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metaCCAZE

Deliverable 1.1:

Trailblazer LLs - Status Quo map, prototype ZESM Use Cases for passengers and freight

WP1

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Abbreviations and Acronyms

ACRONYM	Description
AI	Artificial intelligence
ASG	Adaptive Speed Governance
AVL	Automated Vehicle Location
AVs	Autonomous Vehicles
BIGMs	Business Innovation and Governance Models
CAVs	Connected Autonomous Vehicles
CCAM	Connected, Cooperative, and Automated Mobility
CCC	Climate City Contract
CVs	Connected Vehicles
EU	European Union
EVs	Electric Vehicles
GNSS	Global Navigation Satellite System
ITS	Intelligent Transportation Systems
KPIs	Key Performance Indicators
LEVs	Light Electric Vehicles
LL	Living Labs
ODD	Operational Design Domain
PT	Public Transport
RTK	Real-Time Kinematic
SIEF	Standardized Impact Evaluation Framework
SME	Small and Medium-sized Enterprises
SUMP	Sustainable Urban Mobility Plan
TEN-T	Trans-European Transport Network
T-LL	Trailblazer Living Labs
TMC	Tradable Mobility Credits
UC	Use Case
V2I	Vehicle-to-Infrastructure
V2U	Vehicle-to-User

V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Everything
WP	Work Package
ZESM	Zero Emission Smart Mobility

Background: About the metaCCAZE project

Transport is the second largest source of greenhouse gas emissions (GHG) and accounts for more than 30% of the total energy consumption. A series of global crises highlight the need for a significant shift from conventional vehicles to well-integrated, energy efficient, connected and automated passenger and freight services that meet the ambitious EU goals. To do so, a paradigm shift is required in the operations of electric vehicles that tackles their inherent vulnerabilities, including: the electric fleet-grid supply mismatch, the slow charging times, and the vehicle delays at charging stations. This requires automated charging processes, intelligent scheduling operations and matching to the grid, interconnectivity and automation of transport operations, and a shift from private cars to shared modes.

metaCCAZE is a Horizon Europe MISSION project co-funded by the 2Zero, CCAM-and Cities' Mission partnerships. It participates in the CIVITAS Initiative, an EU-funded programme working to make sustainable and smart mobility a reality for all and contributes to the goals of the EU Mission Climate-Neutral and Smart Cities.

The metaCCAZE project aims to revolutionise mobility in European cities, serving both passengers and freight, with innovative electric, automated, and connected solutions designed to make transportation smarter, net zero, and more efficient for all. It builds on the expertise of 44 partners from 12 different European countries and contributes to the green metamobility era that the Green Deal, 2ZERO, CCAM, Cities Mission, CIVITAS and other EU initiatives aim to reach by 2030. In the vibrant streets of four trailblazer cities – Amsterdam, Munich, Limassol, and Tampere – metaCCAZE implements, tests and demonstrates cutting-edge technologies and services that support shared zero emission mobility solutions for people and goods, contributing to climate neutrality. Successful technologies and activities are transferred and implemented in six Follower Cities – Athens, Krakow, Gozo, Milan, Miskolc, and Poissy, Paris.

metaCCAZE organises a series of metaDesign activities and develops a toolkit called metaInnovations. This toolkit is pioneered in passenger and freight services (public transport, on-demand minibuses, bike and scooter sharing, deliveries) and related infrastructure (mobility and logistics hubs, traffic management centres, charging infrastructure, transport and energy integration) and widely demonstrated in our four trailblazer cities for a whole year. Successful metaInnovations and metaServices are transferred, implemented and demonstrated in the six follower cities for up to 8 months, to ensure their transferability and resilience potentials.

Executive Summary

This deliverable presents a comprehensive overview of the initial activities and progress achieved within the metaCCAZE project, focusing on the co-design and prototyping of twelve innovative Use Cases (UCs) aimed at accelerating the deployment of smart, shared, zero-emission mobility solutions in four Trailblazer Living Labs (T-LLs) located in Amsterdam, Munich, Limassol, and Tampere. These UCs are designed to address critical urban mobility challenges and facilitate the transition towards sustainable, zero-emission transport for both passengers and freight in these four cities.

The UCs developed for each T-LL are as follows:

Amsterdam LL will implement four UCs:

- Autonomous Electric Waterborne Vessels for Logistics (AM-UC01): Focuses on deploying autonomous electric vessels for logistics, initially piloted in the Port of Amsterdam, with the goal of expanding operations to the city centre.
- Speed Management of Connected E-Bikes (AM-UC02): Tests Adaptive Speed Governance (ASG) for e-bikes, allowing dynamic speed control based on real-time conditions, with large-scale testing planned in Vondel Park.
- Optimizing Intermodality of Waste Collection (AM-UC03): Implements an intermodal waste collection system using cargo bikes and ships to improve waste management in Amsterdam's city centre.
- Tradable Mobility Credits (TMC) Scheme (AM-UC04): Designs and tests a TMC system to manage traffic-related environmental impacts.
- The use cases are supported by digital twining environments where the interventions can be visualized and monitored.

Munich LL will implement two UCs:

- Dynamic Curbside Management (MU-UC01): Implements a dynamic curbside management system with digital mapping and monitoring, complemented by a connected, semi-automated zero-emission vehicle for last-mile transport.
- Establishment and Operation of a Multimodal Logistics Hub (MU-UC02): Establishes a logistic hub for last-mile delivery using cargo bikes and energy-efficient vehicles, aiming to reduce car traffic and enhance road safety.

Limassol LL will implement four UCs:

- On-Demand Mini-Bus Services (LI-UC01): Launches an on-demand electric mini-bus service, initially for school transport, with potential expansion to tourists and city employees, optimized through AI algorithms.
- Shared E-Bikes (LI-UC02): Implements a new shared e-bike service with strategically placed docking and charging stations, managed by an AI-driven platform.
- Multimodal Passenger Hub (LI-UC03): Establishes a Mobility Hub to centralize various transportation modes, ensuring seamless connectivity and enhancing access to public transport.
- Transport & Energy Integration and Management (LI-UC04): Develops an IoT platform to integrate transportation, EV charging, and the electricity grid, optimizing charging times based on energy availability.

Tampere LL will implement two UCs:

- Autonomous E-Shuttles (TA-UC01): Demonstrates the feasibility of remote operations for driverless shuttles, supported by a Remote-Control Centre and necessary infrastructure upgrades.
- Tram-Feeder Service (TA-UC02): Integrates automated shuttles with a tram line to expand its coverage area, also supported by the Remote-Control Centre and inductive charging solutions.

These UCs represent a diverse range of innovative solutions tailored to the unique needs of each T-LL, setting the ground for their implementation and demonstration starting in 2025. The success and lessons learned from these UCs in the four Trailblazer cities will be pivotal as they are subsequently transferred to and implemented in six Follower Living Labs (F-LLs) across Europe.

This document outlines the foundational work carried out across the four T-LLs during the first nine months of the project (January 2024 to September 2024), including the Status Quo Map, the design and prototyping of UCs, and the development of Business Innovation and Governance Models (BIGMs). Particularly, the Status Quo Map provides a preliminary assessment of each T-LL's current capabilities, stakeholder needs, and data availability. Meanwhile, the prototype UCs detail the operation of smart systems and services, user interactions, and technical requirements, and the BIGMs outline the collaborative roles and value creation mechanisms for each UC.

The methodology for developing the prototype UCs and BIGMs involved a metaDesign (co-creation) approach that engaged stakeholders through workshops and iterative refinement. Each T-LL organized workshops to co-create detailed models of smart mobility solutions, capturing essential aspects such as user interactions, technical requirements, and operational concerns. The prototypes were refined based on feedback and harmonized across different T-LLs to ensure adaptability and scalability.

The outcomes of this work will guide the validation of the UCs and BIGMs in the coming months, ensuring their readiness for implementation and demonstration. This deliverable also serves as a foundation for future project work, including the development of the Standardized Impact Evaluation Framework (SIEF) and planning of cross-fertilization activities between T-LLs, F-LLs and beyond, contributing to a broader transition towards zero-emission urban mobility across Europe.

1. Introduction

1.1. Objectives of the Deliverable

This deliverable provides a comprehensive overview and detailed description of the activities undertaken within the metaCCAZE project, focusing on the preliminary work and prototyping essential for co-designing and shaping twelve innovative Use Cases (UCs). These UCs will be implemented and demonstrated in four Trailblazer Living Labs (T-LLs) located in Amsterdam, Munich, Limassol, and Tampere, as referred already, with the goal of accelerating the deployment of smart, shared, zero-emission mobility solutions for both passengers and freight in these cities. Successful UCs will subsequently be transferred, implemented, and demonstrated in six follower cities.

This document outlines the foundational work carried out across the four T-LLs during the first nine months of the project (January 2024 to September 2024), including the Status Quo Map, the design and prototyping of UCs, and the development of Business Innovation and Governance Models (BIGMs). Particularly, the Status Quo Map provides a preliminary assessment of each T-LL's current capabilities, stakeholder needs, and data availability. Meanwhile, the prototype UCs detail the operation of smart systems and services, user interactions, and technical requirements, and the BIGMs outline the collaborative roles and value creation mechanisms for each UC.

To achieve these outcomes, the project organized a series of metaDesign activities involving multisector stakeholders and population groups to co-design and share UCs and collaboratively develop BIGMs. The continuous interaction between the metaCCAZE core technical team, the four Living Labs, technical support partners, technology providers, and stakeholders, along with the population groups involved in the co-design process, is captured in this deliverable.

The results presented lay the foundation for further refining the UCs and BIGMs during the second half of 2024 and for designing the impact evaluation framework that will monitor and assess the implementation and demonstration of all twelve UCs starting in 2025.

1.2. Structure of the Document

This deliverable begins with an introductory chapter that provides context and outlines the purpose of the document, setting the stage for the subsequent sections. The document is then divided into three main chapters:

- Chapter 2 - Use Cases Introduction and Definition: This chapter introduces the concept of Use Cases (UCs) and provides an overview of each UC. It aims to guide the reader through the document by detailing the UCs around which the rest of the content is structured.
- Chapter 3 - Status Quo Map: This chapter outlines the methodology used to assess the current situation in each T-LL, focusing on capability, empathy, and data mapping. It presents a detailed Status Quo Map for each city, summarizing the findings and establishing a foundation for the development of prototype UCs and BIGMs.
- Chapter 4 - Prototype UCs and BIGMs: The final chapter describes the process of developing and refining the prototype UCs and BIGMs. It details the methodologies applied in co-creation workshops, the integration of stakeholders' feedback, and the harmonization of results across the T-LLs. The chapter concludes with an analysis of the outcomes for each UC and BIGM within each T-LL.

In addition to its four chapters, the document includes two annexes:

- Annex I - Summary of Data Map: Summarizes the availability of mobility and traffic data across T-LLs.

- Annex II - Data Map for Each T-LL: Comprehensive data maps for the four T-LL cities, detailing data categories, sources, formats, and other relevant information.

1.3. Relation to Project Documents

This document is the first in a series of Work Package 1 (WP1) deliverables. It is aligned with Deliverable D6.1 - Project Handbook (Inception, Quality, and Risk Management), particularly concerning management structures and risk management procedures. Additionally, it is expected to serve as a foundation for Deliverable D1.3, which shares similar objectives but aims to establish the preliminary work essential for co-designing and shaping Use Cases (UCs) in the six Follower Living Labs (F-LLs). Deliverable D1.2 will also build on this document, presenting the framework and details regarding cross-fertilization activities and specifications for transferability between the T-LLs and F-LLs.

Furthermore, this document will form the basis for the work in the upcoming months to fine-tune UCs and BIGMs and design the SIEF, which will guide the implementation of smart, shared, zero-emission mobility solutions within WP3. This process of fine-tuning and validation will also be captured in Deliverable D1.4, as it will present the final UCs and BIGMs that will be transferred to WP3 for implementation and demonstration.

1.4. Overall Approach

This deliverable was developed through close collaboration among the WP1 Task leaders, particularly those involved in Task 1.1 (LLs' resources, SUMP, and Status Quo Map), which was led by TRT and co-led by BABLE (focusing on stakeholder and user needs specification) and NTUA (focusing on the recognition of cities' available data). Additionally, Task 1.2, which focuses on the metaDesign of zero-emission shared mobility use cases (UCs), was led by BABLE, while Task 1.3, dealing with metaDesigned collaborative business and governance models, was led by ERTICO. The overall orchestration of the deliverable was managed by TRT, the partner leading WP1.

The authors also consulted key project documents, including the Grant Agreement and Deliverable 6.1 - Project Handbook (Inception, Quality, and Risk Management), to ensure that all descriptions and processes outlined here are aligned with these key documents.

The T-LL partners (both leaders and supporters), along with other partners responsible for related activities, contributed to writing sections of the document that pertain to activities being implemented in their respective living labs. These contributions included describing the Status Quo and UCs specific to their T-LLs. The inputs provided by the T-LL partners were then refined to ensure consistency and comparability across the four T-LLs. The final results, including the Status Quo Maps and Prototype UCs and BIGMs, were re-elaborated and interpreted by the WP1 core partners and subsequently reviewed and fine-tuned by the T-LL partners, as well as reviewed by internal to the consortium experts on the topic.

This collaborative approach was designed to ensure that all descriptions contained in this deliverable are aligned with the vision of the T-LLs and other partners who design or influence the metaServices and metaInnovations that will be implemented and demonstrated during the metaCCAZE project.

Additionally, the project adopts a metaDesign framework (established by BABLE within Task 1.6 - LLs cross-fertilisation and transferability activities), which emphasizes the involvement of stakeholders, including citizens, in the co-creation of UCs and BIGMs. This participatory approach ensures that the solutions developed are not only technically robust but also socially accepted and aligned with stakeholder and user needs.

2. Use Cases introduction and definition

In the context of the metaCCAZE project, a Use Case (UC) represents an innovative service for zero-emission people mobility and/or freight transport, addressing specific challenges identified within the project for a designated area in each metaCCAZE Living Lab. Each UC integrates various measures that combine metaServices and metaInnovations to achieve common objectives. Throughout the project, each UC will be prototyped, developed, and refined through metaDesign (co-creation) activities.

Each UC outlines the interactions between the system, services, and users and may encompass multiple scenarios reflecting the diversity of fleets, service operators, and users (whether passengers or freight). Each scenario will have its own business model and governance (BIGMs) structure to facilitate replication.

Over the course of the project, UCs will be implemented, evaluated, and subsequently transferred to Follower Living Labs. This transfer process will be supported by the transferability and cross-fertilization methodologies developed within the project.

As outlined in the first Chapter, this document is organized around the four metaCCAZE Trailblazer cities and their twelve UCs. This introductory chapter offers an overview of these UCs to guide readers through the document. Each UC is identified by a unique code, a title, and a brief description. The following two chapters add more details to this introduction by presenting an Status Quo Map for each city (Chapter 3) and detailed descriptions of the prototype UCs and BIGMs (Chapter 4).

Table 1: Trailblazer Living Lab's Use Cases

LL	UC CODE	UC TITLE
Amsterdam	AM-UC01	Autonomous electric waterborne vessels for logistics
	AM-UC02	Adaptive Speed Governance of connected e-bikes
	AM-UC03	Optimizing intermodality of waste collection in the urban systems
	AM-UC04	Tradable Mobility Credits (TMC) scheme
Munich	MU-UC01	Dynamic Curbside Management
	MU-UC02	Establishment and operation of multimodal logistics hubs
Limassol	LI-UC01	On-demand mini-bus services
	LI-UC02	Shared e-bikes
	LI-UC03	Multimodal passenger hub
	LI-UC04	Transport and Energy Integration and Management
Tampere	TA-UC01	Autonomous e-shuttles
	TA-UC02	Tram-feeder service

2.1. Amsterdam's Use Cases introduction

Autonomous electric waterborne vessels for logistics (AM-UC01)

This UC focuses on deploying autonomous electric vessels for logistics in Amsterdam, beginning with pilot tests in the Port of Amsterdam. The UC aims to refine the technology for potential use in the city's complex waterways, integrating sustainable transportation solutions into urban environments. The ultimate goal is to expand automated vessel operations within Amsterdam's congested city centre.

Speed management of connected e-bikes (AM-UC02)

The second UC tests Adaptive Speed Governance (ASG) for e-bikes, allowing dynamic control of vehicle speeds based on real-time conditions. The system will enable city officials to adjust speed regulations in response to various factors, such as events, weather, or construction works. The pilot will demonstrate ASG's effectiveness on e-bikes and cargo bikes, with large-scale testing in Vondel Park in Amsterdam's city centre.

Optimizing intermodality of waste collection in the urban systems (AM-UC03)

In this UC, Amsterdam plans to implement an intermodal waste collection system using electric vehicles of different capacities to address the challenges of waste management in the city center. This pilot seeks to synchronize cargo bike and ship networks, contributing to the city's sustainability goals and addressing the complexities of demand uncertainty and electric fleet management.

