (World Population Review, 2022). Nevertheless in Paris there are several modes of public transportation and shared bike services available for the citizens. Inside inner Paris there are 16 Métro lines with 308 stops available. This makes it one of the most dense networks in the world. In addition to this, at nearly every stop Vélib shared bike stations are available for the last mile of a trip. For travellers coming from the Ile-de-France region the operator companies RATP (Autonomous Parisian Transportation Administration) and SNCF (French National Railway Company) provide a network of regional express trains connecting the 12 million additional people living in the metropolitan area with central mobility

nodes in Paris (RATP Group, 2022). In addition to a (night-)bus network, in recent years eight new tramlines were implemented in the outer parts of Paris to close gaps in existing mobility infrastructure (civitatis Paris, 2022).





SWOT ANALYSIS

Strengths

- Dense network of Metro and Velib stations
- Walkability of the city (see modal split)
- High determination of Paris' socialist mayor Anna Hidalgo towards sustainable mobility system
- Flat topography except few places, the convenience for the cycling

Weaknesses

- Lack of accessibility on public transport especially in Metro stations
- High Levels of air pollution due to motorised vehicle traffic
- Public transport as important transport mode saturated
- Great amount of congestion in the inner city of Paris (relevance of commuting from the suburbs)
- Because of the land problem, lack of protected cycling infrastructure

- Using the 2024 Olympic Games as catalyst for transformative urbanmobility
- Sense of urgency for change amongst society and public authorities
- Less pride in owning individual modes of transportation, providing a chance for shared services
- More equal distribution of street space among different transport modes and usages An attractive city for companies to implement their ideas (experimentation)

- When promoting the policy agenda for the Olympic Games in 2024, some needs (e.g. tourism) are prioritised, leaving other needs out of the discussion.
- further gentrification through pedestrianisation, 'quiet-zones', and focusing mobility transformations on the inner city of Paris, leaving the greater area of Ile-de-France out
- Setting goals so ambitious that there's barely room for consultation and public feedback
- Fast grow of population comparing to the rest of the France

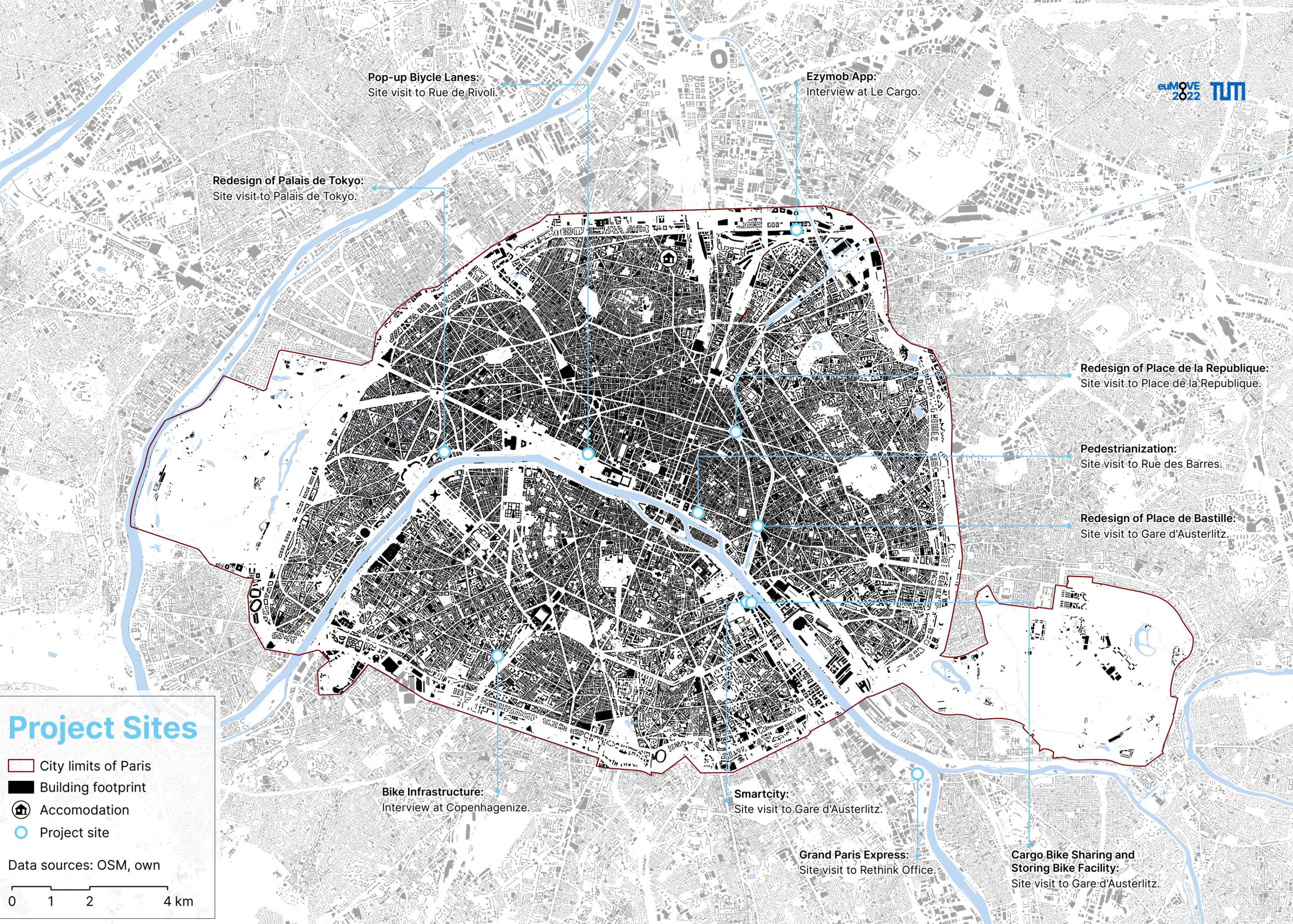
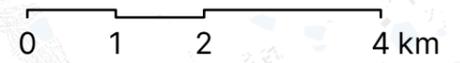
Opportunities

Threats

Project Sites

- City limits of Paris
- Building footprint
- Accomodation
- Project site

Data sources: OSM, own



Pop-up Biycle Lanes:
Site visit to Rue de Rivoli.

Ezymob App:
Interview at Le Cargo.

Redesign of Palais de Tokyo:
Site visit to Palais de Tokyo.

Redesign of Place de la Republique:
Site visit to Place de la Republique.

Pedestrianization:
Site visit to Rue des Barres.

Redesign of Place de Bastille:
Site visit to Gare d'Austerlitz.

Bike Infrastructure:
Interview at Copenhagenize.

Smartcity:
Site visit to Gare d'Austerlitz.

Grand Paris Express:
Site visit to Rethink Office.

Cargo Bike Sharing and Storing Bike Facility:
Site visit to Gare d'Austerlitz.

'ZONE APAISÉE' OR 'QUIET ZONE'

The inner city of Paris will become a 'quiet zone' by late 2024, where the mobility landscape and streets are transformed in favour of pedestrians, cyclists, and public transportation users. (Paris J'écoute, 2022). The concept of the 'quiet zone' and pedestrianisation is one of the primary campaigns for transforming Paris' mobility system. It is the process of limiting or restricting car access to streets or public areas so that pedestrians have exclusive or priority access. It refers to the redistribution of public space away from motorised forms of transportation towards more active modes of transportation - walking or cycling.

Motivation and Goals

The city of Paris has launched a public campaign to promote pedestrianisation and the redesign of 'quiet zones,' claiming that the initiative will reduce car accidents, noise, and air pollution around schools, promote active mobility, strengthen communities, and thus contribute to making their cities more enjoyable places to live (Paris J'écoute, 2022). By making walking and cycling safer and more pleasant, the number of motorised vehicles and their speeds in neighbourhoods is being reduced. In addition, the 'quiet zones' are intended to streamline and smooth the movement of consumers, workers, and public services in the respective areas. Furthermore, enhancing the safety of non-motorised means of transportation is assumed by policymakers to make it appealing for citizens to interact, converse, engage, and allow small children to play securely in public space, explains the researcher Bertolini (2020).

Implementation

Hidalgo launched a showcase project along the Seine River in 2015 to jumpstart and test the concept of pedestrianisation and, so called, transformation into the 'quiet zone' of Paris (Paris J'écoute, 2022). According to the media and interview data (Kirmizi, 2021; Sociologist and researcher, personal communication, July 4, 2022; Willsher, 2015), this flagship project was a huge success, inspiring a series of pedestrianisation projects across Paris's central area. According to a sociologist and researcher (personal communication, July 4, 2022), this flagship project has been a great success and led to a variety of pedestrianisation projects across the city of Paris.

Starting from 2019, pedestrianisation efforts spreaded towards the space in front of schools and kindergartens (Child in the City, 2021; Michiel Modijefsky, 2020). Either partially or fully, the roads have been transformed into safer areas for children when commuting to or from school, as well as providing space for the local community to take a rest, play on the streets, or likewise.