Tradable Mobility Credits (TMC) scheme (AM-UC04)

This UC involves designing and testing a Tradeable Mobility Credits (TMC) system in Amsterdam. The system uses “cap-and-trade” market instruments to manage traffic-related environmental impacts. A digital twin platform will function as a real-time dashboard, enabling visualization, monitoring, and planning of the city's mobility network. This marketplace will empower citizens to manage their transportation needs through a highly connected environment facilitated by the digital twin technology.

2.2. Munich’s Use Cases introduction

Dynamic Curbside Management (MU-UC01)

This UC aims to implement a dynamic curbside management system where the curbside and public spaces are digitally mapped, managed, and monitored. Ad-hoc geofencing and booking features will streamline logistics, local vendors, public utilities, shared mobility, taxis, and on-demand passenger services. Additionally, a connected, semi-automated zero-emission vehicle (Rickshaw) for last-mile passenger and freight transport will be further developed to demonstrate the system's effectiveness in managing curbside operations and autonomously reserving slots.

Establishment and operation of multimodal logistics hubs (MU-UC02)

This UC will implement logistic hubs for last-mile delivery using cargo bikes and other energy-efficient vehicles. Inspired by Munich's "Viehhof" hub, new hubs will facilitate parcel delivery to individuals and goods transport to businesses. The UC aims to reduce car traffic, enhancing road safety and environmental protection. Testing will also include the use of connected semi-automated zero-emission vehicles (Rickshaws) for last-mile delivery.

2.3. Limassol’s Use Cases introduction

On-demand mini-buses services (LI-UC01)

An on-demand mobility service will be launched in the city, featuring electric mini-buses and private vans. Initially, it will serve school transport for teens (12-18) and their after-school activities, expanding later to tourists and city employees. AI algorithms will optimize fleet deployment and route planning. The service will also explore pricing strategies and carpooling options. After a certain period of operation, the data generated by this service will be used to recommend convenient fixed public routes or bike-sharing for the first/last mile of trips.

Shared e-bikes (LI-UC02)

This UC involves the implementation of a new shared e-bike service with strategically placed docking stations throughout the city of Limassol. The service platform will use AI to manage bike availability and demand efficiently. An app will show docking station locations and bike availability, while all bikes will have smart systems, including GPS, to track usage. Quantitative data from this service will be stored in a data warehouse to develop AI models. Bike sharing stations will also serve as charging stations for e-bikes.

Multimodal passenger hub (LI-UC03)

Limassol's third UC will establish a Mobility Hub in Limassol to centralize various transportation modes and ensure seamless connectivity for travellers. The hub will facilitate transfers between buses, bicycle paths, and other transport options, enhancing access to public transport. It will feature transit facilities, bike parking, bike-sharing services, Park&Ride lots, EV charging stations, real-time information systems, and other amenities, improving the travel experience.

Trasport & Energy Integration and Management (LI-UC04)

This UC consist of an Internet of Things (IoT) platform that integrates transportation, electric vehicle charging, and the electricity grid in the city of Limassol. It will help the city, operators, EV owners, and electricity authorities manage charging demand by guiding users to charge during off-peak hours or when renewable energy is available. The platform will consolidate data from various sources, including V2I and V2U connectivity, traffic counts, smart bus stops, and charging stations.

2.4. Tampere's Use Cases introduction

Autonomous e-shuttles (TA-UC01)

This UC aims to demonstrate the feasibility of remote operations for driverless vehicles and test a public transport new line served with automated buses. It involves developing a Remote-Control Centre to manage these shuttles by integrating traffic lights, city traffic data, and incident information with third-party tools. Infrastructure upgrades will include safe turn points, precise positioning systems, automated charging facilities, and V2X/LTE traffic signals.

Tram-feeder service (TA-UC02)

This UC will utilize the same technologies employed in TA-UC01, integrating them into a different service context. Specifically, automated shuttles will connect to a tram line, transporting passengers to and from the tram to expand the tram's coverage area and attract more riders. As in UC01, this UC will be supported by the Remote-Control Centre, necessary infrastructure changes, and inductive shuttle charging solutions.

3. Status Quo Map

The development of the Status Quo map (Task 1.1) followed a comprehensive and structured approach aimed at evaluating the current situation of the T-LLs in terms of capability (SUMP, CCC and Resources Mapping), empathy (stakeholders' specific needs), and data (availability of datasets).

This process aims to understand each T-LL's readiness and establish a solid foundation for preparing metaCCAZE demonstrations. Specifically, the Status Quo map establishes a well-defined basis for shaping the other WP1 project activities, such as the prototype UCs (Task 1.2) and BIGMs (Task 1.3) presented in Chapter 4, as well as the set of KPIs to be integrated into the Impact Evaluation Framework (Task 1.4), and the Social Embracement surveys (Task 1.5) that will be prepared in the following months.

In this chapter presents the methodology used to build the Status Quo map, followed by the specific four T-LLs maps and a summary of the findings.

3.1. Methodology

This section outlines the methodology employed to construct the Status Quo Map (Task 1.1). The work was organized into three sub-tasks:

- SUMP and Resources Mapping or ***Capability Map*** (Sub-task 1.1.1);
- Ecosystem Dialogues for Needs Specification or ***Empathy Map*** (Sub-task 1.1.2);
- Identification of Cities' Available Data or ***Data Map*** (Sub-task 1.1.3)

The outcomes of these sub-tasks were then consolidated and compared to create a comprehensive ***Status Quo Map*** for each city. This section details the methodology employed for these three core components.

3.1.1. Capability map methodology

The SUMP and Resources Mapping, or Capability Map, aims at identifying the current positioning of each T-LL during the first year of the metaCCAZE project. This preparatory step was essential to start refining the UCs and BIGMs (see Chapter 4). It assesses the preliminary ideas and the available smart systems and services in each T-LL to understand the cities' current situation and evaluate their potential for achieving zero emissions.

The map also analyses lessons learned, recurring challenges, and existing barriers based on previous and current experiences with smart systems and services in each city. It further explores the research and innovation outcomes from previous projects, such as 2ZERO, CCAM, and MISSION, to determine how these outcomes can be utilized within the metaCCAZE project.

Additionally, the map evaluates each T-LL's Sustainable Urban Mobility Plan (SUMP) and Climate City Contract (CCC) to establish a baseline and understand the broader objectives and targets of each city.

To accomplish this Task, each city, assisted by the respective support partner, followed a standardized procedure by completing a template (see Annex II) with information on the following aspects:

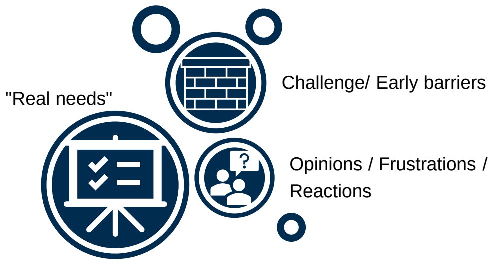
- General information about the city and its main characteristics
- Status of the Climate City Contract (CCC) and description of actions focusing on urban mobility, particularly smart systems and services for zero-emission mobility.
- Information about the SUMP targets and goals.
- Available systems and services related to zero-emission mobility, including functionalities, existing challenges, and SUMP solutions to address these challenges (including KPIs).

- Preliminary descriptions of UCs, including the assessment of its alignment with SUMP and CCC objectives, as well as preliminary barriers, and past studies or tests addressing similar aspects.
- Research and innovation outcomes from previous research projects, including 2ZERO, CCAM and MISSION, focusing on topics related to the LL measures and how these outcomes can be used within metaCCAZE.
- Media and other communication channels necessary both for the successful implementation of LLs and for identifying local communication channels for the activities of the project.

The common approach was designed to provide a consistent framework across different LLs and UCs offering a comprehensive overview of existing capabilities and resources. Through an iterative process, the results for each city were analysed, integrated, and structured into a common structure.

3.1.2. Empathy map methodology

The ecosystem dialogues for needs specification, or Empathy map, has been designed as a tool to gain a deeper understanding of the Living Labs' target audiences by capturing what they think, feel, see, hear, say, and do, as well as their pains and gains.



This exercise has been also adopted in line with the preparation of the guidelines of the metaDesign activities (T1.6.1), specifically through the organization of mini dialogues (metaDesign activity LL1) during Month 4 (April 2024) of the project. The mini dialogues aimed at discussing and specifying the needs of stakeholders involved in the LL's SUMP. All-in-all, the 3 main expected outcomes from the mini-dialogue exercises were discovering a) the real needs, b) the early barriers, and c) specific opinions on the use cases.

To help guide the previous, the following questions were shared, in a form of aggregated and adapted Empathy map canvas.

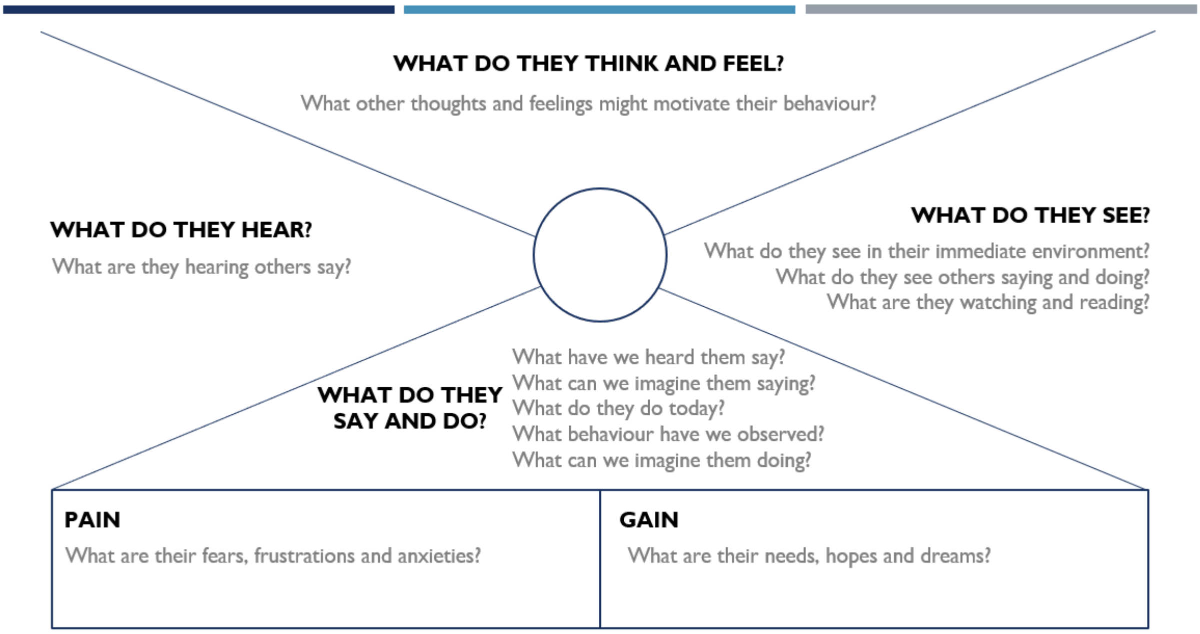


Figure 1. Adapted Empathy map canvas sent to the Living Labs to guide the activities (Credits: BABLE)

The four T-LLs were invited to take part in the realisation of the mini-dialogues, having provided specific information on:

- The overall need of the project from the cities and city supporters,
- A clear definition of the goal of the Task,
- Specifications on how to carry out the Task – letting each LL decide which way was more appropriate considering their context,
- Guidance on the definition of the relevant stakeholders. Lead for the next steps,

The LLs could choose to organise in-person events or carry out the activity online with hybrid events/dialogues with relevant stakeholders following each city's circumstances or preferred approach. The following table summarises how each city has carried out the activity.

Table 2: MetaDesign activity LL1: mini-dialogues

CITY	FORMAT	ACHIEVED ON:
Amsterdam	1:1 interviews	31.05.2024
Munich	Online form	27.06.2024
	Online form	22.07.2024
Limassol	Physical event	26.02.2024
	1:1 interviews	19.04.2024
	Online form	27.05.2024
Tampere	Online event	14.05.2024

The results of these events were analysed individually and are detailed under each UC for each T-LL, providing detailed information on the characteristics and nature of the event, the participants involved, and the main outcomes.

3.1.3. Data map methodology

The scope of the data map involves identifying all necessary, city-specific data from available secondary sources, existing models and simulation datasets, and previous co-creative labs. Key principles for the Data Map include ensuring available data is suitable for monitoring and impact evaluation, which requires before-and-after data as well as time-series data. It is crucial to exploit existing data infrastructure, encompassing mobility data (traffic, public transport, active travel, public space, etc.) and city data (economic and social metrics). This information, along with the results of the capability and empathy map, will serve as the foundation for selecting KPIs for each UC to include in the Evaluation Framework that will be developed in the coming months.

For the construction of the Data Map for each city, the following principles were followed:

1. **Consistency:** Consistency in data means collecting and formatting the data in the same way across all sources or time periods. When consistent methods are used, it becomes much easier to compare and analyse the data, which leads to more accurate identification of trends and patterns. By applying the same approach, such as using the same units of measurement, data categories, or collection techniques, you ensure that the data is reliable and can be meaningfully compared, leading to clearer insights and better decision-making.
2. **High-Quality:** Ensuring data is reliable, accurate, and up-to-date enhances the credibility of metaCCAZE outcomes. High-quality data promotes trustworthiness in the results and supports evidence-based decision-making, allowing for more informed and effective conclusions or actions.
3. **Compatibility:** When data is structured in a way that aligns with common formats or standards, it's easier to integrate with other datasets, even if they track different KPIs. This flexibility facilitates collaboration and enables a broader understanding of complex issues across different areas, as diverse data sources can be combined and analysed seamlessly.
4. **Efficiency:** Implementing standardized practices saves time and effort by creating more streamlined workflows. It enables teams to work more efficiently, minimizes errors, and maximizes the effective use of resources. By following consistent procedures, organizations can focus on productivity and better outcomes rather than addressing inefficiencies or correcting mistakes.
5. **Transparency and Trust:** By documenting where the data comes from, how it's collected, and how its quality is ensured, we build trust with stakeholders. This transparency makes metaCCAZE more credible and accountable.

To ensure comprehensive data collection and infrastructure support within the metaCCAZE project, it is essential to achieve uniform coverage across all relevant categories of vehicles, services, and technologies for each use case of each Living Lab, assuring the proper data are being collected in each case. Considering the comprehensive coverage required for all UCs, a proposed set of data has been consolidated.

This data map ensures that not only the UCs but also all categories of vehicles, services and technologies that may be included are thoroughly considered and incorporated to support the metaCCAZE project effectively. The data categories to be gathered from T-LLs cities can be depicted in the next table.

Table 3: Data categories and data variables included in the Data Map

DATA CATEGORIES	DATA VARIABLES	DESCRIPTION
Traffic Data	Average Daily Traffic (ADT)	Number of vehicles passing through a specific location on a road or highway within a day
	Traffic Flow Patterns	Peak hours, congestion hotspots, directional flow
	Vehicle Types and Classifications	Distribution of vehicle types (e.g., cars, trucks, buses, bicycles)
	Origin-Destination Data	Origin and destination of trips, commuter and freight traffic
	Traffic Volume	Number of vehicles passing through a specific point or section of road within a given time frame
	Traffic Density	Measure of vehicle concentration per unit length of road
	Average Speed	Mean speed of vehicles along a road segment or corridor
	Free Flow Speed	Speed vehicles would travel at under ideal conditions, unaffected by congestion
	Congestion Index	Measure of traffic congestion level, often based on travel time compared to free-flow conditions
	Queue Length (Intersections / Bottlenecks)	Length of vehicle queues at intersections or bottlenecks during peak hours
	Lane Utilization - Lane Capacity	Proportion of lane capacity utilized by vehicles, indicating traffic density
	Delay Time	Additional time spent by vehicles in traffic congestion compared to free-flow conditions
	Flow Distribution	Distribution of traffic flow across different routes or road segments
	Peak Hour Traffic	Traffic volume and flow patterns during peak hours of the day
PT data	Ridership Statistics	Number of passengers using public transit services
	Frequency and Reliability	Frequency of public transit services and reliability
	Accessibility of Stops and Stations	Availability and accessibility of public transit stops and stations
Charging Infrastructure	Number and Locations of Charging Stations	Count and geographical distribution of electric vehicle (EV) charging stations
	Charging Capacity and Compatibility	Charging rates and compatibility with different EV models
	Utilisation Rates	Usage patterns and utilization rates of charging stations
	Availability of Fast Charging	Presence and distribution of fast charging stations
Transport Network	Road Network Characteristics	Lane widths, speed limits, classifications
	Bicycle and Pedestrian Infrastructure	Availability of bike lanes, sidewalks, crosswalks

	Freight Routes and Distribution Centres	Routes and hubs for freight transportation
	Public Transport Stops and Stations	Locations of bus stops, train stations, and transit hubs
Transport Technology	Intelligent Transport Systems (ITS)	Technologies used for traffic management and control
	Vehicle-to-Infrastructure (V2I) Communication	Communication technologies between vehicles and infrastructure
	Vehicle-to-Vehicle (V2V) Communication	Communication technologies between vehicles
	Advanced Driver Assistance Systems (ADAS)	Adoption and prevalence of ADAS technologies
Travel Behaviour	Travel Survey Data	Mode choice, trip purposes, trip lengths
	Commuting Patterns	Commuting modes and travel times
	Ride-Sharing and Micro-mobility	Usage rates and preferences for ridesharing, micromobility
Environmental Impact	Air Quality Monitoring Data	Pollutant concentrations, emissions
	Noise Pollution Levels	Levels of noise pollution along transport corridors
	Greenhouse Gas Emissions Inventory	Emissions from transport sources
Social Impact	Demographic Profiles	Characteristics of communities served by transport infrastructure
	Accessibility for Vulnerable Populations	Accessibility barriers for vulnerable populations
	Public Perception Surveys	Public attitudes and perceptions towards transport
Economic Impact	Transportation Expenditures	Costs related to transportation, fuel, maintenance
	Economic Benefits of Transport Investments	Job creation, business growth resulting from investments
	Cost-Benefit Analysis	Costs and benefits associated with transport projects

To standardize information collection and gain a better understanding of the available data in each city, an Excel file with predefined answers was distributed to all T-LLs. Each T-LL needed to specify, for each available datasets provided in the Data Map (following the classification in Table above), as much information as possible.