"pedestrianised spaces should not be just empty spaces with sealed surfaces" (Sociologist and researcher, personal communication, July 4, 2022)

KEY FACTS

'quiet zone' is planned to be fully implemented by 2024



'ZONE APAISÉE' OR 'QUIET ZONE'

Stakeholders

Throughout our field and desk research, it became evident that the way citizens, shop owners, and other non-governmental groups are involved in planning procedures is not easily researched. However, some of the interviews we performed show that citizens are involved primarily after the implementation of pedestrian friendly zones to offer their feedback (Researcher in Urbanism and Urban Planning, personal communication, July 22, 2022; Sociologist and researcher, personal communication, July 4, 2022). Interestingly, while writing about the 'quiet zone' policies, many media outlets (Mayors of Europe, 2022a; Michiel Modijefsky, 2020; Willsher, 2015) and the city of Paris (Paris J'écoute, 2022) focus on spreading the word about how the government is promoting them, while not mentioning the users' viewpoints intensively.

Outcomes and Discussion

In Paris, a \$8 million plan led by Anne Hidalgo that was revealed in 2015 with the objective of replacing the Seine's right bank's crowded motorway with green space and sidewalks is the primary starting point of the 'quiet zone' and pedestrianisation (Willsher, 2015). The busy roadway that once bordered the French capital's riverbank is replaced by waterside gardens, playgrounds, and grassy paths. As of this point at the latest, the streets in the heart of Paris are being converted one by one into pedestrian-only areas, involving streets in front of schools and kindergartens. In a way, it is further drawing attention to the vision that cars and motorised vehicles are no

longer welcome in Paris. This is precisely in line with Anna Hidalgo's goal of introducing a new mobility system that is safer for pedestrians altogether (Child in the City, 2021; Michiel Modijefsky, 2020; Paris J'écoute, 2021).

The initiative was started and implemented in a timely manner due to the mayor's strong commitment. This is further supported by the broad theme that transportation serves as an instrumental mechanism for establishing political and institutional leadership and visibility across levels within the political realm and beyond (Halpern & Le Galès, 2016). Also, the acceptance and widespread use of car-free zones along the Seine River as a flagship initiative indicates the project's applicability.

Apart from some of the benefits, focusing mostly on the inner city centre fosters gentrification, segregation and polarisation of groups of society, and neglects to address the concerns of people who must commute from residents living outside the Périphérique into the city. Kirmizi (2021) researched that the local business owners had little to no participation, which contributed to their low level of acceptability. Furthermore, our group observed that not all pedestrianised spaces are frequently visited by residents since, in certain places, there is a lot of concrete, few places to rest, and minimal flexibility for users to use the space more unplanned. The widespread adoption of the "quiet-zone" is anticipated to happen until 2024 and has already begun in some districts (Mayors of Europe, 2022b; Paris J'écoute, 2022). Nonetheless, the associated bike infrastructure as well as alternate car traffic routes and public transportation must also be properly planned and put into place at the same time.

Applicability to Munich

We consider that the concepts of pedestrianisation and a few smaller "quiet zones" in specific areas are clearly transferable to the city of Munich based on the insights, information, and prior scholarly work. However, it must be noted that due to the prevalent high use of privately owned cars, Munich's acceptance of car-free and low-emission zones may differ significantly. To ensure the success of the effort, the community has to be heavily involved in the design process for these "quiet zones."

Outlook

We learn that when redistributing public space and beginning to prioritise zero- or low-emission modes of transportation, the City of Paris and those seeking to fill the area must involve the society early and extensively. In this way, not only are such pedestrianisation initiatives assessed for their applicability, but society is also given the free problem space, which may

then be filled with suggested solutions by the users themselves. We assume that a more active engagement may ensure user approval, originality, and future widespread use.



Figure 24. Map of planned quiet zone (Paris J'écoute, 2022)

Project Transferability



Project Impact



PARIS - Project Overview

PLACE DE LA REPUBLIQUE AND PLACE DE LA BASTILLE

Over the last ten years the Place de la Republique as well as seven other major squares of infra-structural and historic importance are in the process of being re-designed to reassign space for citizens and active mobility. This follows the premise that public space in Paris should no longer belong to cars. The initiative is implemented to meet the objectives of the Paris Climate Agreement and make Paris climate neutral by 2050 (O`Sullivan, 2015). Overall, the Paris government led by Anne Hidalgo aims to reclaim 25.000 m² from traffic lanes and turn them into sidewalks, bike paths, sitting areas, and vegetation (Kent University's Paris School of Arts and Culture, 2021). These efforts, as well as the breaking up of sealed surfaces, not only cut carbon emissions in the city but also serve to counteract the heat island effect (Schmitt, 2016).

Motivation and Goals

Besides creating a more sustainable and livable city for Parisiennes and visitors alike, two of the already completed squares also give space to the subcultural activity of skateboarding. Since its rise in the 1970s skateboarding has been constantly accompanied by conflicts regarding the use of public and private space and property (Borden, 2019).

Implementation

Through a three-stage consultation process involving planners, citizens, and local governments alike and the allocation of some ten million euros to the different projects Paris not just created spaces for leisure and active mobility but also internationally renowned skate spots on the newly designed squares. The inclusion of local stakeholders ensures that possible conflicts can be resolved before construction processes are finalised and that all interest groups can contribute to the city they live in. In the first stage of the consultation process common goals of use are defined which then are realised by planners who can contribute their design options in the second stage through town hall meetings and an online platform. In the third stage local stakeholders assess the plans and give feedback (Waine, 2013).

Outcomes and Discussion

Skateboarding on the Place de la Republique and Place de la Bastille is an example of how cities can create offers to subcultural groups traditionally pushed outside city centres and benefit from synergies like the sense of responsibility skateboarders feel towards their sports facilities. For example, the local skateboarding community has a strong interest to keep the squares clean and in good shape and thus actively maintain public space (local skateboarder, personal communication, July 1st, 2022).

The two re-designed squares both were transformed from car centred concrete jungles into community spaces for the surrounding arrondissements where citizens and initiatives meet and spend their freetime. The inclusion of skateboarding opened up these places for even another (very distinctive) group of users. But as skateboarding is inherently dependent on a sealed-concrete surface every area dedicated to it, is a missed opportunity to create green islands within the city providing shade and coolness.

KEY FACTS

7 mayor squares re-designed

Public Space is negotiated between stakeholders



Figure 25. Place de la Bastille in 1858 (Hoffbauer, 1875)



Figure 26. Bastille in 2005 (Place de La Bastille in Paris, France, 2005b)



Figure 27. Bastille vtoday (thelocal, 2019)

PARIS - Project Overview

PLACE DE LA REPUBLIQUE AND PLACE DE LA BASTILLE

Applicability to Munich

Even though Munich is not extensively planning on redesigning major squares such as Sendlinger-Tor-Platz or Goetheplatz, the city government is envisioning some areas in the city for pedestrians, cyclists and public life. For example in the project Freiraumquartierskonzept Innenstadt (open space quarter concept city centre) the city of Munich plans to give back space to its citizens such as the Sonnenstraße in the centre of Munich (Stadtverwaltung, 2021). The developments in Paris can function as an example of how another European metropolis approaches the redistribution of public space in favour of more sustainable and liveable solutions.

Outlook

We learn that when redistributing public space and beginning to prioritise zero- or low-emission modes of transportation, the City of Paris and those seeking to fill the area must involve the society early and extensively. In this way, not only are such pedestrianisation initiatives assessed for their applicability, but society is also given the free problem space, which may then be filled with suggested solutions by the users themselves. We assume that a more active engagement may ensure user approval, originality, and future widespread use.



Figure 28. Okami Bike Riding collective gathering at Place de la Bastille



Figure 29. Skateboarding at Place de la République

Project Transferability



Project Impact



PARIS2CONNECT - SMART CITY

Smartcity is a project in Paris that connects three train stations (Gare de Lyon, Gare d'Austerlitz, and Gare de Paris-Bercy) with an autonomous network infrastructure (figure xx) (paris2connect, n.d.). It started in 2018 with the initiation of Paris2connect and companies and start-ups are called to contribute to the project in every 2 months over 2022 (paris2connect)

Motivation and Goals

The idea behind the Paris2Connect and also Smartcity project is to provide a connected infrastructure to improve and develop new use-cases which will help the management of the territory and connected mobility (paris2connect, 2022).

Recently, some of the solutions have already been tested to offer people with visual impairment better accessibility conditions. In the future, autonomous mobility services are also intended to be run to establish a well-connected autonomous structure over a 3.5 kilometre circuit (paris2connect, 2022).

Implementation

The project is still in its initial stages, and Paris2Connect claims that its primary priorities are "territory management" and "connected mobility." They intend to accomplish so with smart lighting, autonomous public transportation, autonomous robot logistics, and other technologies. In addition to that, voice memos will assist visually impaired persons in navigating their surroundings.