The information requested for each dataset referred to the following variables: Availability, Type, Source, date of the last updated, Spatial Coverage, Quality, Collection Method, Coverage, Temporal Resolution, Spatial Resolution, Format, Access Restrictions, Aggregation Level, Source Reliability and Usage Restrictions. To facilitate this process, precompiled answers were provided for the each of the requested information variables.

In addition, the T-LLs were asked to provide information about their available data, concerning mainly three different levels: i) Data generally available for all cities; ii) Specific data for each city according to the Use Cases they will be implementing within metaCCAZE; and iii) Any other data that was not included in the provided initial list, but T-LLs cities might want to consider.

The results of the data map were analysed individually and are summarized under each T-LL. The full version for the Data Map for each city, and the common variables across T-LLs are discussed in Annex I and II.

The outcomes of these three sub-tasks were consolidated and compared to create a comprehensive ***Status Quo Map for each city***, which are presented below.

3.2. Status Quo Map for Amsterdam

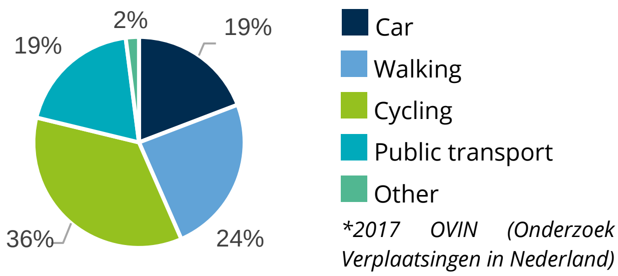
Amsterdam is the capital and largest city of the Netherlands, known for its historical significance, cultural heritage, and economic importance. It is located in the western part of the Netherlands and is a major hub for finance, commerce, culture, and tourism, attracting millions of visitors each year. The city is part of the Randstad; a large conurbation comprising of Amsterdam, Rotterdam, The Hague, and Utrecht, as well as their surrounding areas. It's one of the most densely populated areas in Europe.

Amsterdam is characterized by diversity, progressivism, and active citizen engagement. The city plays a significant role both in national politics as well as in shaping social and cultural trends. Amsterdam faces a range of urban challenges, including housing affordability, gentrification, and transportation issues. These challenges often shape political debates and policy priorities in the city.

A FEW FACTS…

Amsterdam is one of the MISSION CITIES, but by the time this report was drafted, it had not yet signed the Climate City Contract.

882.000 inhabitants



**2017 OVIN (Onderzoek Verplaatsingen in Nederland)*

Key facts:
Capital city # Economic, financial and touristic centre # Most developed cycling city # Historic canals network # Urban challenges of affordability and gentrification

TEN-T Comprehensive network:
North Sea - Baltic - Rhine - Mediterranean corridors

Sustainable mobility goals:
- Amsterdam is one of the MISSION CITIES – committed to achieve climate-neutrality by 2030
- Its "EU Mission Label" is still in process
- Amsterdam does not have a single sustainable urban mobility plan (SUMP) but has multiple Strategic Mobility Plans with different geographical scopes and time horizons.

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3.2.1. Sustainable mobility planning policies

Amsterdam does not have a traditional SUMP as understood by the EU "Guidelines for developing and implementing a Sustainable Urban Mobility Plan[1]". However, there are several documents that outline the city's policy objectives and measures regarding sustainable mobility. These include:

Amsterdam Accessible and Attractive - Mobility Approach Amsterdam - Target 2030[2]: It focuses on making Amsterdam more accessible and attractive by improving urban mobility. Key goals include:

- Offering improved, affordable, reliable, and accessible mobility options
- Accelerating the transition to shared and alternative mobility to reduce private car use
- Requiring data sharing and user-centric innovations from commercial mobility providers
- Incentivizing behavioral change through attractive alternatives to private cars

Mobility Implementation Agenda[3] - Target 2030: This agenda details specific actions and projects to achieve the mobility goals outlined in broader strategic plans. It includes timelines, responsible parties, and KPIs. Key measures include:

- Establishing zero-emission zones for taxis, vans, trucks, scooters, and pleasure craft by 2025
- Transitioning the city's own land and water fleet to zero-emission
- Expanding electric vehicle charging infrastructure and implementing smart charging systems

Spatial Vision Amsterdam - Target 2050[4]: Provides long-term vision outlining Amsterdam's spatial and urban development goals up to 2050. It integrates mobility with other urban planning aspects like housing, green spaces, and economic activities (transforming Amsterdam into a sustainable, liveable, and accessible city). It focuses on reducing private car use, improving public transport, and promoting cycling and walking.

Amsterdam Transport Region (Smart Mobility)[5]: It is a regional plan that coordinates transport policies across the Amsterdam metropolitan area, promoting smart mobility solutions to enhance connectivity and sustainability. Initiatives include testing autonomous vehicles, improving multimodal mobility, and leveraging data and digital technologies.

MRA Smart Mobility platform[6]: Brings together stakeholders from the Amsterdam Metropolitan Area to coordinate smart mobility efforts. Supports the development and implementation of smart mobility solutions in the Metropolitan Region Amsterdam (MRA). It focuses on innovation, data-driven decision-making, and sustainable mobility.

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[1] EU SUMP Guidelines and Decision Makers Summary - Link

[2] Amsterdam aantrekkelijk bereikbaar – mobiliteitsaanpak Amsterdam 2030

[3] *Uitvoeringsagenda mobiliteit* - Link

[4] *Omgevingsvisie Amsterdam 2050* - Link

[55] *Vervoerregio Amsterdam* (Smart Mobility) - Link

[6] *MRA Smart Mobility platform* - Link

Timing:

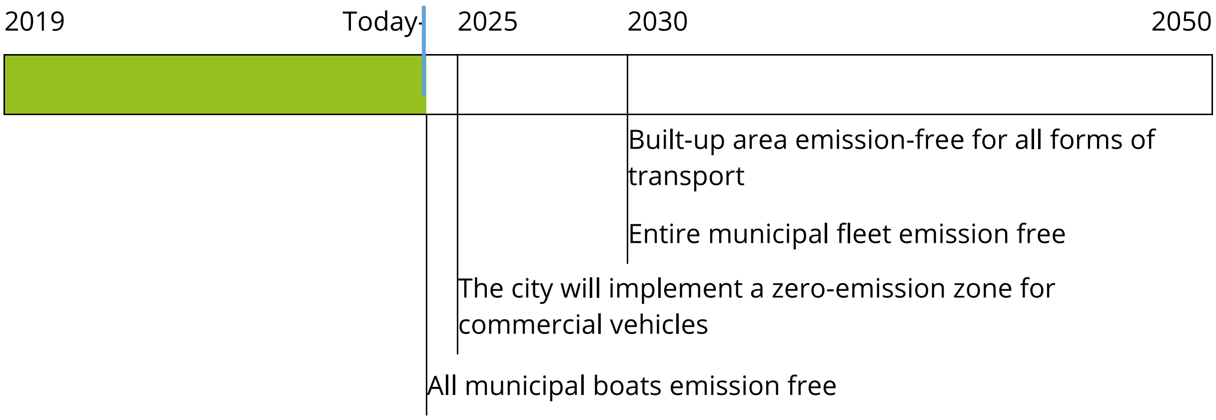

Figure 2. Sustainable mobility planning policies main targets - Amsterdam

Sustainable mobility monitoring schemes:

The municipality carries out a regular monitoring of the mobility system. The following documents provide the outcomes of this:

- Traffic Safety Monitoring (2022)[7] - monitoring traffic safety and promoting measures to improve safety for pedestrians and cyclists.
- Spatial Vision Monitoring (2023)[8] - monitoring the implementation of long-term Spatial Vision Amsterdam 2050
- Amsterdam Accessibility Thermometer (2021)[9] – monitoring the accessibility and mobility of Amsterdam.

3.2.2. Climate City Contract policies and metaCCAZE alignment

Amsterdam is one of the MISSION CITIES and is committed to achieving climate neutrality by 2030. Although the Climate City Contract (CCC) has not been signed yet, and therefore the city has not received its "EU Mission Label," it has already identified key actions.

The following table presents a list of the anticipated actions related to urban mobility that will be included in the CCC. For each action, it is indicated whether the metaDesigned UCs will contribute (or not) to their implementation.

Table 4: Policies contained in the CCC of Amsterdam

POLICIES CONTAINED IN THE CCC	UC
Public Transportation	
○ Create more green and active journeys, including creation of space for public transport	✓

[7] Monitor Verkeersveiligheid 2022 – Link

[8] Monitoring omgevingsvisie 2023 - Link

[9] Amsterdamse Thermometer Bereikbaarheid 2021 - Link

- Explore business and commuter transportation of employees using cycling and public transport
- Shared municipal service vehicles using a municipal carpool
- Build 'emissions-free coalition' of parties in the city for coaches
- Develop sustainability strategy for GVB ferries
- Facilitate scaling-up of public rapid charging points for taxis and others
- Determine charging locations for ferries
- Tender concessions for charging points for passenger boats
- Support marinas with installation of charging infrastructure

Micro-mobility

✓

- Facilitate comfortable cycling networks, including widening busy cycle routes
- Facilitate convenient bicycle parking, including expansion of bicycle parking places
- Facilitate new cycling norms, including boosting cycling-friendly behavior

Private Vehicle Electrification

✗

- Actively approach owners of old diesel vehicles
- Make agreements with businesses and institutions on 100% emissions-free taxi transport
- Draft vision on charging infrastructure for public charging points
- Facilitate roll-out of hydrogen fuelling stations
- Demand-driven and strategic rollout of charging points for public charging points
- Set up website for emissions-free recreational watercraft
- Tender concessions for public charging locations for recreational vessels

Freight Transportation

✗

- Investigate the tightening of the environmental zone for lorries in 2022
- Tighten environmental zone (diesel) delivery trucks
- Explore options for coach hubs
- Research the scaling-up of hubs and rapid charging infrastructure for logistics
- Replacement of municipal passenger and delivery transport with electric vehicles
- Focus on HVO (biodiesel) municipal fleet during the transition period
- Research the scaling-up of hubs and rapid charging infrastructure for logistics

Transportation Demand

✓

- Create space with fewer car journeys, including introduction of intelligent access to city centre
- Create space by having fewer car-parking spaces, including fewer parking permits
- Investigate differentiated parking charges, in partnership with central government
- Introduce environmental zone (diesel) for passenger cars

Smart Technologies

✓

- Use technological innovations, including smart bicycle-parking

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- Smart organisation of transport in the city, including working on alternatives to ownership
- Smart use of new mobility solutions, including neighbourhood hubs with electric vehicles
- Research feasibility of emissions-free water transport

3.2.3. Amsterdam's UCs - Resources and needs

As anticipated in Chapter 2, Amsterdam proposes four Use Cases that will be tested within metaCCAZE. For each UC, a summary of the key takeaways of the ***capability map*** and ***empathy map*** are presented.

The following sections build on the information collected by the Amsterdam Living Lab partners and TU Delft, the Support Partner. For each UC, they provide a description of the measures to be implemented within metaCCAZE, along with the preliminary barriers, existing services potentially related to each UC, and relevant projects, studies, and past experiences that could be leveraged. In addition, the sections include the main outcomes of the mini dialogues hosted in Amsterdam between April and May 2024.

The city of Amsterdam has carried on, with support of the AMS Institute and the TU Delft, a set of individual discussions with stakeholders and citizens. The discussions were based on what were the general needs at the heart of the different use cases presented.

3.2.3.1. Automated electric waterborne vessels for logistics (AM-UC01)

Table 5: Amsterdam Use Case 1 - capability

USE CASE AM-UC01	
Autonomous electric waterborne vessels for logistics	
USE CASE DESCRIPTION	The initial pilots are likely to be conducted in the Port of Amsterdam, followed by exploration into how to conduct pilots in the city centre. This strategic decision is driven by the Port of Amsterdam's robust infrastructure and conducive environment for testing innovative maritime technologies. Following the successful implementation of pilots in the port, attention will shift towards adapting and refining the technology for potential deployment in Amsterdam's city centre. This transition underscores the broader objective of integrating sustainable and efficient transportation solutions into urban environments. By leveraging the expertise and resources available in the Port of Amsterdam, the initiative aims to pave the way for the eventual expansion of automated and electric vessel operations to more congested and complex waterways within the city centre.
AREA DESCRIPTION	The measure will be implemented within the Port of Amsterdam, situated in the western part of the city. The Port of Amsterdam serves as a vital gateway for international trade and logistics in Europe. Boasting state-of-the-art infrastructure and modern facilities, it accommodates various types of vessels, including cargo ships, tankers, and cruise liners. Located strategically along the North Sea Canal, the Port of Amsterdam offers convenient access to major European markets and inland waterways, making it

an ideal location for testing innovative maritime technologies like Autonomous Electric Waterborne Vessels. Its proximity to Amsterdam's city centre further enhances its significance, providing seamless connectivity to urban areas and transportation networks.

OBJECTIVES Alignment with:	**MOBILITY STRATEGIES**	**CCC**
By utilizing electric propulsion systems, the measure seeks to significantly reduce greenhouse gas emissions and other pollutants associated with traditional diesel-powered vessels, thereby mitigating environmental damage and contributing to cleaner air and waterways.	✓	✓
Autonomous sailing technologies integrated into these vessels promise to streamline logistics operations by optimizing routes, reducing human error, and minimizing operational costs associated with manual piloting and maintenance.	✓	✓
By introducing autonomous navigation capabilities, the measure seeks to alleviate congestion in busy waterways and ports, improving overall traffic management and enhancing safety for both vessels and nearby infrastructure.	✓	✓
The deployment of Autonomous Electric Waterborne Vessels demonstrates a commitment to sustainable transportation solutions and promotes innovation within the maritime industry, paving the way for future advancements in autonomous and electrified maritime technologies.	✓	✓
By exploring the potential for conducting pilots in Amsterdam's city centre, the measure aims to address the unique challenges of navigating congested urban waterways and integrating sustainable transportation solutions into densely populated areas. This involves considerations such as safety, compatibility with existing infrastructure, and public acceptance.	✓	✓

BARRIERS

One significant barrier could be navigating the **complex regulatory framework** governing inland waterways in Amsterdam and the Netherlands. This includes regulations related to vessel operations, safety standards, environmental requirements, and licensing procedures. Ensuring compliance with these regulations while integrating autonomous and electric technologies poses a considerable challenge.

Adapting existing infrastructure within the Port of Amsterdam and potentially in the city centre to accommodate Autonomous Electric Waterborne Vessels may present challenges. This includes ensuring the availability of charging stations, docking facilities, and navigational infrastructure compatible with autonomous navigation systems.

Introducing autonomous vessels into urban waterways may raise **concerns among the public regarding safety, privacy, and the impact on traditional maritime jobs**. Addressing these concerns and garnering public acceptance will be crucial for the successful implementation of this measure.

While the technology for Autonomous Electric Waterborne Vessels is rapidly advancing, there may still be limitations in terms of **costs, reliability, performance, and scalability**. Overcoming technological barriers and ensuring the readiness of these vessels for real-world operations will be essential.

PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC
Roboat studies in Automated Electric Waterborne Vessels: Five years of technological research between TU Delft and MIT have resulted in the demonstration of two working autonomous boats in 2021. In 2023 the research on Autonomous electric waterborne vessels spun off from the AMS Institute into the start-up 'Roboat'. Since then, the company has conducted multiple ongoing studies to advance autonomous electric waterborne vessels. Together with the city's public transport company GVB, Roboat is looking at ways to support skippers on the Amsterdam ferry between Central Station and Noord. They are also working on a 3D printed autonomous vessel for the Olympic Games in Paris of 2024. So far, their main focus was passenger transport. With the metaCCAZE project, their R&D focusses on making the autonomous technologies modular and the possibilities for applying this on larger barge vessels.

RELATED EXISTING SERVICES	BARRIERS / SOLUTIONS FROM CITY'S MOBIILITY STRATEGIES
Environmental, safety and traffic management in the Port of Amsterdam - autonomous barging ship	<u>Barriers:</u> While the implementation of the autonomous barging ship offers numerous benefits, there may be challenges related to regulatory compliance, public acceptance, and technological readiness. Addressing these issues will require collaboration with stakeholders and proactive measures to mitigate risks. Autonomous propulsion, without the presence of a skipper is not yet legal. At this moment, it is required to have a minimum of one skipper on board and if the ship's propulsion systems, or its bow or stern thrusters are in operation, a person authorised to manoeuvre the ship must be present in the wheelhouse. <u>Solutions:</u> Identify measures to address potential challenges associated with the implementation of innovative transportation solutions. This includes updating regulatory frameworks to accommodate autonomous vessels, conducting public awareness campaigns to promote acceptance, and investing in research and development to enhance technological capabilities.

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STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public entities	Municipality of Amsterdam Thomas Vernooij - Programma Varen
	Kees Stants – Municipality of Amsterdam – Ruimte en Duurzaamheid
	Marcel Stiphot – Municipality of Amsterdam – Afval en Grondstoffen

Mini-dialogue for Amsterdam UC01 (AM-UC01)

For this UC, the mini dialogue consisted of one-to-one discussions with Thomas Vernooij, Strategic Policy Advisor in the city of Amsterdam; Kees Stants, Policy advisor; and Marcel Stiphout, from the city of Amsterdam. The results of the discussion were elaborated using the Empathy Map methodology (see Chapter 3.1.2) and are summarized in the following table.

Table 6: Amsterdam Use Case 1 - empathy

	STAKEHOLDER PERSPECTIVE
Identification of real needs:	• Seen as a key step towards advancing Amsterdam's sustainability goals. • Ambition from the city to protect the quays and investigate deeper water transport. • Integration between water and road transport is necessary. • Low emission vehicles are a promising alternative for the last mile logistic. • Need of ensuring safety of navigation. Implementation of safety measures and regulations to mitigate risks
Identification of early barriers/concerns:	• Concerns about practical implementation challenges, such as regulatory hurdles and infrastructure requirements. • The quay walls and roads next to the canals of the inner city are vulnerable. • The cost of transport over water are relatively high compared to road transport. • The current regulation requires one captain to be always present on board a vessel on Dutch waterways. At this stage, autonomous sailing requires a captain on board. • Availability of electric vessels is a bottleneck at the moment.
Specific opinions on the use case:	• Feeling that logistic companies expresses interest in cost savings. • Environmental organizations advocate for emissions reduction. • Regulatory authorities should provide guidance on compliance of the objectives. • Start with a pilot where the autonomous mode supports the captain while navigating in and out, e.g: Roboat – GVB ferry pilot.

PAIN	GAIN
1. Higher cost of transport over water 2. A potential damage to valuable city infrastructure by heavy goods road vehicles 3. Large vessels cause safety risk and traffic jams on the canals	1. Reduction of emissions 2. Efficiency Improvements 3. Innovation Leadership 4. Improved Mobility 5. Safety improvement

4. Not enough space on the canals for all activities (logistics, passengers, pleasure)
5. Autonomous sailing is not allowed at the moment, only supervised by pilots in the inner canals of the city.
6. Autonomous sailing can contribute to solving the shortage of employees

3.2.3.2. Speed management of connected e-bikes (AM-UC02)

Table 7: Amsterdam Use Case 2 - capability

AM-UC02			
Speed management of connected e-bikes			
USE CASE DESCRIPTION	This Use Case will test Adaptive Speed Governance (ASG) for e-bikes, a set of technologies that enable cities to dynamically control vehicle speeds based on real-time situations on the ground. City officials can dynamically change speed regulations for any area in the city, such as a school zone or central business district, factoring in events (e.g. festivals, sports matches, etc.), construction works, or environmental situations (e.g. adverse weather). The technology has already been demonstrated on e-Bikes and Cargobikes. MetaCCAZE is performing a wider scale testing in public space coordinated by the metaCCAZE partner Townmaking Institute.		
AREA DESCRIPTION	The Vondelpark, a monumental park in the city centre of Amsterdam, was selected as the initial testing area. The technology will initially be applied for Vondelpark' cycling paths to regulate e-Bike behaviour. Contrary to social expectations, the Vondelpark records the highest cycling speeds, particularly with rushing commuters and delivery riders on e-Bikes who treat the park's broad streets and smooth tarmac as a highway.		
OBJECTIVES	Alignment with:	**MOBILITY STRATEGIES**	**CCC**
Preserve Vondelpark's heritage as a pedestrian-friendly public space.		✓	✓
Address high cycling speeds, especially among commuters and delivery riders on e-Bikes.		✓	✓
Implement speed control measures without altering the park's infrastructure (As a heritage site, the city is unable to install the usual physical speed measures, such as speed bumps)		✓	✓
Utilize Adaptative Speed Governance technology to govern cycling speeds and enhance safety.		✓	✓
Promote harmonious coexistence between cyclists and pedestrians in the park.		✓	✓
Promote a collaborative approach, working together with multiple bodies within the Municipality.		✓	✓

BARRIERS
- Public acceptance. - Lack of legal framework governing the technology. - Ethical concerns: autonomy, privacy.

PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC
Previous tests in speed control – 2023 - 2024: A basic demonstration test of "nudges" (speed advice) was done in 2023. The effects on behaviour were mildly positive. Longer tests on e-bikes that have similar riding characteristics are needed to analyse the riding behaviour. Additionally, a demonstration of the "nanny" (speed control) was performed in early 2024. **e-Hubs (Smart Shared Green Mobility Hubs) - 2019 - 2023:** This project led by the city of Amsterdam with TU Delft participation was funded by Interreg NW and had as main objective to create and test the concept of shared mobility hub in this European region. The project focused on the design, implementation, and field test of the concept in several cities. Studies of before and after were carried out to assess the impact of this type of mobility infrastructure. As part of the tests, the city was able to understand **what degrees of freedom are added by using electric bikes when compared to the normal bikes**. Lessons learned from Smart Shared Green Mobility Hubs, such as the negative consequences for safety brought by higher speeds of e-bikes, can bring initial expertise to this UC.

RELATED EXISTING SERVICES	BARRIERS / SOLUTIONS FROM CITY'S MOBIILITY STRATEGIES
Shared scooter vendors incorporating speed controls by 2026	The initiative involves the installation of speed controls on all shared scooters operating in Amsterdam. This measure is part of a broader effort to improve the safety and user experience of shared mobility services, particularly for pedestrians and other road users. The speed controls will help ensure that scooters operate within safe and regulated speeds, reducing the risk of accidents and improving overall traffic management. <u>Barriers:</u> changes to existing regulations and agreements with scooter companies. Integrating speed controls into the existing scooter infrastructure requires significant technological investments. Managing speed controls across a large fleet of scooters can be complex, especially if the scooters are operated by multiple companies.
Cycling and public transport corridors	<u>Barriers:</u> there is limited space in Amsterdam and such a plan requires a redistribution of public space. <u>Solutions:</u> the proposal is to remove parking spaces for cars to create space for walking and cycling.

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public entities	Municipality of Amsterdam - Sietze Faber - Verkeer en Openbare Ruimte
	Municipality of Amsterdam - Rashna Kadier - Gebiedsmakelaar Vondelpark
	Kees Stants – Municipality of Amsterdam – Ruimte en Duurzaamheid

Mini-dialogue for Amsterdam UC02 (AM-UC02)

For this UC, the mini dialogue consisted of a one-to-one discussion with Sietze Faber, Policy Advisor Bicycle & Road Safety at the city of Amsterdam. Alike AM-UC01, Rashna Kadier, Real estate agent, and Kees Stants were part of the interviews. The results of the discussion were elaborated using the Empathy Map methodology (see Chapter 3.1.2) and are summarized in the following table.

Table 8: Amsterdam Use Case 2 - empathy

	STAKEHOLDER PERSPECTIVE
Identification of real needs:	• There is a need to govern the e-bike speeds due to the growing number of e-bikes, the excessive speeds of e-bikes, the higher share of cyclists in accidents, and challenges in changing the physical infrastructure. • Conflicts with some users, specifically in areas like Vondelpark, where some people complaint about the high speed of the bike riders has been shown.
Identification of early barriers/concerns:	• The type of infrastructure conditions the average speed of the cyclist. • Cyclists may not be willing to reduce their speed as it will increase their travel time. • Cyclists may resist the idea of a system that reduces their speed because it takes away their autonomy.
Specific opinions on the use case:	• There are areas in the city where physical changes to the infrastructure are impossible because they are monumental. These are most promising pilot areas. • Any ethical concerns with the technology should be dealt with upfront.
PAIN	**GAIN**
1. High e-bike speeds 2. Large number of accidents and near misses on bike paths specifically involving children	1. Improved safety on the bike path 2. Improved cycling experience 3. More people use the bike as a mode of transport 4. Improved pedestrian safety

3.2.3.3. Optimizing intermodality of waste collection in the urban systems (AM-UC03)

Table 9: Amsterdam Use Case 3 - capability

AM-UC03	
Optimizing intermodality of waste collection in the urban systems	
USE CASE DESCRIPTION	By 2030, Amsterdam wants to have a network of on-demand waste collection in the city centre. The city centre does not have the space for underground waste storage facilities that other districts have. Meanwhile, heavy garbage trucks face challenges moving through the narrow streets of the city centre. All while the city

	centre is bustling with cafes, restaurants, hotels, retail, and tourism. This pilot will be focusing on intermodal waste collection services between cargo bikes and cargo ships in the city centre. The fleet size of the cargo ships is yet to be decided in relation to the efficiency of such a system. Creating synchronized networks of cargo bicycle and ships aligns with the sustainability and environmental goals of the city. Deciding where to allocate consolidation centres is a key consideration that can influence spatial usage in urban areas. Additionally, accounting for the uncertainty of demand and the state-of-charge of the electric fleet makes planning more complex. This is where research can contribute to creating green and efficient waste transport systems.
AREA DESCRIPTION	The measure will be applied to a selected area of the city given that it requires significant coordination between stakeholders and the involvement of the citizens. Such area has not been selected yet, it will depend on several constraints and the feedback of the stakeholders in these early stages.

OBJECTIVES Alignment with:	**MOBILITY STRATEGIES**	**CCC**
Enhance spatial efficiency by optimizing land use and infrastructure utilization.	✓	✓
Contribute to removing the trucks from narrow streets of Amsterdam	✓	✓
Promote multimodality in logistics to minimize truck traffic on roads and alleviate congestion.	✓	✓
Implement measures to reduce noise pollution generated by transportation activities.	✓	✓

BARRIERS

The current fleet size of ships is small (only two). The plan of the city is to expand for better coverage. Also, using cargo bikes might not be well accepted by riders who need to transport smelly goods. Finally, the canals in Amsterdam are used by other boats for different purposes. The canals currently operate close to their maximum capacity. The capacity of the canals may be a barrier to expansion.

PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC

Goods delivery with Cargo-bikes: From a contextual and methodological perspective, the models have been tested but not with electric fleets.

e-Hubs (Smart Shared Green Mobility Hubs) - 2019-2023: As in AM-UC02 (adaptive speed governance of connected e-bikes), this UC can also make use of lessons learned from the Smart Shared Green Mobility Hubs project. In the project, it was possible to understand what configurations made more sense for these hubs, what modes and who the clients can be. The hubs also included a logistics aspect with cargo bikes that can be used by delivery riders. The hubs are still being used in several cities.

SINERGI Sustainable Innovative digitalized NEtwork of uRban loGIstics (JPI-ERANET) – 2023-2026: Micro-delivery services are promising solutions for on-demand city logistics. To improve delivery efficiency, on-demand meal delivery platforms seek to optimize real-time management of their courier resources based on anticipatory insights into demand distributions within the city. Accurate and real-time demand models are essential to these systems' efficiency. Display optimization, downranking of restaurants in the shortage of couriers, behavioral models for both riders and consumers, routing suggestions while keeping the bike lanes safe are few of the challenges these services need to cope with. SINERGI project is dedicated to tackle different aspects of this multi-dimensional and multi-stakeholder problem.

Real Time Synchro-Modal Planning - 2024-2028: This project has been dedicated to synchro-modal logistics system in collaboration with logistics providers in the Netherlands. The focus has been on "Venlo", a multi-modal transport hub located in the province of Limburg. Synchro and multi modal logistics transport of goods have been investigated. Disruption scenarios have been studied and models have been introduced to replan under uncertain circumstances.

Smart Hubs (EIT) Creating smart shared mobility options for the city of tomorrow 2020-2022: This project led by AMS with TU Delft participation had as main objective to test mobility hubs solutions across Europe with a view to create business opportunities for shared mobility providers but also for consultancy companies to support the deployment of mobility hubs. A decision support tool was created to help regions and cities find the most suitable locations for these hubs based on multicriteria analysis. The project was funded by the Urban Mobility KIC therefore the business-oriented perspective of its activities.

RELATED EXISTING SERVICES	BARRIERS / SOLUTIONS FROM CITY'S MOBIILITY STRATEGIES
Zero emission zone for commercial vehicles.	Barriers: The affordability and availability of electric commercial vehicles is very challenging. This means that businesses will have to carry high costs to acquire zero emission vehicles. Solutions: The city provides subsidies for purchasing electric commercial vehicles to some businesses. The city provides and facilitates the construction of the charging and refuelling infrastructure. Providing test drive events for businesses.
Neighbourhood e-hubs Places where multiple forms of electric shared transport are offered to residents and visitors.	A neighbourhood e-hub can contribute to reducing car ownership and car use. For example, a cargo bicycle can be used to transport of large items and an LEV is an alternative to a car journey in the city. By offering different forms of transport, a neighbourhood e-hub supports the transition from ownership to use. Barriers: Neighbourhood e-hubs, despite citizen input, didn't increase scooter use as anticipated. Some hubs without citizen involvement saw higher usage. This suggests the need to reconsider strategies for promotion. Solutions: non-identified solutions
Shared e-mobility providers including cars, bicycles, e-bikes and e-scooters	The city of Amsterdam supports private companies that provide these services by issuing concessions for them to operate and providing them with reserved parking spaces in some instances. Barriers: The financial viability of these systems remains a challenge.

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public entities	Joppe van Driel / AMS / City of Amsterdam
	KEES STANTS – MUNICIPALITY OF AMSTERDAM – RUIMTE EN DUURZAAMHEID

Marcel Stiphot – Municipality of Amsterdam – Afval en Grondstoffen

Mini-dialogue for Amsterdam UC03 (AM-UC03)

For this UC, the mini dialogue consisted of a one-to-one discussion with Joppe Van Driel, from the city of Amsterdam. Alike AM-UC01, Rashna Kadier, Real estate agent; and Kees Stants were part of the interviews. The results of the discussion were elaborated using the Empathy Map methodology (see Chapter 3.1.2) and are summarized in the following table.

Table 10: Amsterdam Use Case 3 - empathy

	STAKEHOLDER PERSPECTIVE
Identification of real needs:	• Solve the illegal littering of abundant waste • Need to execute alternative waste management plans, (waste collection through waste bins underground is not possible in city centre) • Trucks used for waste collection are too heavy for quays and bridges in city centre • No more waste on the street • City continues to grow, amount of waste will not decrease • Increase safety while navigating, especially when sailing in and out • Policy needed on location and duration of transhipments, time/hour, modalities
Identification of early barriers/concerns:	• Increase of costs • Capacity for transport over water is limited • Number of traffic movements for waste collections using LEV's is a concern • Locations (docks) for waste collection on water are limited • Not all citizens want waste collection to take place in front of their home.
Specific opinions on the use case:	• A use case which links to cross-disciplinary challenges: waste and cleaning services, along with city district policy makers. Location: Red Light District. • We need to optimize the change and improve the connection/transhipment between road and water through some sort of control tower, that also connects the nearest LEV with boat (e.g. model of Uber)

PAIN	GAIN
1. Waste overflow 2. High costs of waste collection 3. Low quality of mixed waste streams 4. Chain of waste collection not yet efficient	1. Immediately useful solutions for pressing challenges in waste logistics 2. A long-term vision for an alternative waste collection and recycling system that they can work towards 3. Autonomous sailing can increase safety and can lower the costs

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3.2.3.4. Tradable Mobility Credits (TMC) scheme (AM-UC04)

Table 11: Amsterdam Use Case 4 - capability

AM-UC04			
Tradable Mobility Credits (TMC) scheme			
USE CASE DESCRIPTION	This UC will design and test a system for Tradeable Mobility Credits, using market-based instruments of cap-and-trade to limit the negative side effects of traffic movements within the pilot area. The digital twin platform will be used as a real-time dashboard to visualise, monitor, plan and communicate about the mobility system in Amsterdam. The marketplace will enable people to organize part of their transport needs themselves making use of the highly connected environment that the digital twining allows between vehicles and both passengers and freight.		
AREA DESCRIPTION	The measure will be applied to a selected area of the city or to a specific organisation given that it requires significant coordination between stakeholders and the involvement of the citizens. Such area has not been selected yet, it will depend on several constraints and the feedback of the stakeholders in these early stages.		
OBJECTIVES	Alignment with:	**MOBILITY STRATEGIES**	**CCC**
Promoting sustainable and multimodal transportation choices.		✓	✓
Testing effectiveness on a diverse participant pool.		✓	✓
Encouraging active, light, and electric transport over motorized options.		✓	✓
Fostering shared mobility for first and last-mile connections.		✓	✓
Integrating logistics services like crowd shipping for efficiency.		✓	✓
BARRIERS			
Lack of interest from public authorities due to potential lack of citizens' support. Opposition from those who prefer unsustainable travel modes and cannot afford additional costs to compensate for the externalities they generate. Ethical concerns relating to tracking citizens movements and mobility choices. Additionally, this system may have disproportional impacts on different citizens of the city.			
PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC			
Project Dit4TRAM (Distributed Intelligence and Technology for Traffic and Mobility) - 2021 - 2024: Is a European Union-funded initiative that aims to improve traffic and mobility management through the application of swarm intelligence. The project focuses on developing expertise in mobility credits as a means to reduce greenhouse gas emissions from transport. Results from a stated preference survey conducted in the Netherlands as part of this project suggest that respondents do not seem to convert their credits balance or travel cost into monetary terms. Using the exchange rate (current or past) results in lower behaviour model fit			

(discrete choice models) compared to using a parameter directly accounting for the number of credits[10].