The connected infrastructure idea is in its early stages. As previously stated, enterprises and start-ups are encouraged to contribute to the project's future. By Paris2Connect, four main use-cases were declared to draw a projection for the Smartcity vision (paris2connect, 2022):

"Use of data for territory management":

"Use of data for autonomous transport services"

"Using connectivity for autonomous city logistics"

"Demonstration of connectivity for traffic priority management"

Every 2 months
new start-ups
join the project

KEY FACTS

Founded in
2018



Figure 30. Smartcity Project (paris2connect, 2022)

PARIS2CONNECT - SMART CITY

Stakeholders

Paris2Connect works together with the City of Paris as well as five industry partners: ATC France, Aximum, Nokia, RATP, and Signify (paris2connect, 2022). The City of Paris is contributing to the project's digital infrastructure deployment. Aside from the participation of the City of Paris and 5 enterprises in the project, Paris2Connect organises application sessions every 2 months for start-ups to test and experiment with their concepts in a real-time setting.

Outcomes and Discussion

Paris&Co organises street experiments in a variety of disciplines to assist cities in evolving in a more sustainable manner (Paris&Co, 2022). The initiatives are designed in a dynamic environment that allows for the close participation of over 100 multinational corporations. One of the fields where the street experiment takes place is mobility. Paris2Connect is a part of Paris&Co that enables individuals to satisfy their mobility needs through the "smart city" idea. They provide self-driving shuttles, intelligent transportation systems, and movement observatory (paris2connect, 2022).

Moreover, it is expected that the autonomous mobility service will be running soon but the exact time is not clear by now. One of the main concerns about the project is related to health issues. Since the autonomous structure releases radiation to the environment, its possible effects need to be investigated and the actions need to be taken accordingly.

Applicability to Munich

Nowadays, it is possible to see the applications of connecting infrastructure in many parts of the world. Paris also wanted to test the possible effect of the autonomous mobility to connect the three nearby train stations. In terms of its applicability to Munich, different parameters were tested, and results can be seen in Figure XX and YY. The project is seen as having a positive impact in time (accessibility, traffic quality and quality of experience). However, in terms of the usage of space, as the smart systems still promote road transport, it might cause negative effects for the future in terms of the land use. Moreover, as stated before, the possible radiation problem can result in health issues which can be regarded as one of the other sides of this project related to the air aspect.

In terms of its transferability, as the smart-city project requires a high quality and complex infrastructure, it is not easy to implement regarding the governance point of view. Furthermore, that high level of infrastructure will cause local challenges such as resource expenditure and balanced innovation.

Outlook

The Smart City project is one of the experiments organised by Paris2Connect. For this project, we contacted the project manager of street experiments of Paris&Co. At the same time, as a potential interview partner, the person leading this project could be interviewed to take a more detailed insight about the current developments. As this project is at an experimental stage now, the future scope and extent cannot be predicted clearly. When the current ineffective operation of logistics and the congestion resulting from that were thought of, autonomous logistics and public transportation are expected to have a contribution for the future of Paris. However, while many cities have been taking measures to remove the passenger cars from city centres, the outcome of this project needs to be well defined and calculated. The start-ups interested in the Smart City project and the progress will also give a better idea about how all of those applications will be performed in the future.

Project Transferability



Project Impact



BIKE EXPERIMENTS BY PARIS&CO

Paris&Co launched two bicycle-related experiments as part of their street experiments, Cargo Bike Sharing and Bicycle Storing Facilities with the Nielsen Concept. Cargo bike sharing consists of four different cargo bikes for different use cases. Besides, in the same area, in front of Gare d'Austerlitz, the bike storing facility is implemented to promote cycling especially for train users (Paris&Co).

Motivation and Goals

Firstly, the goal of the cargo bike sharing project is to familiarise people with the idea. For various use cases, Nielsen Concept offered four distinct kinds of cargo bikes, most of which were created for families, the elderly, single persons, and individuals as well as for the transport of goods. Secondly, Nielsen Concept and Paris&Co created a new concept to give cyclists further bike storage options. The closed circuit storage facility has a wooden exterior to match the style of the train stations and provide users with a secure parking space where they may keep their bicycles at any time.

On the other hand, the experiment for a bike storage facility was also launched in front of the Gare d'Austerlitz. Following the simple instructions, users have been able to store their bikes in a closed and safe environment (figure 24, following page). Moreover, this service is provided free for people so that the price barrier was lifted for users at least during the trial period.

Implementation

Both concepts are implemented in front of the open space of Gare d'Austerlitz. The cargo bike sharing scheme is providing different use cases for different purposes. Families, elderly people or to carry goods, those cargo bikes were offered to users to take advantage of it (figure 25). During the testing period, consumers can hire the desired sort of bike for 1-24 hours for 10 Euros using the cargo sharing system. The project runs from March 2022 until October 2022.

“Communication is the solution to solve the problem of not used bike parking facility” - PARIS&CO employee

KEY FACTS

Paris wants to promote cycling especially after Covid-19 through experimentation



Figure 31. Cargo Bike Sharing Scheme

BIKE EXPERIMENTS BY PARIS&CO

Stakeholders

The main stakeholders involved are Paris&Co and Nielsen Concept. Moreover, our interviewee claimed that the City of Paris is closely monitoring the developments in the cargo bike sharing initiative and accordingly, the City of Paris investigates the possible replacement of cars with the cargo bikes in the future. The bike storage facility is also actively supported by SNCF, France's primary railway service provider. Furthermore, Paris&Co is in close contact with both local authorities and the City of Paris regarding the success of this experiment, and they are hosting demo days to keep in with the community.

Outcomes and Discussion

During the testing period, consumers can hire the desired sort of bike for 1-24 hours for 10 Euros using the cargo sharing system. The long-term goal of the pricing scheme is that after a trial period, individuals will be used to purchasing their own cargo bike in the future. So far, user feedback has been mostly positive due to the present price and ease of use of the bikes (simple plug-in plug-out mechanism), but our interview partner who is the project experiment manager of Paris&Co is concerned about the future pricing scheme, aesthetics, and bike choice. Although the project is now entirely sponsored by Nielsen Concept, if there is a long-term use, a potential subsidy from the City of Paris is expected and needed.

In terms of the bike storage facility, SNCF is the primary initiator of this project since they seek additional bike parking facilities near train

stations. As indicated before, it was free for users throughout the trial phase, which was well received. Our interview partner said that for the first two months of the experiment, few individuals used the service since they may be hesitant to try new things. However, in subsequent years, particularly young people, began to recognise the system's benefits and started to utilise it more regularly.

Applicability to Munich

To apply those two projects in Munich, the transferability index is again used to evaluate the possible outcomes and when the transferability aspects are reviewed, it can be seen that there seems no high risk both for governance, local context and local challenge points. As the City of Munich is also willing to promote bicycles among the users, the bike storage and cargo bikes projects can be seen within a potential use case.

When the fields of impact of the projects are reviewed, it can be concluded that the time, space and air aspects are mostly evaluated positively. Within the time aspect, both projects will be valuable to increase accessibility, traffic quality and quality of experience. Also, similarly, in terms of the environmental effects, the projects related to cycling are environmentally friendly. However, for the space, the bicycle storing facilities might create problems with its huge land use.

Outlook

The living labs are a way of testing solutions in a real time environment, such as Paris&Co which is in a close collaboration with Nielsen Concept to promote cycling. Regarding that, two projects are the front runners, cargo bike sharing and bike storing facility. To assess the impact of such experimentation projects, for the future, we thought that the communication between users and service providers must be increased. Last but not least, a minimal alternative of bike storing facilities can be thought of in the future so that the high amount of land-use problems can be avoided.

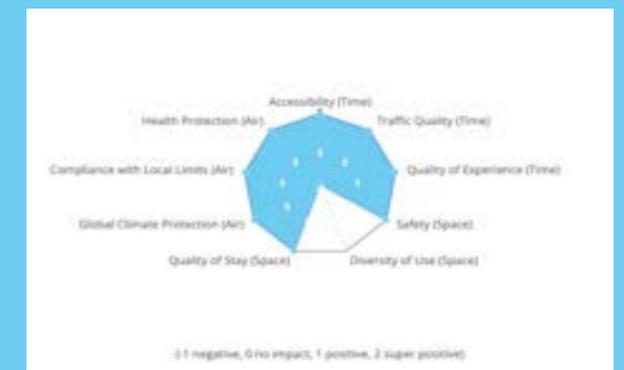


Figure 32. Bike Storing Facility

Project Transferability



Project Impact



GRAND PARIS EXPRESS

The Grand Paris Express (GPE) is the largest rapid transit project in Europe. Until 2030 the expansion and complement of the existing star-shaped network of Paris' metro and the RER lines are envisioned by providing 200 km of 4 new automatic and accessible metro lines in the Ile-de-France, representing a circular route and connecting lines around Paris. Comprising 68 stations, the GPE will link main business, science and technology as well as residential districts and airports. Thereby, it comprises urban development around new metro stations. (SGP, 2022; Enright, 2013)

Motivation and Goals

The GPE is the core of the initiative Grand Paris launched by the state in 2007 intending to create a polycentric and connected Ile-de-France with a strong focus on becoming a thriving and competitive business region paired with taking social and environmental responsibility (Enright, 2016).