The starting TMC budget has a substantial impact on the perception of credits, with a higher budget resulting in a less negative perception. For example, respondents starting with 350 credits were willing to trade 4.15 credits to save 1 minute of travel time.

Besides the surveys, there are also focus groups and gaming experiments taking place. With a major one tested during the Transportation Research Arena in Ireland.

RELATED EXISTING SERVICES	BARRIERS / SOLUTIONS FROM CITY'S MOBIILITY STRATEGIES
In the Netherlands the OV-pay system was recently introduced. This system allows travellers to pay for all public transport using their bank card.	The objective of this system is to make public transport use as simple and straightforward as possible thereby stimulating its use. In addition to that, it also saves costs for both passengers and transport providers as ticketing infrastructure is simplified. None specified barriers
Data publishing through DOVA and NDOV.	In this project, travel information is made freely available to be used by website and app builders thereby facilitating MaaS providers. Additionally, the information is used at stops to provide travellers with live information on the status of their trip. Barriers: The reliability of the data is the biggest challenge.

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public entities	Municipality of Amsterdam
	KEES STANTS – MUNICIPALITY OF AMSTERDAM – RUIMTE EN DUURZAAMHEID
Private stakeholders /businesses /operators:	Technolution/Edwin Mein
Citizens	42 citizens from the city of Amsterdam

Mini-dialogue for Amsterdam UC04 (AM-UC04)

For this UC, the mini dialogue consisted of discussions with 42 Citizens of Amsterdam interested by the solution, who provided valuable insights to understand how the TMC could be better integrated in the Living Lab. The results of the discussion were elaborated using the Empathy Map methodology (see Chapter 3.1.2) and are summarized in the following table.

Table 12: Amsterdam Use Case 4 - empathy

	STAKEHOLDER PERSPECTIVE
Identification of real needs:	• A failure-proof system needs to be implemented which can be trusted by citizens or companies and that will implement the mobility credit system.

[10] tradable mobility credits insights from Dit4TRAM - Linkremate

	• Citizens stated they are sensitive to prices, so TMC is the only one way of balancing modal use.
Identification of early barriers/concerns:	• TMC may discourage the use of the bicycles.
Specific opinions on the use case:	• The system could be better applied on a neighbourhood/street level, whereby residents must share locally among themselves. • Scarcity is not an issue: despite road space being scarce, people still use their cars and accept traffic jams. Despite space being scarce in trains, people still stand in the wagons every day. • Citizens see prices fluctuating heavily and their peers buying low and selling high. Therefore, they participate, enforcing each other's behaviour.

PAIN	GAIN
1. Citizens may not trust the system and hence it will not be accepted. 2. This system may reduce "spontaneity", which according to some is a key feature of urban living.	1. Testing an advanced system that has the potential to bring major changes to mobility sustainability. 2. Steering mobility choices towards improved safety, accessibility and efficiency (especially in logistics).

3.2.4. Data map

The following table provides a comprehensive overview of the various data categories, variables, and descriptions relevant to traffic and transportation analysis for Amsterdam city. It details the availability of these data types and their relevance to pilot projects in each city. Key areas of focus include traffic data, transport technology, travel behaviour, public transport services, weather data, road service status, and logistics (see methodology in Chapter 3.1.3). This structured approach aims to highlight critical data points such as vehicle classifications, average speeds, commuting patterns, and cycling safety perceptions, providing a foundation for informed decision-making and effective urban transportation planning.

Table 13: Amsterdam's LL available data

DATA CATEGORIES	DATA VARIABLES	DESCRIPTION	AVAILABILITY	DATA SOURCE
Traffic data	Vehicle Types and Classifications	Distribution of vehicle types (e.g., cars, trucks, buses, bicycles)	LA	Traffic counters, sensors
	Origin-Destination Data	Origin and destination of trips, commuter and freight traffic	LA	Traffic counters, sensors
	Average Speed	Mean speed of vehicles along a road segment or corridor	LA	Traffic management agencies
	Peak Hour Traffic	Traffic volume and flow patterns during peak hours of the day	LA	other
	Bicycle intensity	Traffic count of bicycles	PA	Traffic surveys, government records

	Cycling speeds	Speed	PA	Traffic counters, sensors
Transport Technology	Intelligent Transport Systems (ITS)	Technologies used for traffic management and control	PA	Transportation planning agencies
Travel Behaviour	Travel Survey Data	Mode choice, trip purposes, trip lengths	LA	Traffic surveys, government records
	Travel pattern data	Travel motives	PA	Traffic surveys, government records
	Ride-Sharing and Micromobility	Usage rates and preferences for ride-sharing, micromobility	LA	Ride-sharing company data
Public Transport Services	Public Transport Ticketing Data	Data related to ticketing and fare collection on public transport	PA	Transit authority reports
	Existing Origin-Destination Analyses	Analyses of existing trip origins and destinations	LA	other
	Average Speed for Vehicles in Urban Environment	Average speed of vehicles in the urban environment	LA	Traffic management agencies
	Road Service Status	Information on road conditions, maintenance, and construction	PA	Traffic management agencies
	Speed Regulations for the Road Network	Legal speed limits and regulations for road traffic	PA	Transportation planning agencies
Traffic Safety	Curbside Information for the Urban Environment	GIS data related to curbside management in urban areas	PA	Transportation planning agencies
	Number of accidents	Data on number of traffic accidents where an ambulance was called in Amsterdam	PA	other
	Cycling safety perception	Survey on cyclists' perception of safety (in Amsterdam)	LA	other
	High risk cycling safety locations	Analysis of cycling safety at various locations in Vondelpark	LA	other
Logistics	Number of logistics vehicles and movements in Amsterdam	Counts of number of logistic vehicles entering the environmental zone in Amsterdam daily	LA	other
Environmental Impact	Air Quality Monitoring Data	Pollutant concentrations, emissions	PA	Traffic counters, sensors
	Noise Pollution Levels	Levels of noise pollution along transport corridors	PA	Traffic counters, sensors
	Greenhouse Gas Emissions Inventory	Emissions from transport sources	PA	Traffic counters, sensors
Social Impact	Public Perception Surveys	Public attitudes and perceptions towards transport	PA	Traffic surveys, government records
Transport Network	Road Network Characteristics	Lane widths, speed limits, classifications	PA	Traffic management agencies
	Bicycle and Pedestrian Infrastructure	Availability of bike lanes, sidewalks, crosswalks	PA	Traffic management agencies
	Freight Routes and Distribution Centres	Routes and hubs for freight transportation	LA	GPS

Modal Split	Distribution of trips across different modes of transport	Percentage of trips by car, bus, bicycle, etc.	PA	Traffic surveys, government records

Note: LA: limited availability, PA: Publicly available

This information, along with the results of the capability and empathy map, will serve as the foundation for selecting KPIs for each UC to include in the Evaluation Framework that will be developed in the coming months. Further details about the characteristics of the available data in Amsterdam can be found in Annex II.

3.2.5. Communication channels

The following table provides a mapping of the media and other communication channels necessary for the successful implementation of LLs, and for the communication and dissemination of metaCCAZE activities.

Table 14: Communication channels of the city of Amsterdam

COMMUNICATION CHANNELS		TARGET AUDIENCE	LINK
1	Newspapers		https://www.parool.nl/
2	Smart City socials	Businesses, local government and citizens interested in the Smart City topics	https://amsterdamsmartcity.com
3	Partner social media accounts (LinkedIn, Instagram, X, etc.)		https://www.linkedin.com/company/amsterdam-institute-for-advanced-metropolitan-solutions/mycompany/
4	Local Government news and branch organisations	Local governments	https://www.binnenlandsbestuur.nl/ / https://www.vng.nl

3.3. Status Quo Map for Munich

With a population of just under 1.5 million in 25 districts, Munich is the capital of Bavaria and the third most populous city in Germany. Munich is a European centre for digitalisation, science, technology, innovation, education and tourism with a very high standard of living. The economy is based on the automotive industry, insurance and technology, IT and technology companies and start-ups, biotechnology, services and tourism, creative and gaming industries, and a strong SME sector.

Munich is a key European hub for air, rail and road transport and an urban node at the intersection of two TEN-T corridors: the Scan-Med and the Rhine-Danube corridors. The main railway station is a hub for the Budapest-Paris and Helsinki-Palermo corridors, and new freight train tracks run through Austria to Italy as part of the Scan-Med corridor. Munich Airport (freight) and the new electric tracks to Lake Constance are also part of the TEN-T network. In 2019, the Munich City Council decided to develop an overall strategy for shared mobility and an integrated Vision Zero road safety concept.

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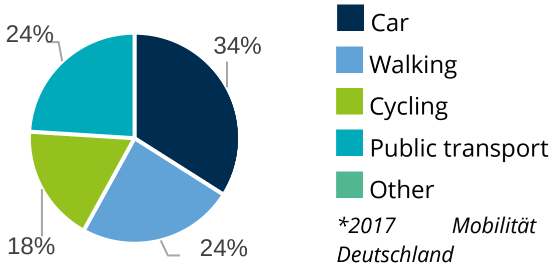
A FEW FACTS…

Munich is one of the MISSION CITIES, but by the time this report was drafted, it had not yet signed the Climate City Contract.

1.488.200 inhabitants



**2017 Mobilität in Deutschland*

Key facts:

Bavaria capital city # Industrial and technological centre # European air, rail and road hub

Vision ZERO objectives # Safeguard quality of life and the common good through space efficiency

Urban node at the intersection of two TEN-T corridors:
the Scan-Med and the Rhine-Danube corridors

Sustainable mobility goals:

- Munich is one of the MISSION CITIES – committed to achieve climate-neutrality by 2030
- Its “EU Mission Label” is still in process
- Its SUMP was approved in 2021 and includes targets and objectives for 2035.

3.3.1. Sustainable mobility planning policies

In June 2021, Munich’s City Council adopted the draft of a new overall strategy for mobility and transport. The guiding principle of the new "**Mobility Strategy 2035**"[11] is to safeguard quality of life and the common good. The Mobility Strategy 2035 defines space efficiency as a key indicator for future planning.

The mobility strategy's concrete goal is therefore that by 2025 at least 80 percent of traffic in the Munich city area will be carried out by zero-emission vehicles, public transport, walking and cycling. The Mobility Strategy 2035 comprises many sub-strategies, all of which are important building blocks for a successful mobility transition. In total, the Mobility Strategy 2035 comprises the following 19 sub-strategies: road safety, public transport, walking, cycling, shared mobility and mobility as a service, motorised private transport, multimodality, traffic management, management of public (road) space, mobility concepts in urban planning and urban redevelopment, social justice, participation and inclusion, commercial transport, climate and environmental protection, regional and commuter mobility, communication, digitalisation, crisis stability and resilience, financing, research and innovation

Transport should also be climate-neutral by 2035. Further goals result from the 19 sub-strategies, insofar as they have already been defined. For example, the road safety sub-strategy defines **"Vision Zero"** as a concrete goal: no one should die on Munich's roads. In the local transport plan, which forms the basis for the public transport sub-strategy, it has been decided that the share of public transport should increase to 30% of all journeys by 2025. Shared mobility is to be supported by 2,500 stationary sharing parking spaces and the construction of 200 mobility points. Numerous

[11] https://muenchenunterwegs.de/2035

measures for pedestrian and commercial transport have also been defined in sub-strategies that have already been adopted.

The initial measures for inner-city commercial transport, developed by the Mobility Department together with the business associations, contain many innovative approaches to strengthen and accelerate Munich's commercial traffic and, at the same time, improve traffic safety and the quality of life. The measures that have now been adopted are the first stage on the road map for commercial transport up to 2030.

Urban logistics is also part of the Mobility Strategy 2035, with which the city of Munich is pursuing important goals:

- Munich should have sustainable and efficient supply and disposal in the future,
- the local economy is to be promoted,
- traffic safety and quality of life are to be improved and
- emissions are to be significantly reduced by 2035.

Geographical scope:

The geographical scope of the Munich city SUMP is at the city level. A regional SUMP is currently under development process.

Timing:

Approved in 2021 towards 2035 objectives

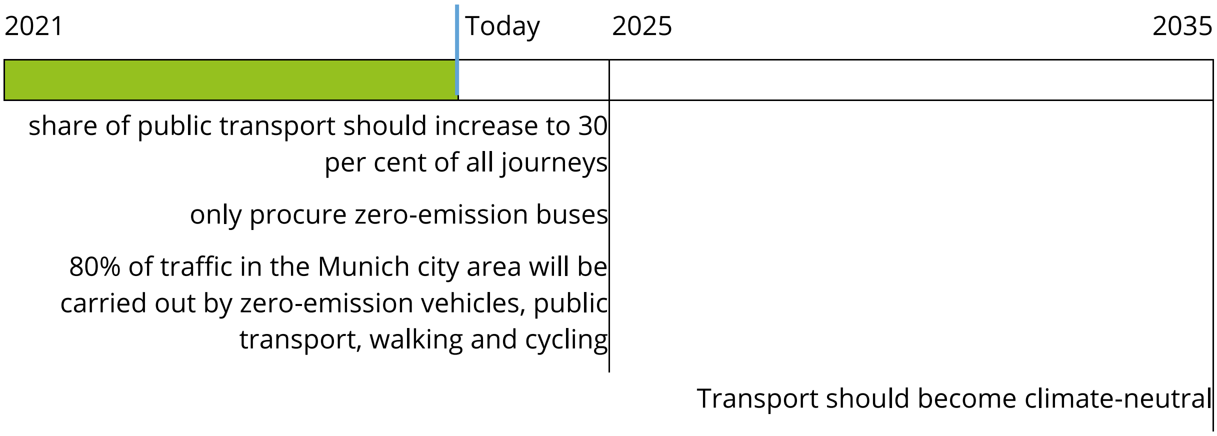


Figure 3. Sustainable mobility planning policies main targets - Munich

SUMP - Mobility Strategy 2035 monitoring from its approval:

The SUMP for Munich was approved in 2021 and has a monitoring scheme in place. The monitoring report is to be done every three years, and the city is currently in the first cycle of the SUMP. Hence, the monitoring report is yet to be published. The data is collected within the SrV study[12] every five years, started in 2023, and the results for this phase study will be published in 2025. Thenext data collection cycle will be in 2028.

3.3.2. Climate City Contract policies and metaCCAZE alignment

Munich is one of the Mission Cities and is currently working on the preparation of the CCC, whose draft is aimed to be submitted in September 2024. Considering the absence of a draft at the time

[12] https://tu-dresden.de/bu/verkehr/ivs/srv/das-srv

of the reporting, it is not possible to present a list of the foreseen actions related to urban mobility included in the CCC as per the other LLs where, for each action, it has been indicated whether the metaDesigned Use Cases will contribute to their implementation.

3.3.3. Munich's UCs - Resources and needs

As anticipated in Chapter 2, Munich proposes two UCs that will be tested within metaCCAZE. For each UC, a summary of the key takeaways of the ***capability map*** and ***empathy map*** are presented.

Building on the information collected by Munich Living Lab partners and TUM, the Support Partner, the following sections provide, for each UC, a description of the measures to be implemented within metaCCAZE together with the preliminary barriers, existing services potentially related to each UC, and relevant projects, studies and past experiences that could be leveraged. In addition, the sections include the main outcomes of the mini dialogues hosted in Munich between June and July 2024. The city has planned a staged process for stakeholder engagement, which varies according to the different topic areas. The city has developed two sessions of mini-dialogues and workshops on co-creation in the two UCs.