The current Parisian urban transit network is seen as one of the worlds' most unequal and centralised ones sustaining territorial disparities between Paris and its metropolitan area (Enright, 2013). The GPE project aims to foster social and territorial cohesion and the economic, sustainable and inclusive development of the Ile-de-France. It promises to ease travel expenses in Paris' suburbs and support the current public transport system. By being an alternative to private cars it further targets the reduction of congestions and air pollution. (SGP, 2022)

Implementation

In the 1990s a ring line metro was already envisioned but only made possible by the Grand Paris act in 2010 building the legal framework for the GPE launched one year later (SGP, 2022). Initially, its complete operation was

planned to be in 2025 (Enright 2013). However, today the official completion of the project is postponed to 2030 and first lines are to be run by 2025 (SGP, 2022; Faure, 2021).

Delays within the construction process are caused by changes and expansion of the initially planned network in 2013 as well as the inclusion of the Olympic Games 2024, giving priority to main and event relevant lines (Faure, 2019; Faure, 2021). Also, increased costs are induced by adjustments made leading to a current investment of 36,1 billion Euros which is financed by the SGP through a regional taxation system mostly (SGP, 2022; Faure, 2019).

circular metro line in the Ile-de-France region

Completion in 2030

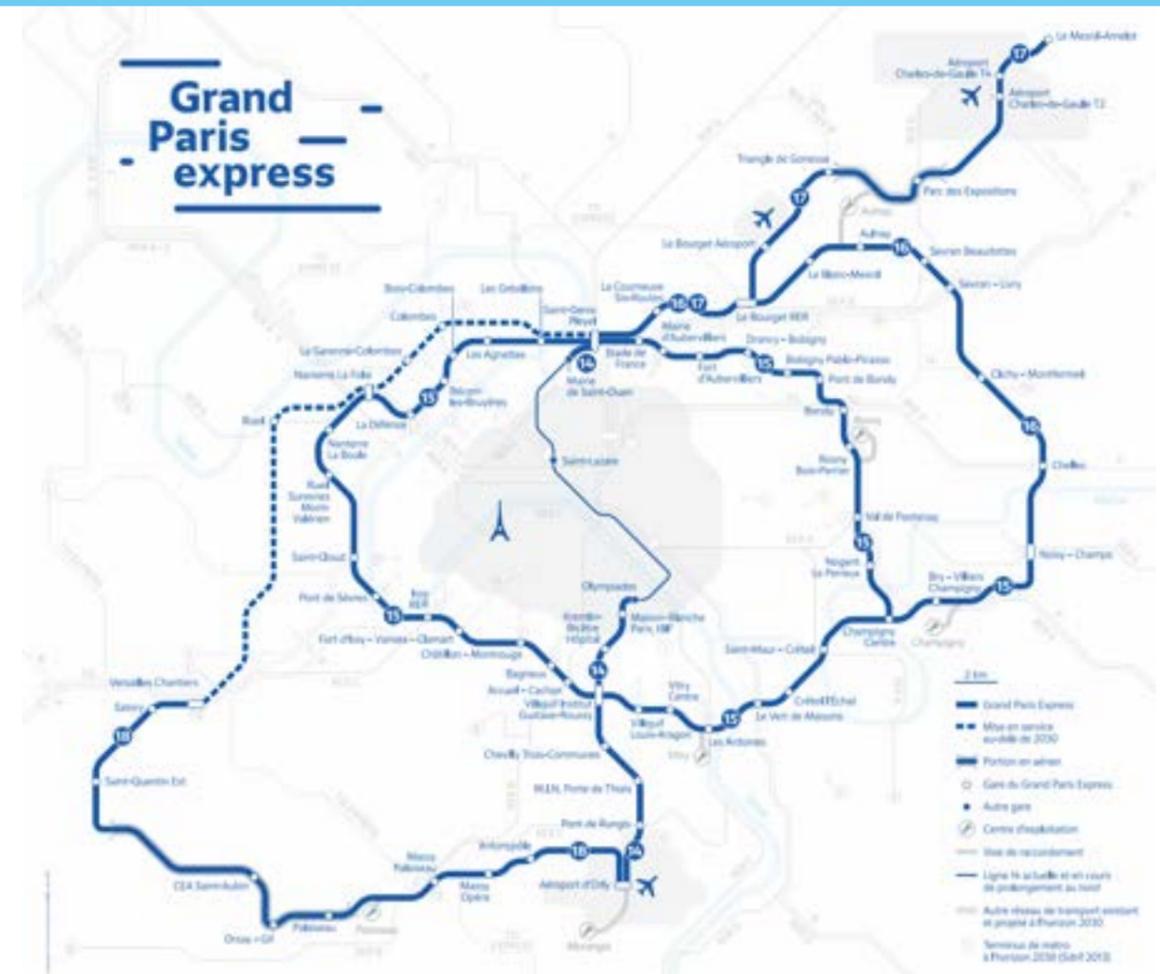


Figure 33. Network of the Grand Paris Express (Horizon Employer, 2018)

GRAND PARIS EXPRESS

Stakeholders

The GPE project represents a multi-stakeholder negotiation between local, regional and national actors (Faure, 2019). It is managed by the state-owned public agency Société du Grand Paris (SGP) established in 2010. Once in operation, the GPE network will be managed by the RATP and Ile-de-France Mobilités. The SGP further ensures the development within and around stations by working together with regional planning experts. (SGP, 2015; SGP, 2022; Faure, 2019).

Outcomes and Discussion

By expanding the public transport infrastructure in the region, it can provide better accessibility and ease its saturation. At the same time, the GPE will induce further mobility demand that needs to be satisfied (Lorthiois & Smit, 2019; researcher in urbanism and urban planning, personal communication, July 21, 2022). Besides, a connection to active and shared mobility is planned for the areas around the new stations (SGP, 2022).

Several concerns are raised that the GPE leads to uneven development increasing regional disparities (Enright, 2013; Lorthiois & Smit, 2019). By setting an economic focus on certain districts, remaining spatial inaccessibility is seen to challenge social responsibility of the GPE (Enright, 2013; Enright, 2016; Lorthiois & Smit, 2019). This is reinforced by the view that the GPE is being built primarily for future residents of the Ile-de-France rather than for existing inhabitants of the Parisian suburbs (architect and urban planner, personal communication, July 6, 2022). Likewise, part of the redesigned network is its expansion to the east promising

to reduce disparities between east and west suburbs (Beaucire & Drevelle, 2013).

The GPE is seen to improve accessibility to mass transportation in the metropolitan area of Paris long term, raising the urge for short term measures that allow mobility improvements soon not only in the City of Paris but especially in its suburbs (social science researcher, personal communication, June 29, 2022).

Applicability to Munich

Mobility is promised to be improved by the GPE in Paris' metropolitan area, similar to the project of the 2nd trunk line in Munich. The GPE aims to reduce private car use as well as travel time by making rapid transit accessible for the inhabitants in the region, thereby the reduction of commuting induced congestion as well as improved air quality is made possible.

Yet, there are aspects to consider. These include the GPE project's demands of extensive human, material and financial resources that are negotiated within a governance and legal framework designed for the project. Its specific characteristics are further enhanced by the impacts of the Olympic Games 2024. Despite the differences to current plans of expanding Munich's suburban rail network, the GPE's concept with a ring route addresses mobility demands such as daily commuting of a growing population in Munich's metropolitan region. In sum, a transfer of the project's idea to Munich seems possible according to the considered criteria.

Outlook

One of our key learnings regarding the planned rapid transit network in Paris' metropolitan area is the fundamental decision of where and for whom accessibility is created (architect and urban planner, personal communication, July 6, 2022). The GPE project reveals challenges, while potentially bringing forward opportunities, such as a greater accessibility to public transport to those who commute within the Ile-de-France.

Our team believes that a project of this size is difficult to fully assess in terms of its implications prior to implementation. Involving social scientists, users, and learning from similar projects are all important perspectives to consider in order to minimise and mitigate potential negative dynamics. However, once fully operational, the effects of the GPE on mobility patterns and regional dynamics will become apparent, and should then be reviewed and analysed on a regular basis.

Project Transferability



Project Impact



PLAN VÉLO

Since Hidalgo's (Socialist Party) inauguration as mayor of Paris in 2014 the transformation of Parisienne bike mobility has been significantly shaped by the two introduced Plan Vélos (bike plans). In the first plan Vélo (2015-2020) the city spent 150 million Euros to support existing and build new infrastructure to make Paris the cycling capital of the world (Mairie de Paris, 2022a).

Motivation and Goals

The plan was based on public opinion research and included not just the planning of hundreds of kilometres of new bike (express-)bike lanes but also the introduction of altered right-of-the-way rules and traffic signs favouring active mobility over motorised vehicles (Nadege, 2019). Furthermore, to incentivize active mobility Paris citizens can request up to six hundred Euros in subsidies for the acquisition of new e- or cargo bikes (Mairie de Paris, 2021). In the second term of the Hidalgo led government the follow-up Plan Vélo (2021-2026) which claims to make Paris 100% cyclable till 2026 was introduced. It builds upon the achievements of the implementation of its predecessor but changes the focus from big scale construction processes to small scale interventions such as the instalment of parking facilities and the connection between the bike network and public transport (Mairie de Paris, 2021). Both of the plans emphasise the importance of the public bike sharing system Vélib. Vélib is one of the biggest bike sharing systems operating today with more than 1400 stations (1000 inside the peripherique and 400 in the neighbouring suburbs and more than 18 thousand electric and conventional bikes carrying more than 350 thousand subscribers through the city of Paris on a daily basis (Vélib, 2022). The 2024

Olympic and Paralympic Games in Paris will set a benchmark for the realisation of the plan vélo (2021-2026) as the city wants to present itself as sustainable and cycle friendly to its visitors and wants to ensure that 70 percent of the visitors of the game can reach the sport facility in less than 30 minutes via bike (Bell, 2022).

Implementation

As the two plan vélos contain a wide-ranging catalogue of measures such as building and broaden existing bike lanes, creating green-wave signal traffic systems for bikes and public transport, replacing car parking spaces for thousands of bicycle arches and supporting bicycle associations the implementation process is as manifold as the applications (Mairie de Paris, 2021). But because Hidalgo governs only the inner area of Paris, most of the infrastructural changes relate only to the twenty arrondissements in the city core (Mairie de Paris, 2021, urban planner, personal communication, July 4, 2022). Although efforts are made to ensure continuities between the outer boroughs and the inner city, inner-city travel is particularly favoured, which leads to increasing gentrification effects and a manifestation of socioeconomic differences in and outside the Peripherique (Razemon, 2021).

1094 km of bike lanes in 2021

KEY FACTS

400 million Euros spent on bike infrastructure

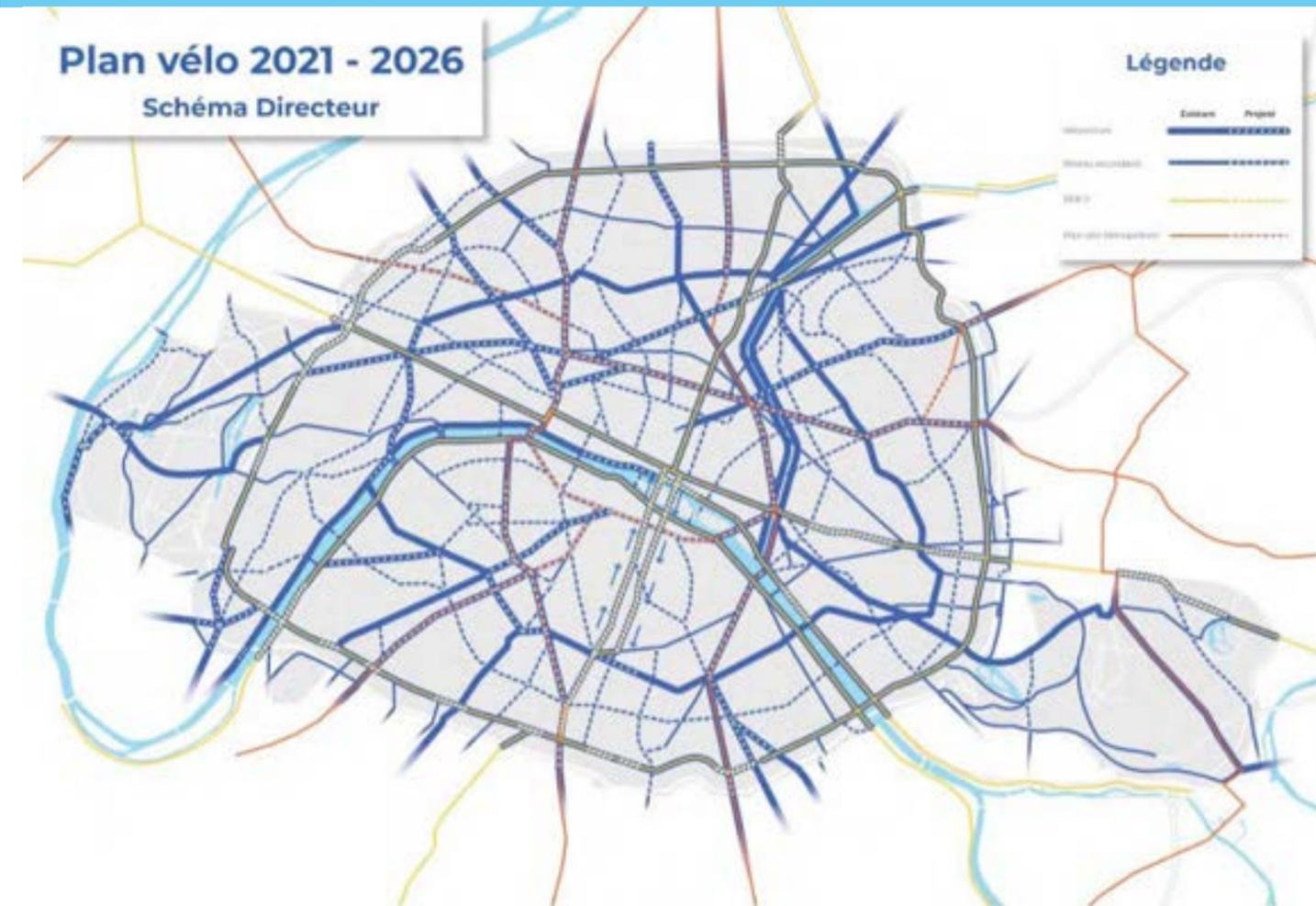


Figure 34. Bike net in Paris. Dotted lines are planned to be realized till 2026 (Mairie de Paris, 2022)

PLAN VÉLO

Outcomes and Discussion

Although not least due to the Corona pandemic and the strike of the mobility company at the end of 2019, the number of bicycle trips in Paris almost doubled between 2019 and 2020, various interest groups such as the bicycle collective Okami Riding, the consulting firm Copenhagenize and the bicycle interest group Paris en Selle criticise the implementation of the Plan Vélos (Transport Environment, 2020, Initiator of Okami Cycling Collective, personal communication, July 2nd, 2022). For example, many people who have recently switched to bicycles lack sufficient training, which leads to an increase in dangerous situations between cyclists. Some cyclists now even feel more endangered by other cyclists than by motorised traffic (Initiator of Okami Cycling Collective, personal communication, July 2nd, 2022). To monitor the ambitious goals of the Plan Vélos, the bicycle advocacy group Paris en Selle introduced a tracker for the progress of the reconstruction measures, quantifying not only how much has been built but also how much has been implemented satisfactorily according to their standards. Only 1000 km of the targeted 1400 km of bike lanes have been realised, with nearly 200 km of the new bike lanes judged unsatisfactory for safety and usability reasons (Paris en Selle, 2022).

According to Hidalgo the delay is caused by „all the consultations necessary to ensure that all those concerned were able to give their opinion: the police, the public transport network (RATP), cycle clubs and so on, and as a result we often had to find a compromise and modify the programme”(Project Pacte, 2019). This statement frames public participation and consultation as hindering the pace of innova-

tion and possibly distorting the goals of the plan vélo even though the plan itself is actively promoting the cooperative planning processes with different stakeholders involved.

Applicability to Munich

With the Munich Radentscheid (bike referendum) and the vote on the planned bike-Altstadtring, the state capital also received a comprehensive plan for improving the bicycle infrastructure. However, this plan was introduced into politics through the collection of signatures and two citizens’ petitions from civil society and was not decided from the top down as in Paris (Radentscheid München, 2022). In both Paris and Munich, bicycle associations criticise the speed of implementation of the plans, although Paris realises significantly more kilometres of new bike lanes per year in absolute terms (Paris en Selle, 2022, Radentscheid München, 2022). This sheds light on one of the central points of our analysis, namely that the political culture in France and Paris allows planned measures to be implemented much faster. Although the speed of construction of new cycling infrastructure lags behind Paris, significantly more of the daily trips in Munich are made by bicycle (18% in 2017) than in Paris (Stadtverwaltung, 2021a). This does not relieve the Munich city government of its obligation to meet the commitments set out in the coalition agreement, but suggests that the pressure to innovate is not as great as in Paris, where only two percent of the trips are made by bike in 2019.

Outlook

Paris has visibly changed since the beginning of Hidalgo’s first term in 2014. Space for cars is relocated, Vélib stations can be found everywhere and some of the most prestigious streets such as the Rue de Rivoli which passes the Tuileries Gardens and the Louvre are now places for active mobility instead of congestion and pollution. Till 2026 the bike infrastructure will further grow with a goal of 180kms of new bike lanes and the Olympic and Paralympic games as a stress test for Paris which set out to become the bike capital of the world in 2015 (Mairie de Paris, 2022). Besides all efforts there are roadblocks which are not so easily to overcome such as the problem of bike theft. In a study 81% of the respondents stated that they are not buying bikes because of fear of theft (Paris en Selle, 2022). If the Paris government is able to reach their goals and use an inclusive and holistic approach towards bike usage beyond the mere implementation of infrastructure the city has potential to compete with the bike capitals of the world even.