3.3.3.1. Dynamic Curbside Management (MU-UC01)

Table 15: Munich Use Case 1 - capability

MU-UC01	
Dynamic Curbside Management	
USE CASE DESCRIPTION	This use case aims to implement a dynamic curbside management system in which the curbside and public spaces are digitally mapped, managed, and monitored. Ad-hoc geofencing and booking capabilities could then be used to effectively manage the operation of logistics, local vendors, public utilities, shared mobility services, taxis, and on-demand passenger vehicles. Additionally, a connected (semi-)automated small zero emissions vehicle—Rickshaw—for last-mile passenger and freight transport will be further developed during the project. The vehicle will be used to demonstrate the use of the dynamically managed curbside areas for passenger and freight pick-up and drop-off operations as well as to prototype the autonomous reservation of slots for such processes. We propose a twofold approach to this UCs: - A local-level dimension aims to pilot the monitoring and booking technologies, explore changes and challenges in the regulation, understand the interaction with stakeholders, and gain insights into the real-world operation of such a system. - A network-level dimension is intended to investigate how to successfully expand the concept to larger areas and explore its systemic effects. The activities in each of the dimensions can be classified into three stages: (1) Planning, understanding how to optimally deploy the systems; (2)

	Implementation/Simulation, bringing the activities into the real/simulated world; (3) and Evaluation, measuring the impacts.
AREA DESCRIPTION	In the local-level dimension, a pilot project with 4 to 10 dynamic curbside spaces will be implemented in the central area of the city of Munich, within the so-called Mittlerer Ring. The exact location of these areas is still not defined, but they will be selected considering legal, budgetary, and technical constraints (preferably in proximity to each other to create a network effect). The area within the Mittlerer Ring is Munich's most vibrant and densely populated area, and it is marked by a mix of residential, commercial, educational, and cultural hubs. Although public transport is well-developed, with extensive U-Bahn, S-Bahn, tram, and bus networks, this zone faces important traffic congestion during peak-hours due to high vehicle and active-mobility user volumes. Besides, the high volumes of logistics and delivery vehicles and the lack of sufficient space for their operation lead to negative impacts on the surrounding traffic.

OBJECTIVES Alignment with:	**SUMP**	**CCC**
Reduce the time spent looking for parking spaces in the logistics sector, thus reducing emissions.	✓	TBD
Reduce the time spent looking for parking spaces in the logistics sector, thus saving time and money.	✓	TBD
Minimize the impacts of logistics operations on the general and public transport traffic.	✓	TBD
Maximize the utilization of the public space.	✓	TBD

BARRIERS

As the project involves building/modifying infrastructure, there are intrinsic risks related to the tendering and the construction process (e.g., delays from the construction company, delays in the arrival of materials, etc).

PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC

CONDUCTOR 2022 - 2025: The project focuses on developing a simulation model to depict an integrated service encompassing both passenger and freight transport, operated with automated vehicles (CCAM). To assess the traffic impact of this service, the project integrates the simulation software "FleetPy," designed for mobility-on-demand services, with the traffic simulation software "Aimsun." This coupling enables a comprehensive evaluation of traffic dynamics and system performance. Within the coupled simulation model, the project investigates the effects of various traffic control measures. Additionally, it aims to develop cooperative routing strategies to ensure a balanced network load, particularly under scenarios with high penetration rates of fleet vehicles. Through these efforts, the project seeks to optimize the efficiency and effectiveness of integrated automated transport services, contributing to the advancement of smart and sustainable mobility solutions.

Tempus 2021 – 2023[13]: Integrating diverse road types provides valuable insights that can inform the design of test environments. Lessons learned from road technology and data transfer play

[13] Tempus project - Link

Co-funded by the European Union

a crucial role in guiding infrastructure setup. Achieving scalable standards is essential for ensuring interoperability among systems. Opening test areas encourages collaboration among stakeholders. Additionally, methods used for AVF (Automated Vehicle Functionality) assessment can be adapted to evaluate new initiatives effectively.

Easyride 2018 - 2020: Automated driving is currently one of the most important innovations in the field of mobility. It does not only promise increased comfort and safety in private transport, but also opens opportunities for the creation of novel mobility services and the transformation of the mobility system, especially in the urban environment. Using the example of the City of Munich, the EASYRIDE project defines goals from a municipal perspective, develops realistic development paths for the "mobility transformation" and derives specific recommendations for action, while considering identified risks, opportunities, and uncertainties. Lessons learned from Easyride might be useful for connected (semi-)automated small zero emissions vehicle implementation in this UC.

RELATED EXISTING SERVICES	BARRIERS / SOLUTIONS FROM CITY'S MOBIILITY STRATEGIES
Parking Dual: day-night and summer-winter alternation	The project aims to adapt parking spaces to the changing needs of residents by alternating between car and bicycle parking depending on the time of day or season. This dual-use approach helps maximize the limited public space, improve accessibility, and protect urban greenery. Day-Night Switch: Some parking spots are designated for bicycles during the day and cars at night. Summer-Winter Switch: Other spots are for bicycles from April to October and for cars from November to March. Barriers: The system is still in a pilot phase. It can be expected that the right balancing between the different uses is challenging. Solutions: n.a.
MVGO	MVG Go is the mobility app for Munich and the surrounding area that combines public transport and sharing services. It allows buying tickets, accessing routing information, disruption reports, live departure times, and checking the location of shared-bikes, e-scooters, car sharing, charging stations, etc. The users can conveniently access in one app all the taxi and public transport services, as well as the bike and car sharing services of MILES, SHARE NOW, SIXT and STATTAUTO. Barriers: During the first few months of operation the app was slightly unstable, but then widely used. The previously existing app, MVG Fahrinfo, was still supported. Many users expressed dissatisfaction with the MVGO app, finding it to be "bloated", "not very intuitive", and lacking important features like easy access to departure times and delay information that were available in the old app. Since then, the new app incorporated new features and reached hundreds of thousands of downloads. Solutions: The old MVG Fahrinfo app is being shut down on August 2, 2024 and replaced by the new MVGO app

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public entities/Academia	Munich's municipality (both the transport and logistics departments),
	Technical University of Munich and 2 transport researchers

Private stakeholders/ businesses/ operators	3 representatives of logistic companies.
	4 representatives of passenger transport companies (two from public transport operators and two from taxi/ride-hailing).
	2 merchants/craftspeople
	2 two representatives of mobility service providers (e.g., car sharing).
Citizens groups/associations	1 transport planner
	1 citizen without direct connection to transport and logistics activities.

Mini-dialogue for Munich UC01 (MU-UC01)

The mini-dialogue activity of the Dynamic Curbside Management Use Case consisted of an online survey implemented in the Microsoft Forms platform (see screenshot below). The link to the survey was included in the invitation to the LL2/LL3 workshop (see Chapter 4), as well as sent directly to relevant stakeholders in the city. The survey—which contained a brief introduction to the concept of Dynamic Curbside Management and a mix of multiple-choice, ranking, and open-field questions—was completed by 15 respondents.

metaCCAZE project - Mini-Dialogue

Sehr geehrte Teilnehmer,

das von der EU geförderte Projekt metaCCAZE (metaccaze-project.eu) zielt darauf ab, Spitzentechnologien zu testen und zu demonstrieren, die emissionsfreie Mobilitätslösungen für Personen und Güter unterstützen. Die Stadt München ist eines der vier Living Labs, in denen zwei dieser Technologien erprobt werden sollen.

In der ersten Phase des Projekts sind wir daran interessiert, die Bedürfnisse, Meinungen und Ängste der Beteiligten zu verstehen. Daher würden wir es sehr begrüßen, wenn Sie die folgenden Fragen kurz beantworten könnten. Die Beantwortung wird weniger als 5 Minuten in Anspruch nehmen. Ihre Antworten werden anonym behandelt. Wenn Sie weitere Informationen wünschen, wenden Sie sich bitte an

Vielen Dank im Voraus!

Mobilitätsreferat - Landeshauptstadt München & Lehrstuhl für Verkehrstechnik - Technische Universität München

Dynamisches Curbside Management

Eine der Innovationen, die in München in einem Testformat umgesetzt werden soll, ist das **dynamische Curbside Management**, bei dem der Bordstein (= Curbside), noch konkreter Parkflächen, digital kartiert, verwaltet und überwacht werden. Buchungsfunktionen können dann genutzt werden, um den Betrieb von Logistik, lokalen Anbietern, öffentlichen Versorgungsunternehmen, Shared-Mobility-Diensten, Taxis und On-Demand-Personenfahrzeugen effektiver zu ermöglichen. Dabei wollen wir auf lokaler Ebene die Überwachungs- und Buchungstechnologien erproben, Änderungen und Herausforderungen bei der Regulierung untersuchen, die Interaktion mit euch, den Beteiligten, verstehen und Einblicke in den realen Betrieb eines solchen Systems zu gewinnen. Außerdem soll perspektivisch untersucht werden, wie das Konzept erfolgreich auf größere Gebiete ausgeweitet und seine systemischen Auswirkungen erforscht werden können.

Figure 4. Munich Dynamic Curbside Management Mini-dialogue

The most promising use of the dynamic curbside areas, as reported by the participants, was the boarding/alighting of passengers, followed by the boarding/alighting of freight, the temporary parking during a work assignment, and the charging of e-vehicles. The respondents identified the reduction of second-row parking, faster search of parking spaces, and fewer blocking of traffic and cycle lanes and bus stops as the most relevant benefits of the proposed solution. Besides, the more rational, efficient and fair use of the public space among all traffic participants was mentioned. The digital interface was positively considered as it would offer a better knowledge of parking availability in real-time. Regarding mobility providers, Dynamic Curbside Management was considered an advantageous solution offering easy-to-find and safe boarding/alighting locations.

Participants also showed their concerns about the potential challenges hindering the implementation of the use case. For example, in terms of governance and regulation, some respondents mentioned the difficulty of bringing all stakeholders together, the limited social acceptance (particularly due to the need to remove existing parking spaces), and the challenging regulatory framework (booking public parking spaces is currently not allowed in Munich). The issue of securing the availability of a booked space and the enforcement of the curbside-use regulation was also raised, as well as the need to provide sufficient spaces. Furthermore, there were concerns about the stability of the IT infrastructure, the app interface, and the burden of getting an additional app just to use these spaces. Finally, it was mentioned that the solution would be only meaningful if applied to the whole city level, as otherwise, people would not make the effort to get familiar with the system, create an account, etc.

The results of the event were elaborated using the Empathy Map methodology (see Chapter 3.1.2) and are summarized in the following table.

Table 16: Munich Use Case 1 - empathy

	STAKEHOLDER PERSPECTIVE
Identification of real needs:	• The vast majority of the participants (>70%) reported having significant problems finding a stop/parking place in the city centre (the area within the Mittlerer ring). • Almost half of the participants also reported that it was challenging to find a stop/parking area outside of the city centre. • Road users (also cyclists) suffer from the illegal stops of vehicles (for cargo and passenger boarding and alighting) and the short-term double parking. • People want to have real-time information on parking availability. • Mobility providers would benefit from easy-to-recognize and safe boarding areas.
Identification of early barriers/concerns:	• Regulations might not currently allow the booking of public space. • Social acceptance. Implementation would require the removal of parking spots. • IT infrastructure stability, app interface, etc. • Burden to download a specific app just for this purpose. • How to ensure that the booked space is actually available and how to enforce the curbside-use regulations.
Specific opinions on the use case:	• Overall positive. It is seen as a way of using the public space in a more efficient and rational way. • The participants acknowledge the challenges of implementing the solution in real life. • The solution might only make sense if implemented at a whole-city (or even better, at a regional/national) level. Otherwise, no incentive for the stakeholders to adapt to it.

PAIN	GAIN
1. Download and use the booking interface (either by app or API). 2. Ensure that the curbside-use regulations are enforced.	1. Reduce dwelling time looking for parking. 2. Less disturbance to car and bike traffic due to illegal parking

3.3.3.2. Establishment and operation of multimodal logistics hubs (MU-UC02)

Table 17: Munich Use Case 2 - capability

MU-UC02	
Establishment and operation of multimodal logistics hubs	
USE CASE DESCRIPTION	This Use Case aims to evaluate the use of logistic hubs that enable the last-mile delivery of parcels via cargo bike, rickshaw, and other small and energy-efficient vehicles. For this purpose, several logistic hubs will be constructed following the example of Munich's first bicycle logistics hub, "Viehhof", in the district of Sendling. From these new delivery hubs, logistic companies will deliver parcels to private individuals as well as goods and pallets to commercial enterprises, craft businesses and construction sites. The transport will be carried out with state-of-the-art e-cargo bikes, which relieve residential areas of car traffic, thus making the roads safer and protecting the environment. Additionally, a connected (semi-)automated small zero-emissions vehicle—Rickshaw—for last-mile passenger and freight transport will be further developed during the project. This vehicle will be used as a test vehicle/demonstrator to analyse the feasibility of using (semi-)automated vehicles at the logistic hubs in the future.  *Credits: LHM, DobnerAngerman[14]*
AREA DESCRIPTION	The exact location of the mobility hubs is still under consideration. Most likely, one of them will fall within Munich's inner city, whereas the other will be built further north in an area with high relevance for logistics operations. As previously mentioned, the city centre of Munich suffers from heavy traffic congestion, and the high volume of delivery vehicles performing frequent stops for delivery exacerbates further this problem. Besides, the current delivery fleet is mostly formed by combustion-engine vehicles, leading to pollution and air quality problems.
OBJECTIVES	Alignment with: **SUMP** **CCC**

[14] From München unterwegs | Der erste Radlogistik-Hub Münchens am Viehhof (muenchenunterwegs.de)

To reduce the number or van-like delivery vehicles driving in the city, which occupy large amounts of public space, lead to congestion and emissions.	✓	TBD
To shift the last-mile delivery of goods to smaller, more flexible electric vehicles.	✓	TBD

BARRIERS

As the project involves building/modifying infrastructure, there are intrinsic risks related to the tendering and construction process (e.g., delays from the construction company, delays in the arrival of materials, etc.).

The final market implementation of small electric connected (semi)-automated vehicles faces barriers, including the need for infrastructure upgrades and robust cybersecurity. High initial costs, market adoption challenges, and complex liability and data privacy regulations could also hinder progress. Gaining public trust, managing behavioural changes, and addressing ethical issues are critical societal challenges. Additionally, resource availability and ensuring sustainable charging infrastructure pose environmental and resource-related obstacles.

PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC

Civitas Eccentric 2016 - 2020: Mobility Hubs were tested in a dedicated location at the outskirts of the city and are now part of the mobility strategy for the whole of Munich. The project delivered results for the shared mobility sub-strategy in general. Micro depots were tested and were, therefore, a pioneer for the first bicycle logistic hub at Viehhof.

City2Share 2016 - 2020: Learnings from micro depots and last-mile delivery: The successful UPS delivery concept with cargo bikes and micro-depots in the Munich study areas has demonstrably led to positive effects. As the demand for logistics space will continue to increase in the future, the municipality should make active provision for space and designate a network of suitable areas throughout the city for micro hubs. This gives a mandate to the bicycle logistics hubs planned within metaCCAZE.

Tempus (2021 – 2023) and Easyride (2018 – 2020), described in MU-UC01 (Dynamic Curbside Management), might provide interesting insights for connected (semi-)automated small zero-emissions vehicle implementation in this UC.

RELATED EXISTING SERVICES	BARRIERS / SOLUTIONS FROM CITY'S MOBILITY STRATEGIES
Bicycle Logistics Hubs	Barriers: The practicalities of the hub – like the design of the hub to allow efficient truck and delivery-bike drive-in and drive-out. Also, building e-loading infrastructure, so that all companies can equally well charge their vehicles. Solutions: n.a.

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public entities/Academia	Representatives from the state ministries of North Rhine-Westphalia and Bavaria, representatives from the cities of Munich, Aachen, Bremen, Köln
	Technical University of Munich
Private stakeholders/	Mobility/Logistics stakeholders: Cargo bike manufacturers, courier companies, delivery companies

businesses/ operators:	E-commerce
	Others: 3xIT companies, 3xreal-state companies, a park-and-ride subsidiary of the municipality
Citizens groups/associations:	Society groups, consumer associations, chamber of Commerce of Munich and Chamber of Commerce of Babaria, Chamber of Industry of Munich

Mini-dialogue for Munich UC02 (MU-UC02)

The mini dialogues related to this UC comprised two different online surveys conducted in June 2024 in order discover the real needs, early barriers, and specific opinions of citizens and stakeholders.

The first survey targeted the overall UC of the **Multimodal Hub**: the development of several logistic hubs allowing the operation of small last-mile electric delivery vehicles. The survey was implemented in the platform SurveyMonkey, and the link to it was included in the invitation to the LL2/LL3 activities (see Chapter 4) that took place on June 27th. In total, responses from 22 participants were obtained.