Figure 35. Evaluation of Plan Vélo (Paris en Selle, 2022)

Project Transferability



Project Impact



EZYMOb APP

Ezymob is a young tech start-up creating software solutions with an app for the participation of impaired people in public transport and public buildings. They give their service mostly for closed areas such as providing guidance at subway stations, improving the experience of disabled people at their workplaces or increasing the accessibility of people with needs in any indoor event (ezymob, 2022).

Motivation and Goals

People with disabilities often struggle in daily life, and they also have a hard time meeting their accessibility needs. When they are on a subway or in a closed area, it is challenging for them to navigate themselves without proper assistance. As a result, the motivation behind the idea is that the Ezymob is creating opportunities for disabled and elderly people to access public life throughout the city by making sure that they can do all of those things using one app.

Implementation

The cofounder of Ezymob claimed that during their development processes, they put so much emphasis on cooperating with their potential users to evaluate their needs and getting constant feedback from them so that the company has been able to get a firsthand perspective of shortcomings in the accessibility of Paris' public transport. Their operations are not only limited to people with visual impairment but also they focus on elderly people as well as children.

Stakeholders

Our interview partner who is the Cofounder of the Ezymob App shared the importance of the collaboration with the Ile de France Government and the other authorities. However, at the same time, he also declared the negotiations between authority and company cause them loss of time. At the later stages of the project, they intend to form partnerships with other companies in the sector as well.



“Accessibility is marketing” -
Co-founder of Ezymob



KEY FACTS

An App helping impaired as well as elderly people and children to navigate themselves



Figure 36. Impaired person at a RER station (ezymob, 2022)

EZYMOb APP

Stakeholders

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Outcomes and Discussion

At the first stages of the project, our interviewee claimed that due to the lack of feedback sessions between the users and company, they were not efficient enough to predict the needs of the potential users. After they realised the importance of getting constant feedback from users, they started to operate more constructively. Furthermore, as they have all their features embedded in already existing mobility apps, it is easier for users to navigate themselves using the advantages of the app.

For the future of mobility, in alignment with the vision of Ezymob app, he states if all metro areas are automatic, everyone will be aware of the process, and it will be easier for impaired people to commute using PT while also using the Ezymob App.

Applicability to Munich

Mo When the accessibility in Munich is reviewed, it can be said that the subway stations are providing better conditions than in Paris. Most of the U-Bahn and S-Bahn stations

have lifts and escalators which make the job of disabled people easier. Therefore, this project has a huge potential to be implemented in the Munich context.

The Ezymob project does not have huge risks in terms of the governance part as it is directed by a private company and its scope is mostly determined by the people who are using the service. Whereas, to apply this project in Munich, different parameters need to be calculated by the company as also our interviewee clarified in his interview. Every city has its own characteristics and different needs. Therefore, there needs to be a prior analysis before going depth into any city.

In terms of the field of the impact, the Ezymob App can be regarded positively in general. For both aspects, time, space and air, Ezymob provides effective solutions for impaired people mostly and regarding all of those aspects, the detailed evaluation can be seen in Figure XX.

Outlook

The accessibility of disabled people is a problem in Paris. In most of the subways, there is a lack of lifts or esclators. In that case, the right guidance for people in need gains more importance. Moreover, in a closed area, there are obstacles such as ramps and narrow hallways that those people can experience. To overcome those issues, the Ezymob app is developed with giving importance to the opinion of its users. Their scope is limited to France for now and if they can find a way to extend their use-cases in different countries and cities, an important need for impaired people would be satisfied for the future as well. .



EZYMOb

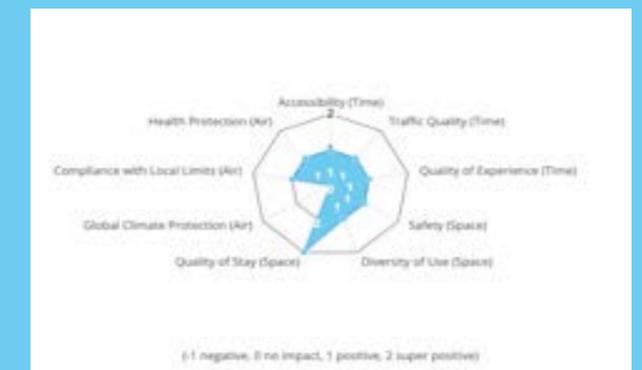
LE PROGRÈS AU SERVICE DES DÉFICIENTS VISUELS

Figure 37. (ezymob, 2022)

Project Transferability



Project Impact



POP-UP BIKE LANES

The pop-up bike lanes are seen as one core measure of the temporary arrangements in Paris' public space during the pandemic (Denis & Garnier, 2022). These 50 km so-called coronapistes blend in the existing and planned bike network across Paris after the first lockdown in May 2020.

Motivation and Goals

The unique situation of the pandemic required action to provide a mobility alternative to the reduced capacity of the already saturated metro as well as to avoid increased private car usage (Paris.fr 2022, Nikitas et al. 2021; urban planner and project manager, personal communication, July 5, 2022). Hidalgo used the opportunity of the emergency situation to accelerate the implementation of bike lanes already envisioned in Paris' Plan Vélo 2015-2020 to establish more sustainable mobility patterns (O'Sullivan, 2020; Nikitas et al., 2021; Appleton, 2020; urban planner and project manager, personal communication, July 5, 2022).

Implementation

On 13th May 2020 the city of Paris announced the implementation of temporary bike lanes within a few weeks (Denis & Garnier, 2022). Here, the experimental approach combined with the emergency situation allowed passing standard-construction procedures (Moran, 2022; Denis & Garnier, 2022; urban planner and project manager, personal communication, July 5, 2022). The bike lanes replace traffic lanes as well as on-street parking (Moran, 2022; Denis & Garnier, 2022). Created across Paris, they cover long distances and follow metro routes frequently as well as connect outskirts with



Figure 38. Temporary bike lane following the Métro line 13

KEY FACTS

50 km of pop-up bike lanes

Introduced in spring 2020

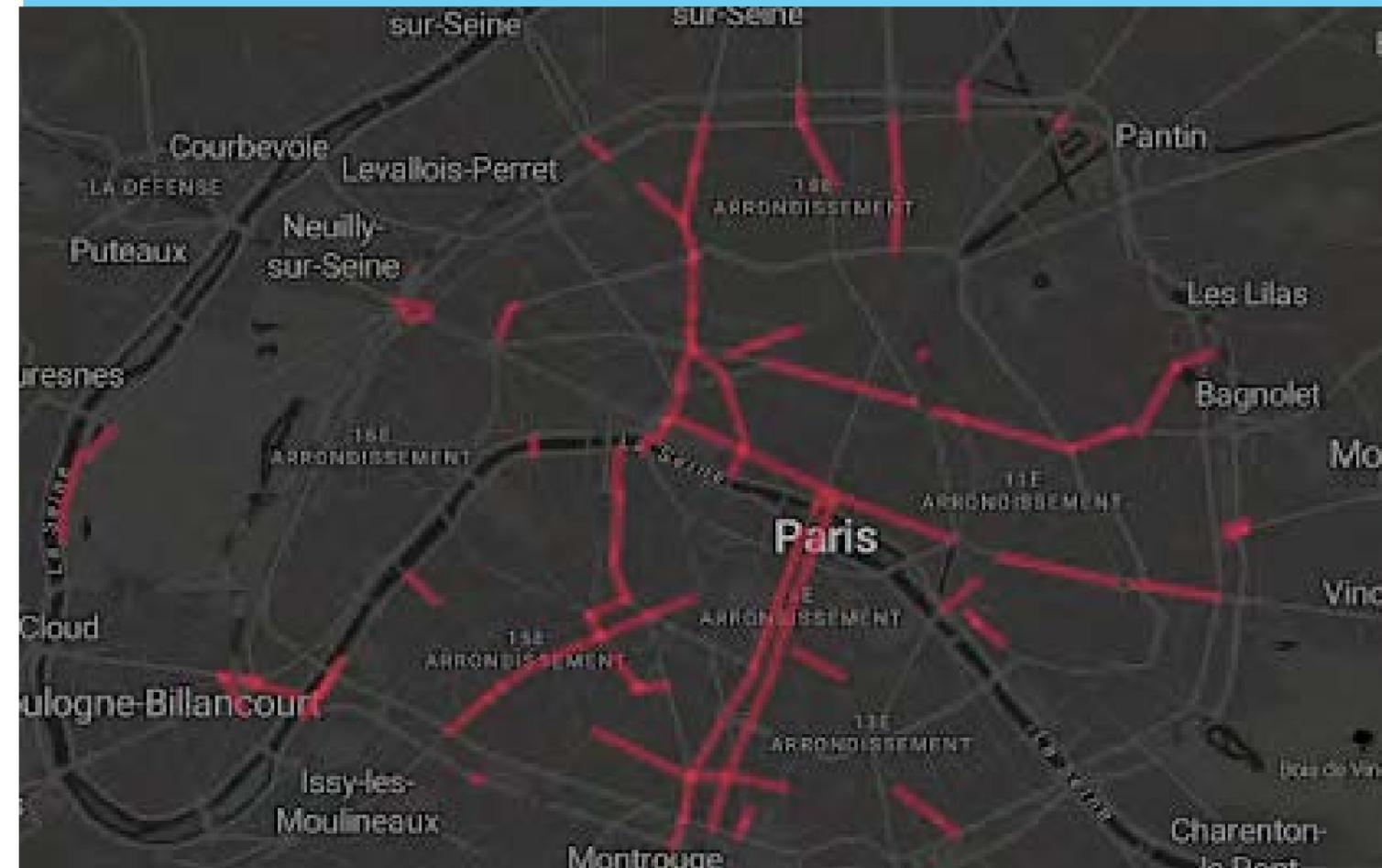


Figure 39. Map of created pop-up bike lanes (Direction de la Voirie et des Déplacements - Ville de Paris, 2022)

POP-UP BIKE LANES

Stakeholders

The implementation of the temporary bike lanes was based on the mayor's decision bypassing any kind of consultation (Denis & Garnier, 2022). Therefore, a joint dialogue on street space distribution was neglected (Jachmann, 2021; Denis & Garnier, 2022). However, adjustments of pop-up bike lanes were made reacting to site-specific needs and challenges enabled by their flexible design (Denis & Garnier, 2022). Moreover, the engagement of the regional prefect allowed the expansion of temporary bike lanes to several suburbs in Paris' metropolitan area (ibid.).

Outcomes and Discussion

Since Spring 2020 the pop-up bike lanes are in use across Paris, initially designed with temporary elements such as yellow marks, staggered concrete blocks and plastic posts (Moran 2022; urban planner and project manager, personal communication, July 5, 2022). In the same year, Hidalgo promised the permanence of these lanes in the city (Denis & Garnier, 2022).

The number of cyclists has increased within the first year of the health crisis by two thirds and more diverse people are cycling now in Paris (Jachmann, 2021; urban planner & project manager, personal communication, July 5, 2022). Difficulties appear due to fast redistribution of street space among different transport modes, safety challenges on shared lanes of bike and bus as well as missing connections of lanes at intersections (urban planner and project manager, personal communication, July 5, 2022, DRIEA, 2020). At the same time, the pop-up bike lanes are more protected, bi-directional and interconnected than the ones

of the pre-pandemic bike network leading to increased security, comfort and route choices for cyclists (Moran, 2022).

Paris' pop-up bike lanes are an example of strategically used tactical urbanism. By implementing low-cost, temporary elements the long term envisioned redistribution of street space in favour of cycling is made possible. The experimental approach of the coronapistes further allows testing out and experiencing new bike infrastructure, not as a representative sample but on a 1:1 scale. The increase of bicycle traffic finally allowed the justification to make these bike lanes permanent in favour of the mayor's mobility policy. (Denis & Garnier, 2022)

Applicability to Munich

Long distanced pop-up bike lanes connected with existing ones in Paris smoothen bike traffic flows and allow flexibility in route choice. The coronapistes' design enhances comfort and security by not only replacing motorised traffic lanes as in Munich but also parking spots and frequently adding separating elements. On the Rue de Rivoli for example an increased quality of stay is reached by replacing motorised traffic overall. Pop-up bike lanes potentially enhance air quality when shifting the modal split to more sustainable transport modes.

In many European cities, pop-up bike lanes were introduced as an covid-19 mobility measure, but the one in Paris has been striking in size due to constituting already existing plans (Kraus & Koch, 2020). Little resources are needed to install temporary bike lanes and their flexibility allows site-specific adjustments. Similar to Paris, Munich created these

ones within a few weeks in 2020. However, the importance of car infrastructure in Munich can be seen by implementing only five short-distance pop-up bike lanes without disrupting parking spaces (cycling coordinator, city of Munich, personal communication, October 21, 2020). Unlike Paris, the experimental approach in Munich was not designed to be turned into permanent infrastructure straight away (cf. euMOVE report 2021).

Outlook

Just before the pandemic, despite bad weather conditions, cycling mobility increased due to several weeks of public transport strike (Denis & Garnier 2022, urban planner and project manager, personal communication, July 5, 2022). Given the circumstances of the pandemic, people tend to avoid public transport (urban planner and project manager, personal communication, July 5, 2022). The pop-up bike lanes were not only a relief of public transport

but represent street space allocation in favour of cycling by accelerating already planned bike lanes with an experimental approach (Moran 2022).

Overall, the pandemic related circumstances will not be replicable due to its uniqueness which is seen as one of the main successors of the coronapistes (Denis & Garnier 2022).

Project Transferability



Project Impact



CONCLUSION

To summarise, we can see that Paris is a city from which we can learn and reflect a lot when it comes to the transformation of mobility in European cities. Of course, a simple copy-and-paste approach will not lead us to what we are aiming for - socially robust, sustainable mobility solutions. Nonetheless, the case study at hand allowed us to observe a city that incentivizes experimenting with new ideas (as indicated in the Cargo Bike Sharing, Pedestrianisation, or Smart City projects) and enacting policies in a timely manner.

We discovered that single technological solutions are unable to produce the desired effect of a holistic ecologically and socially sustainable mobility system. Consider the initiatives associated with the Redistribution of Space. Simply removing parking spaces in certain places without addressing how people access other forms of transportation or, for example, the viewpoint of local shop owners would not result in a successful new system. Furthermore, we internalised the need for new conceptions to make sense of space that was, for instance, previously dominated by motorised vehicles. These spaces may now be and are being turned into open public spaces where people can coexist, interact, and meet. They do so outside outdoor cafés and restaurants, in front of schools and kindergartens, while moving in a multimodal manner that mixes several types of active mobility and public transportation.

We appreciated the project as an interdisciplinary group of students mostly because of the numerous fascinating observations and insights for mobility systems that we collected throughout the field trip.

Obtaining insights and perspectives on transformative urban planning activities in Paris supports us in addressing mobility strategies in Munich. The case study indicates that modifying user mobility behaviour is not a merely technical planning task that can be completed by a few dedicated experts. Quite the contrary. Our four-person team recognised and embraced the fact that for mobility change to be generally adopted by society and users, multiple stakeholders must provide input on each solution under consideration. It can only be applied successfully if external factors like political culture, decision-making processes, social science perspectives, and other interest groups are continuously and actively considered.

Beyond discovering mobility solutions in Paris, we got to know thought leaders from a car-free city ecosystem and network, start-up founders, scholars, or urban planners. They, for instance, create experimental and creative solutions for participation for people with disabilities, rethink industrial neighbourhoods, as well as tackling problems such as bike theft or cargo-bike sharing.



BENCHMARKING

As described in the methodology chapter, the applicability index summarises the studied projects abroad and shows if they are applicable to Munich in terms of expected impact and transferability. The table gives an overview of all projects in all cities, ranked by their applicability to Munich for each cluster. In the following paragraphs, the applicability index will be summarised for all five clusters.

In the ‘Redistribution of Space’ cluster, the majority of the projects have a medium or high positive impact, while the transferability is mostly rated medium. The high impact in all three criteria (air, time and space) can be explained by the fact that these projects typically give back urban territory to pedestrians and cyclists, thereby simultaneously lowering emissions, improving travel times and embellishing public space. The transferability values imply that the projects can be implemented in Munich, but require some adjustments to the local context. Especially the Piazze Aperte (Milan) and Low Traffic Neighbourhoods (Brussels) projects have a high overall positive applicability index and are therefore recommended to read.

The ‘Innovative Planning’ cluster stands out in terms of high transferability, while the impact of these projects is mixed. However, the projects with low or medium impact should not be dismissed, as they are typically innovative in one particular criteria (air, time or space), which can be seen in the individual project descriptions, but which doesn’t translate well to this overall summary of impact and transferability. Nonetheless, three projects in this cluster are holistically impactful and highly transferable: 15 Minute Milan (Milan), Pass Navegante (Lisbon), City 30 (Brussels) and should therefore be referenced for Munich.

The ‘New Transport Infrastructure’ cluster comprises nine projects. Their impact is mostly positive (medium or high level) and the majority of the projects are highly transferable. With the usual major changes and improvements that come with a new or expansion of transportation infrastructure, it stands to reason that these projects also have a major impact on the environment. Since the focus was on innovative mobility projects, the positive impact in times of climate change was to be expected, but pleasing nonetheless. It is assumed that the regulations for infrastructure projects are similar on a European level and therefore the projects can be transferred more easily to Munich. BikeMi (Milan) is a recommended read due to its high overall applicability.