A second survey exclusively targeted the **use of small (semi-autonomous) e-vehicles** for the transport of passengers and freight (the so-called Rickshaw, which is being designed by the Technical University of Munich). This vehicle is a transverse solution to be implemented on both the MU-01 and MU-02. The survey was conducted using the Microsoft Forms platform (see figure below) and was shared via TUM's social media channels, as well as sent directly to relevant stakeholders by Munich's mobility department. The survey—which contained a brief introduction to the vehicle, an exemplary video, and a mix of multiple choice, ranking, and open-field questions—was completed by 19 participants (17 of them residents of Munich). The participants' profile was made up of nearly equal proportions of transport researchers, transport planners, and citizens without any professional connection to transport or logistics. Additionally, two participants worked for transport and logistics companies.

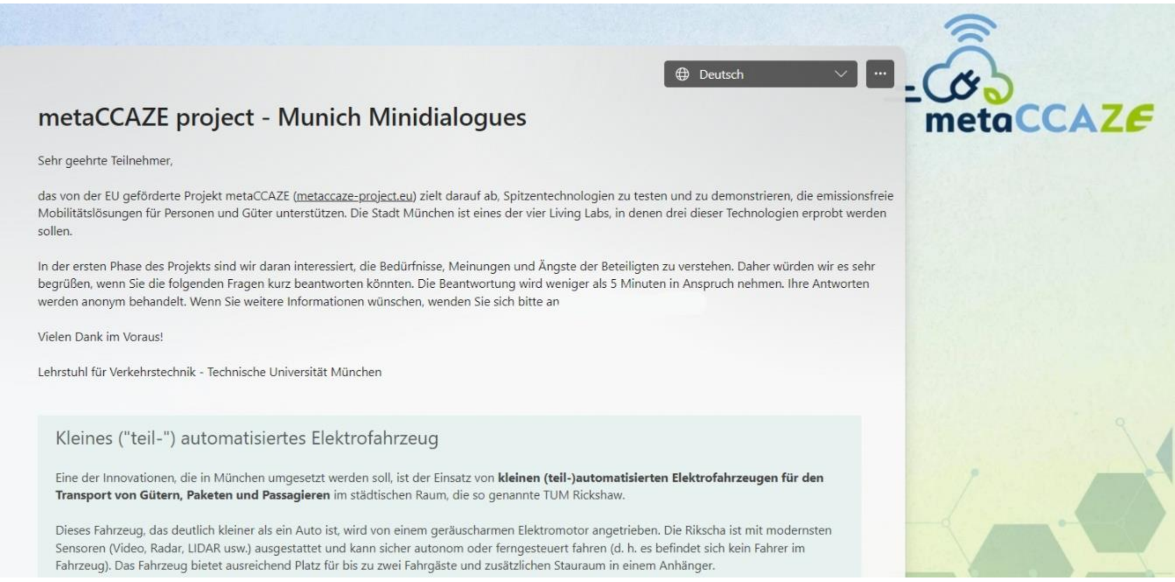


Figure 5. Munich survey for the mini-dialogue focused on semi-automated vehicles

The rickshaw is intended to be a multipurpose mobility vehicle. However, the respondents identified first/last-mile passenger transport and the delivery of small parcels to citizens as the most promising applications for the vehicle. The combined transport of both passengers and parcels in the same vehicle received significant, though somewhat lower, support, followed by its use as a regular transport mode during the summer months (for both citizens and tourists). The use of the rickshaw as a regular transport mode throughout the entire year received the least support by far.

The results of the mini-dialogue were elaborated using the Empathy Map methodology (see Chapter 3.1.2) and are summarized in the following table.

Table 18: Munich Use Case 2 - empathy

STAKEHOLDER PERSPECTIVE	
Identification of real needs:	• Regulations must be adapted to facilitate obtaining the necessary permissions to operate bike logistics and logistic hubs. • Logistics companies would benefit from financing support for the acquisition of the e-bikes • The equipment of the hubs must be appropriate (sufficient charging capacity, space for sorting of packages, etc.). <u>Specific to the rickshaw vehicles</u> • Reduce the time spent by logistic vehicles looking for parking • Improve the traffic conditions by reducing illegal double-lane parking by delivery companies • Sustainable transport alternatives for last-mile
Identification of early barriers/concerns:	• Fears about the financial feasibility of cycle logistics • Access to financing (for the acquisition of the cargo bikes) <u>Specific to the rickshaw vehicles</u> • Driving regulations for such vehicles. Where should they drive? On the carriageway or on bike paths? • Weather condition • Interaction and conflicts with normal cyclists • Sabotages and misuse • How to deliver the parcel to the end customer if the vehicle is fully autonomous (what if the customer is not there?) • Potential lack of cooperation from delivery companies • Fully autonomous driving is not yet allowed on German public roads • Risk of induced demand (people would find the solution too convenient and walk less) • Making the solution attractive and accessible to older people (potentially unfamiliar with digital technologies).
Specific opinions on the use case:	• Two thirds of the respondents reported to be planning or already actively pursuing the expansion of cycle logistics, either as a customer, active cycle logistics provider, client, space provider or supplier. • The companies delivering parcels (CEP) (i.e., small amounts, typically to private individuals or businesses) prefer a higher density of stops (and probably do not need such big sorting and processing areas). Conversely, companies providing B2B services (e.g., the transport of pallets to businesses) prefer fewer hubs but of larger size, to profit from the economies of scale. Dachser,

DB Schenker, and B4B are examples of B2B companies and GLS, DPD, and UPS of the CEP ones.

Specific to the Rickshaw vehicles:

- The vast majority of the participants (around 75%) believe this technology can contribute to the reduction of CO2 emissions, pollutants and noise emissions in the city.
- Also, clear positive opinion about the possibilities to reduce the use of public space (compared to conventional logistics and transport vehicles)
- Different views on whether the respondents would feel comfortable driving or walking around, or driving in the autonomous vehicle (roughly 1/3 against it, 1/3 neutral, 1/3 positive)

PAIN	GAIN
1. Currently higher cost per parcel than traditional schemes 2. Bicycle infrastructure must be improved Specific to the Rickshaw vehicles 1. Rickshaw's impacts might be too small to have large effects on overall mobility of the city, but it could lead to slight improvements at the neighborhood level. 2. Potential safety issues due to autonomous driving.	1. The existence of logistic hubs is needed to transfer the parcels between larger vehicles to last-mile cargo bikes. 2. Synergies between different logistic operators. Specific to the Rickshaw vehicles 3. Use of less space and flexibility 4. Less noise emissions and pollution that private vehicles 5. Potentially shorter travel time (due to use of bike paths or bike streets) 6. Lower contribution to traffic congestion 7. Autonomous (no driver needed) 8. Likely cost-effective (compared to existing ride-hailing solutions)

3.3.4. Data map

The following table provides a detailed overview of the various data categories, variables, and descriptions relevant to traffic and transportation analysis for Munich. It includes the availability of these data types and their respective data sources, offering a comprehensive foundation for urban transportation planning and analysis. The table encompasses key areas such as traffic data, transport network characteristics, electric vehicle infrastructure, weather data, parking data, intersection and curbside management, and logistics hubs.

Table 19: Munich's LL available data

DATA CATEGORIES	DATA VARIABLES	DESCRIPTION	AVAILABILITY	DATA SOURCE
Traffic Data	Average Daily Traffic (ADT)	Number of vehicles passing through a specific location on a road or highway within a day	PA	Mobility department
	Traffic Flow Patterns	Peak hours, congestion hotspots, directional flow	LA	Mobility department

	Vehicle Types and Classifications	Distribution of vehicle types (e.g., cars, trucks, buses, bicycles)	PA	Statistic Office
	Origin-Destination Data	Origin and destination of trips, commuter and freight traffic	LA	Mobility department -- model
	Traffic Volume	Number of vehicles passing through a specific point or section of road within a given time frame	PA	mobility department
	Traffic Density	Measure of vehicle concentration per unit length of road	LA	mobility department-INRIX (external data provider)
	Average Speed	Mean speed of vehicles along a road segment or corridor	PA	mobility department-INRIX (external data provider)
	Free Flow Speed	Speed vehicles would travel at under ideal conditions, unaffected by congestion	PA	mobility department
	Congestion Index	Measure of traffic congestion level, often based on travel time compared to free-flow conditions	PA	mobility department-INRIX (external data provider)
	Queue Length (Intersections / Bottlenecks)	Length of vehicle queues at intersections or bottlenecks during peak hours	NA	
	Peak Hour Traffic	Traffic volume and flow patterns during peak hours of the day	PA	mobility department
Transport Network	Road Network Characteristics	Lane widths, speed limits, classifications	PA	mobility department, local authority department
	Bicycle and Pedestrian Infrastructure	Availability of bike lanes, sidewalks, crosswalks	PA	mobility department, construction department, local authority department
Electric Vehicle Fleet Chargers' Types and Specification	Number and Locations of Chargers	Count and geographical distribution of EV charging stations	PA	mobility department
	Charging Schedule and Charging Stations Occupation Rates	Schedules and occupancy rates for charging stations	Potentially available, from one operator	mobility department, public transport authority

	Weather Data	Meteorological data including temperature, precipitation, etc.	PA (Hourly/Daily data)	Meteorological agencies
	Parking Data / Parking e-Smart Data	Information on parking availability, occupancy, and payment	PA (every parking ticket)	mobility department, construction department
Traffic Safety	Intersection Management	Management strategies and data for traffic intersections	LA	mobility department
Curbside management	Location and characteristics of dynamically managed curbside areas	Dynamically managed curbside areas will be built and digitalized during the project.	These areas are not yet built. Their location and characteristics will be decided during the project.	
	Occupancy of the dynamically managed curbside areas	Time % the areas are available	Not available yet. Will be collected by the sensors during the pilot.	
	Characteristics of the reservations	Types of vehicles (van/truck/regular vehicle), type of user (delivery vehicle, craftsman, ODM), duration of the reservation, anticipation of the reservation	Also not available yet. Will be collected during the pilot.	
	Compliance/Violation rates	Number of users adhering or violating the curbside rules per time unit (day/hour)		
Network of Multimodal Logistics Hubs	Delivered parcels by Logistic Hub/day			
	Delivered parcels by bike/day			
	Daily fleet energy consumption	Either average daily energy price or amount of kwh		
	Handling time	Time since arrival of a parcel to the hub till delivery to the end customer		

Note: LA: limited availability, PA: Publicly available, NA: Not available

This information, along with the results of the capability and empathy map, will serve as the foundation for selecting KPIs for each UC to include in the Evaluation Framework that will be developed in the coming months. Further details about the characteristics of the available data in Munich can be found in Annex II.

3.3.5. Communication channels

The following table provides a mapping of the media and other communication channels necessary for the successful implementation of LLs, and for the communication and dissemination of metaCCAZE activities.

Table 20. Communication channels of the city of Munich

	COMMUNICATION CHANNELS	TARGET AUDIENCE	LINK
1	Internet website for the City of Munich/ Landeshauptstadt München	Citizens, Stakeholders, associations, non-profit organisations, public administration, research institutes etc.	https://www.muenchen.de/ https://stadt.muenchen.de/infos/socialmediaregister.html Instagram: https://www.instagram.com/stadtmuenchen/ Facebook: https://www.facebook.com/Stadt.Muenchen X/Twitter: https://twitter.com/StadtMuenchen Rathaus Umschau: Münchner Rathaus Umschau is the official press service of the City of Munich. https://ru.muenchen.de/ City Intranet Platform: Only for City Employees https://wilma.muenchen.de/home/startseite
2	Internet website for the Department of Mobility/ Mobilitätsreferat, City of Munich	Citizens, Stakeholders, associations, non-profit organisations, public administration, research institutes etc.	https://muenchenunterwegs.de/ Press and public relations: presse.mor@muenchen.de
3	Social Media channels for the Department of Mobility/ Mobilitätsreferat, City of Munich	Same as above	Instagram: https://www.instagram.com/muenchenunterwegs/ Facebook: https://www.facebook.com/Muenchenunterwegs.de
4	Social Media Channels of the Technical University of Munich	Citizens, Stakeholders, associations, non-profit organisations, public administration, research	Technical University of Munich: The Entrepreneurial University - TUM

	institutes, media, industry, etc.	Technical University of Munich: Resumen | LinkedIn Technische Universität München (@tu.muenchen) Profil / X (twitter.com)
5 Social Media Channels of the School of Engineering and Design of the Technical University of Munich	Citizens, Stakeholders, associations, public administration, research institute, media, industry, etc.	TUM School of Engineering and Design (ED) - TUM School of Engineering and Design TUM School of Engineering and Design (ED): Resumen | LinkedIn TUM School of Engineering and Design (ED) (@tum_school_ed) TUM School of Engineering and Design (@ed_tum) / X (twitter.com)
6 Social Media Channels of the Chair of Traffic Engineering of the Technical University of Munich	Citizens, Stakeholders, public administration, research institutions, media, industry, students, etc.	Home - Chair of Traffic Engineering and Control (tum.de) TUM - Chair of Traffic Engineering and Control: Resumen | LinkedIn

3.4. Status Quo Map for Limassol

Limassol is the second largest city in Cyprus with a population of 258,900 inhabitants. The city is experiencing rapid economic and social changes, witnessing a massive transformation into an economic and touristic centre and experiencing a construction boom. The tourism sector is a significant contributor to the local economy and enhances the city's importance in the region.

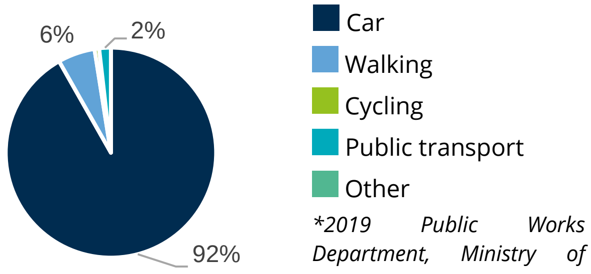
The city's allure extends beyond its stunning beaches and rich historical sites to its robust economic infrastructure. The port of Limassol, located on the Orient/East-Med Corridor of the Trans-European Transport Network (TEN-T), serves as a vital gateway for international trade. Furthermore, Limassol's commitment to education, exemplified by institutions like the Technological University of Cyprus, ensures the city's continued growth and relevance on both national and global scales.

Limassol's multifaceted role as an economic, trade, tourism, and cultural hub positions it as a significant player in the region, contributing to the overall development and connectivity of Cyprus with the broader Mediterranean and international communities.

A FEW FACTS...

Limassol has already its EU MISSION LABEL

258,900 inhabitants



**2019 Public Works Department, Ministry of Transport*

Key facts:
#Rapid economic development #Construction boom #Touristic city #International Port #Cultural hub #University city

TEN-T Comprehensive network:
Western Balkans corridor

Sustainable mobility goals:
- Limassol is one of the MISSION CITIES – committed to achieving climate-neutrality by 2030
- It has been awarded the "EU Mission Label" in March 2024.
- Its SUMP was approved in 2019 and includes targets and objectives for 2030.

3.4.1. Sustainable mobility planning policies

The Sustainable Urban Mobility Plan (SUMP) of Limassol was a comprehensive initiative covering the city's broader urban region, incorporating its six Municipalities and eleven peri-urban Communities. Its primary objective is to enhance mobility and the overall quality of life for residents and visitors alike, with a focus on fostering sustainable economic, environmental, and social development. Through a thorough evaluation of stakeholder expectations, a vision for Limassol in 2030 emerged as an accessible, safe, and functional urban centre, complemented by attractive, green neighbourhoods and a vibrant city centre. This vision also included the creation of numerous spacious public spaces, serving as a nexus for sustainable and intelligent mobility, while facilitating a diverse range of economic, business, educational, recreational, and cultural opportunities.