The applicability in the “Digitalisation and Technology” cluster is balanced. Some projects show low to medium levels of impact with medium transferability, while the others show a medium to high level of impact with a high level of transferability. Clearly, this cluster is difficult to summarise due to the wide range of possibilities offered by digitalisation and technology. In this cluster, the Geofencing and ViaNova and MoveBrussels - Mobility as a Service projects (both Brussels) are of particular interest as they solve regulatory issues with technology.

The Covid-19 Adaption cluster summarises projects which were implemented during the Covid-19 pandemic or as a consequence of it. Most of the investigated projects show a low or medium level of impact with medium to high level of transferability. All projects had to be implemented rapidly, foregoing detailed planning and slow bureaucratic processes. This results in the lower impact (no detailed planning possible) and the higher transferability (no time for slow bureaucratic processes). As the projects were implemented in reaction to the pandemic, they may not be transferable directly to everyday life. Nonetheless, it is recommended to read through these projects individually, as they all provide learnings on how to implement projects faster, independent of the pandemic context.

Overall, it is clear that the projects from the “Redistribution of Space” and “New Transport Infrastructure” clusters in particular are highly impactful and easily transferable, and therefore very applicable to Munich. “Innovative Planning” as well as “Digitalisation and Technology” projects require some adjustments to the local context, as these kinds of projects typically rely more heavily on country- or city-specific regulation and planning processes. Refer to the project descriptions for the particulars of their impact (air, time and space) and transferability (governance, local context and local challenges).

Applicability Level	Low	Medium	High
Legend			

Table 6. Legend for benchmark analysis between Munich and euMOVE 2022 cities.

Cluster: Redistribution of Space

	Project	Impact	Transferability
Paris	Re-design of Place de la Republique and Place de la Bastille	●	●
	Pedestrianisation	●	●
Milan	Piazze Aperte	●	●
	Zone B and C	●	●
	Cambio	●	●
Lisbon	Uma Praça em cada Bairro	●	●
	A Rua é Sua	●	●
Brussels	Low Traffic Neighbourhoods	●	●

Cluster: Innovative Planning

	Project	Impact	Transferability
Paris	Smartcity	●	●
	Bike Experiments	●	●
Milan	Ciclobby	●	●
	15 Minute Milan	●	●
Lisbon	Biciculutra – Comboios de Bicicleta	●	●
	Bicicultura - Veloteca	●	●
	MUBi	●	●
Brussels	Pass Navegante	●	●
	City 30	●	●

Cluster: New Transport Infrastructure

	Project	Impact	Transferability
Paris	Plan Vélo	●	●
	Grand Paris Express	●	●
Milan	GoVOLT	●	●
	Raise UB	●	●
	BikeMI	●	●
Lisbon	Carris: On-Demand and Para-Buses	●	●
	GIRA - Bicicletas de Lisboa	●	●
Brussels	Building a Better Biking Base in Brussels	●	●
	Werken aan de Ring - Working on the Ring	●	●

Cluster: Digitalisation and Technology

	Project	Impact	Transferability
Paris	Ezymob App	●	●
Milan	Numidas	●	●
	IPA2x	●	●
	CityFlows	●	●
Lisbon	Micro Mobility Governance	●	●
Brussels	E-scooter regulations with heavy reliance on technology: Geofencing and ViaNova	●	●
	MoveBrussels - Mobility as a Service	●	●

Cluster: Covid-19 Adaptions

	Project	Impact	Transferability
Paris	Pop-up bike lanes		
Milan	A-Round Corvetto		
	Strada Aperte		
Lisbon	City Bike Lanes		
Brussels	Conforming to Covid		

CONCLUSION

In this year's euMove report 16 students had the chance to visit 4 European cities – Brussels, Lisbon, Milan, and Paris. The teams had the chance to examine the innovative and captivating approaches to mobility in these appealing cities. In summary, as examined in the various parts, split up in the 5 clusters – Redistribution of Space, Innovative Planning, New Transport Infrastructure, Digitalization and Technology, and Covid-19 Adaptations, for the different projects, all aspects were inspected and brought into a perspective, which is fitting for the initial city – Munich. Besides this, all possible up- and down-sides were considered, and in the end, the possibilities and hurdles for a prosperous implementation in Munich were examined.

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, all of which contribute more or less to the overall goal. Furthermore, these initiatives, approaches, projects, and ideas can, even though these differences are seen concerning Munich as well, be seen as examples of how Munich can enhance its mobility plans and approaches to enable the best possible way to reach the common goal by implementing these ideas, but also consider the challenges the cities had to face to implement the projects successfully – especially during a pandemic.

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, all of which contribute more or less to the overall goal. Furthermore, these initiatives, approaches, projects, and ideas can, even though these differences are seen concerning Munich as well, be seen as examples of how Munich can enhance its mobility plans and approaches. This could be a chance to enable the best possible way to reach the common goal by implementing these ideas, but also consider the challenges the cities had to face to implement the projects successfully – especially during a pandemic.

Therefore, 3 major trends, following the pre-defined clusters emerged that ultimately show that all 4 cities are working towards a more sustainable, inclusive, and innovative way of approaching mobility.

1. Enhancing the liveability of the cities by bringing the people together and promoting active mobility

During the pandemic there were and still are several restrictions on how you can get around and meet people. Most people were desperate to get outside, move their bodies and meet other people. This is what the cities understood and where they ultimately stepped in and put more focus on projects that are dealing with these issues. No matter which city one looks at there were various projects that tackled these problems. If it is Milan with the [“Piazze Aperte”, p. 185](#), Lisbon with its projects [“Uma Praça em cada Bairro”, p. 123](#) or [“A Rua É Sua”, p. 127](#) or Brussels and Paris indirectly with their projects of car-free streets and pedestrianisation of their cities (see “Low Traffic Neighbourhoods”; “Pedestrianisation”).

All these interventions have the main goal of enabling safe spaces for active movements or rather also places where the people can come together – outside – safely and healthily, despite the pandemic being still a present topic. This ultimately increases the liveability of the city and feeds the needs of the citizens, as well as visitors, of the city, by also being inclusive for all people involved.

2. Focus on improving the overall situation for cyclists

The trend of making bikes as a mode of transport safer, more interesting, and thus more attractive, ties perfectly with the ideas of the first trend. In particular, during the high times of COVID-19, the people needed alternatives to public transport, which was and still is, in some cases, only accessible restrictively, and cars, as it is commonly known, should not be the main other option. This ultimately led to the need for an alternative way to get around, which is why all of the cities tried and are still trying to make cycling a real alternative.

All of the 4 cities specifically focused on this topic with their individual approaches and thus numerous projects and especially initiatives in this regard were identified. These include for example associations like [“Ciclobby”, p. 197](#) in Milan, as well [“Bicicultura”, p. 131](#) in Lisbon that specifically focus on improving the situation of cyclists and making biking more accessible to a larger number of people by providing the necessary resources. Furthermore, there were and still are numerous projects and initiatives that are focused on biking and thus cyclists, like the promotion of biking initiated by the city of Brussels (see “Building a Better Biking Base in Brussels”), particular plans to enhance the situation for cyclist, like for example seen in Paris (see “Plan Vélo”) or “Pop-Up Bicycle Lanes” or similar initiatives in various cities, including Munich itself.

These associations, projects, and initiatives show that the cities are trying their best to include safe biking in their city planning, even though the topic is indeed somewhat politicised and thus a topic of discussion and not as easy to implement in quite some places.

3. Connection, Sharing, and Digitalisation of different modes of transport and their services

Digitalised approaches towards the connection of services and the offering of sharing multiple modes of transport is another important trend that was identified in the 4 cities examined by the teams. In many cases links to the trends before can be made, particularly looking at the development of bikes as the new and more popular mode of transport. There are indeed several different approaches to this topic, including for example sharing of various types of bikes in Milan (see [“Bikemi”, p. 209](#)), and diverse micro-mobility projects including public-private partnerships in Lisbon (see [“Micro-mobility Governance”, p. 155](#)). Furthermore, MaaS and overall digitalisation in Brussels (see “MoveBrussels”), and ultimately the creation of a network between different train stations in Paris (see “Paris2Connect”) are also great examples of this explored development.

In particular, with regards to the younger generations and of course the current situation this development should indeed be in focus for multiple cities. Therefore, it was great to see that there is indeed a focus on such innovative topics. Moreover, the uniqueness of the various projects shows that there is a lot of potential in different areas concerning urban mobility.

All of these trends are not solely ones Munich is following as well, but also the unique projects show examples of how Munich can engage even more in these topics and thus might be a great example of how these trends can be approached differently and thus enhance Munich's situation.

Overall, these developments and trends show that there is not merely a need but also efforts of all the cities to tackle various problems and issues of the current times. Moreover, it shows that the cities value a more sustainable, connected, and socially advanced approach to mobility for their citizens as well as the visitors of their cities, which was a pleasant development to observe for the 4 teams involved in this report and is a welcomed evolution for all stakeholders.

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