Geographical scope:

Limassol's FUA (6 municipalities and 11 communities) - 222.5 sq/km

Table 21. SUMP geographical scope - Limassol

MUNICIPALITIES	COMMUNITIES	
• Municipality of Limassol	• Pano Polemidia	• Pyrgos
• Municipality of Mesa Yitonia	• Palodeia	• Tserkezoi
• Municipality of Kato Polemidia	• Mouttagiaka	• Trachoni
• Municipality of Agios Athanasios	• Agios Tychonas	• Kolossi
• Municipality of Yermasoyia	• Parekklisia	• Erimi
• Municipality of Ypsonas	• Moni	

The “Metropolitan” SUMP is followed by Limassol Local Plan and Limassol Centre Area

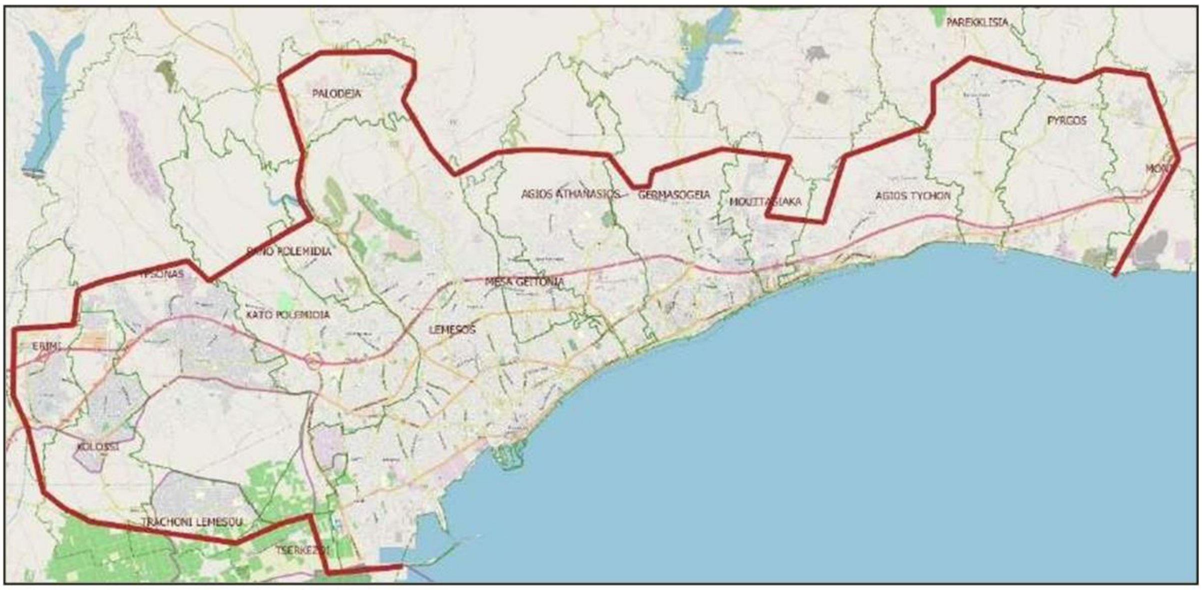


Figure 6. SUMP geographical scope - Limassol

Timing:

Approved in 2019 towards 2030 objectives

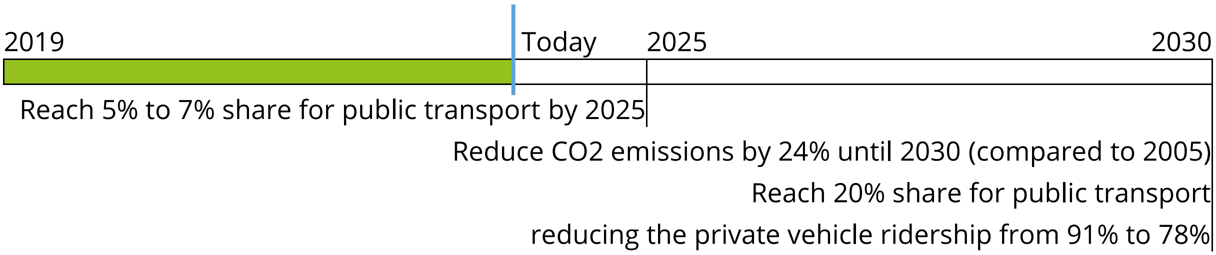


Figure 7. Sustainable mobility planning policies' main targets - Limassol

SUMP monitoring from its approval:

Not yet pursued

3.4.2. Climate City Contract policies and metaCCAZE alignment

The following table presents a list of the foreseen actions related to urban mobility included in the action plan of CCC signed on March 21st, 2024. For each action, it has been indicated whether the metaDesigned Use Cases will contribute (or not) to their implementation.

Table 22. Policies contained in the CCC of Limassol

POLICIES CONTAINED IN THE CCC	UC
Public Transportation ○ Upgrade of bus stops ○ ease regulations for mobility providers ○ implement Open-data initiatives making transportation-related data publicly available ○ Knowledge sharing between academia, industry and public agencies ○ Electrification of bus fleet	✓
Micro-mobility ○ Construction of cycle lanes ○ green axes (tree plantations to increase shadow) ○ user incentives for bike-sharing and Regulatory framework for user incentives ○ Ease regulations for micro-mobility providers ○ Provide shared e-bikes ○ Community engagement ○ Data-driven decision making	✓
Pedestrian Network ○ Provision of street benches and street furniture ○ green axes (tree plantations to increase shadow) ○ Upgrade of pedestrian crossings into 'Pelican' ○ Construction of state-of-the-art pedestrian lanes ○ Revise streetscape manual ○ Revenue generation strategies derived from Transport Demand Management policies that fund sustainable transportation initiatives	✗
(private) Vehicle Electrification ○ Provision of essential and non-essential charging stations ○ Integrate transportation planning with land use ○ Open data initiatives making transportation-related data publicly available ○ New opportunities for private investors ○ Ensure financial inclusion of implemented solutions ○ Ensure social equity ○ Data-driven decision making	✓
Freight Transportation ○ Construction of transportation hubs ○ Electrification of Municipal fleet ○ Establish freight-friendly zoning for integrated freight strategies ○ Establish green freight funding programs ○ Continuous monitoring and evaluation	✗
Transportation Demand ○ Institution of park and ride facilities ○ Construction of mobility hubs ○ Ease bureaucracy motions to ensure the efficiency of TDM measures ○ Ensure user-centric services	✓

○ Empower local communities through capacity-building initiatives	
Smart Technologies ○ Incorporate smart technologies in bus stops ○ Implement carpooling school-related transportation ○ Installation and provision of ITS services in the transportation system ○ Convert crossings to smart crossings ○ Signalize and synchronize roundabouts ○ Development of robust data governance frameworks and privacy regulations ○ Open-data initiatives making transportation-related data publicly available	✓

3.4.3. Limassol's UCs - Resources and needs

As anticipated in Chapter 2, Limassol proposes four Use Cases that will be tested within metaCCAZE. For each UC, a summary of the key takeaways of the ***capability map*** and ***empathy map*** are presented.

Building on the information collected by the Limassol Living Lab partners and MaasLab, the Support Partner, the following sections provide, for each UC, a description of the measures to be implemented within metaCCAZE together with the preliminary barriers, existing services potentially related to each UC, and relevant projects, studies and past experiences that could be leveraged. In addition, the sections include the main outcomes of the mini dialogues hosted in Limassol during April 2024. Due to the idiosyncrasy of each use case, different types of events were chosen for each use case, which will be explained case by case under each UC.

3.4.3.1. On-demand mini-bus services (LI-UC01)

Table 23: Limassol Use Case 1 – capability

LI-UC01	
On-demand mini-buses services	
USE CASE DESCRIPTION	An on-demand mobility service will be developed and implemented in the city. The service will include a mix of electric public transport mini-buses and private vans/mini-buses. Initially, this service will be available for school transport only (for teen students on ages 12 to 18) and for traveling to their after-school activities. At a later stage, it will also be open to tourists and employees of selected companies within the city. AI-based algorithms will match demand with the fleet (supply) and guide the minibus drivers on optimal routes to pick up passengers, taking into account the optimization of waiting and travel times. One challenge we will address is the pricing of this service, as it will operate with a mix of public and private fleets. Carpooling options will also be explored. After a certain period of operation, the data generated by this service will be used to recommend convenient fixed public routes or bike-sharing for the first/last mile of trips. This service is a significant step towards sustainability and climate neutrality, aiming to remove a considerable number of private vehicles from the road and shift these trips to shared minibuses.

AREA DESCRIPTION	Implementation will occur gradually, starting with selected schools, sports centres, and extracurricular activity venues. Students from these institutions will participate in metaDesign activities and act as beta testers. Once the service is deemed reliable, it will expand to a broader geographic area and eventually include all students, employees, and tourists in the Greater Metropolitan area of Limassol as it gains success and improves.

OBJECTIVE Alignment with:	**SUMP**	**CCC**
Reduce private vehicle usage to ease traffic congestion (especially in peak hours when students go out of schools)	✓	✓
Improve availability of real-time information and journey planning for public transport	✓	✓
Improve infrastructure and management of transport services by adopting cleaner, efficient and safer technologies, and practices	✓	✓
Shift transportation modes from private vehicles to public transport and shared modes, altering the modal split	✓	✓
Decrease carbon emissions associated with transportation	✓	✓
Establishment of vehicle electrification strategies	✓	✓
Optimization of transportation demand	✓	✓
Avoid unnecessary travel by motor vehicles, reducing noise and pollution, reducing environmental and social costs	✓	✓
Incorporate smart technologies into sustainable transportation strategies	✗	✓

BARRIERS

Policies and governance: Government subsidies support public transport buses, necessitating a sustainable business model for the on-demand platform. The platform may integrate both public and private buses, with public buses subsidized while private ones not, presenting political and governance-related challenges addressed within metaCCAZE.

Resistance to Change: Parents and children may resist changes impacting their daily routines, posing a challenge to implementation.

Safety Features: Addressing safety concerns is crucial, with parents prioritizing children's safety for the service's viability and acceptance.

PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC

On-demand mini-bus services were not studied in the past in Limassol. The SUMP proposes a reorganization of existing public transport lines to tackle some of these issues.

DESTINATIONS (2016-2021): EU-funded project that aimed to increase the number of electric cars and their infrastructure. It also aimed to increase the usage of public transport and make it more attractive to citizens. Through this European CIVITAS project, actions were taken to increase public transport usage. Finally, Limassol's partners from that project included the promotion of all sustainable mobility modes, as well as all services implemented during DESTINATIONS, in their communication strategy.

RELATED EXISTING SERVICES	**BARRIERS / SOLUTIONS FROM CITY'S MOBILITY STRATEGIES**

Bus Fleet Management System	Barriers: recognized need for the optimization of the bus operation and time-schedules of the Limassol bus operator, while monitoring the service level of bus operation. Solutions: The SUMP recommends centralized and coordinated management of all Intelligent Transportation Systems (ITS) city-related applications, involving key transportation stakeholders. These applications aim to improve traffic conditions, reduce congestion, and enhance transportation efficiency by providing real-time or semi-real-time traffic management actions for both private and public transport operations.
Bus Travellers' Information System Based on the installation of the Automated Vehicle Location (AVL) system in the entire urban and rural bus fleet of Limassol	The dynamic information is available via on-board dynamic displays, LED signs at bus stops and a web-portal application. A web-travellers' portal (http://www.motionbuscard.org.cy) has been also developed, which provides real-time information about arrival times at the bus stops per city, time- tables and routes as well as electronic payment services; such information is also available as a mobile application for bus travellers' information. Barriers: There are currently only six (6) LED signs installed in Limassol. The system is not too popular to stakeholders. Solutions: A central software system hosted in local control rooms at transportation centres should receive and process data from bus operators' fleet management systems, facilitating efficient management of bus service schedules at each terminal. Action can be taken to implement additional signs at bus stops.
Bus ticketing system with smart cards and web-service reservation/purchase system	The smart cards can be purchased and renewed in bus terminals/stations. In parallel, paper ticket can be also purchased and validated in the buses using ticketing machines. Barriers: No barriers identified

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public entities	Ministry of Transport
	Municipality
	Public schools
Private stakeholders/businesses/operators:	Transport infrastructure Operators
	Private schools
	Owners of tourist shops
	Owners of cafes and restaurant
	Tourist agencies
Citizens groups/associations:	Families with kids between 11 to 18

Mini-dialogue for Limassol UC01 (LI-UC01)

The international event was held in English on the 19th of April 2024, in the context of a special session organised within the Cyprus Forum Cities event.

Cyprus Forum Cities is the largest local government conference in Cyprus, which unites experts from the public and private sectors, academia, and civil society. Its mission is to facilitate high-level discussions leading to the formulation of a comprehensive, long-term strategic plan for urban and rural development on the island. Emphasising the imperative of climate neutrality, the conference seeks to engage all local authorities in Cyprus in effecting positive change and fortifying relationships between local governments and citizens. This year's edition focused on the local reform, the challenges of waste management, urban planning, digital transformation, the EU elections, etc.

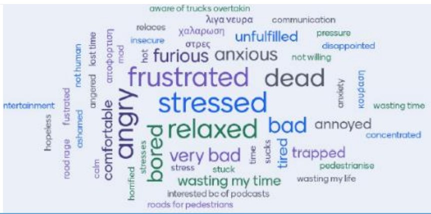
The metaCCAZE session was dedicated to showcasing and discussing the use case of the on-demand services planned for testing and demonstration in Limassol. The discussion was led by MaaSLab and included professional drivers (drivers of public and private fleets), as well as citizens, attracting approximately 50 attendees. The session included a concise 10-minute presentation that outlined the key features of the city's mobility context, and the main features of the on-demand services envisioned for the city (for children going to school, commuters and tourists). This was followed by a panel discussion featuring domain experts who evaluated the concept and proposed additional actions to enhance its implementation and effectiveness. Participants' insights were collected using a Mentimeter (see results below).

Figure 8. the metaCCAZE event for the" On-demand mini-buses service" use case

Poll results from Limassol mini dialogues

The poll's questions addressed elements of the mini-dialogues by identifying some key aspects linked to the current mobility situation in Limassol, clearly dominated by car. Although the session had a clear focus on the development of mini e-buses, among the solutions proposed by the city was a combination of Electric buses (e-bus), on-demand mini e-buses (od-bus), carpooling school-related transportation (carpool), and Shared e-bikes (e-bikes).

QUESTION	RESULTS	N. OF ANSWERS
Which transport mode do you use the most?	Private car = 78% Bike/Scooter = 15% Walking = 5% Public transport = 3% Taxi = 0%	40
Evaluate your experience in Limassol: - Living in Limassol - Driving in Limassol - Accessibility in Limassol	Living in Limassol = 63% Driving in Limassol = 22% Accessibility in Limassol = 15%	29

How do you usually feel when you drive?		102
Rank the measures that could contribute to alleviating traffic congestion	(1st) Offer alternative transport modes of good quality (2nd) Introduce bus lanes (3rd) Extend bike lanes (4th) Journey planner for buses (5th) Add more lanes to the roads (6th) Extend the road network	40
The on-demand service we presented to you, will: 1. Strongly disagree/2. Disagree/3. Neutral/4. Agree/ 5. Strongly agree	Highly contribute to traffic alleviation = 3.4 Free-up parent's afternoons = 3.7 Reduce demand for parking spaces = 3 Not work = 2	31
Will you or your family use such a service?	Yes (21) / No (3) / Not sure (11)	35
How likely it is for families in general to use such a service?	Highly unlikely (2)/ Unlikely (1)/ Neutral (6)/ Likely (17)/ Highly likely (6)	32
How likely it is for commuters to use such a service?	Highly unlikely (0)/ Unlikely (1)/ Neutral (4)/ Likely (18)/ Highly likely (8)	31
Space to write thoughts about this service and how it will impact our streets.		22

The results of the event were elaborated using the Empathy Map methodology (see Chapter 3.1.2) and are summarized in the following table.

Table 24: Limassol Use Case 1 - empathy

	STAKEHOLDER PERSPECTIVE
Identification of real needs:	• Participants showed the need as citizens to have good quality alternative transport modes • Participants showed the need to introduce more bus lanes in the city as well as extending the bike network • Other proposals were based on creating a journey planner for buses
Identification of early barriers/concerns:	• The main concerns on the solution reflected the actual utilisation of this type of service by "cars-attached" users in Cyprus.
Specific opinions on the use case:	• Overall, participants provided positive feedback on the solutions concerning their personal experience of traffic and driving conditions in Limassol.

PAIN	GAIN
1. The service would need to be highly efficient and competitive to convince people not to use private cars	1. Traffic reduction 2. Overall benefit on mental health during commuting.

2. Its implementation is needed on already widely-use apps such as Google Maps (a separate app would decrease attractiveness)

3.4.3.2. Shared e-bikes (LI-UC02)

Table 25: Limassol Use Case 2 – capability

LI-UC02			
shared e-bikes			
USE CASE DESCRIPTION	In this UC, the city of Limassol is introducing shared e-bikes and promoting their use in several locations around the city. Docking stations will be strategically placed, and the service platform will be expanded to incorporate AI-based features for more efficient management of supply and demand. An application will be implemented to display docking stations on a city map and inform users about bike availability. Furthermore, all bikes will be equipped with smart systems, such as GPS, to record demand and routes. Quantitative data from this service will be stored in a data warehouse to develop AI models. Bike-sharing stations will be located throughout the entire city and will also serve as charging stations for e-bikes. The service will be station-based, and bikes can be returned to any of the sharing stations.		
AREA DESCRIPTION	Strategically placing docking stations throughout Limassol to maximize accessibility, targeting high-traffic areas such as the University of Limassol, business districts, tourist attractions, residential neighborhoods, and the mobility hub. Locations will also consider the existing cycling network. The exact location has not been decided yet.		
OBJECTIVE	Alignment with:	**SUMP**	**CCC**
Increase cycling for better urban connectivity. Improve accessibility to quarters' and/ or municipalities'		✓	✓
Promote cycling to reduce emissions and congestion (to reduce motorized traffic)		✓	✓
Increase bike-sharing offer (currently Limassol has 22 docking stations with conventional bikes)		✓	✓
Improve real-time data sharing to optimise the service		✗	✓
Enhance cycling among students		✓	✓
Reduce car traffic in central areas		✓	✓
Promote and support bicycle rental operators and facilities		✓	✗
Increase freedom for the elderly		✓	✓
Integrate cycling with public transportation		✓	✓
Improve interconnectivity with other sustainable modes of transport		✓	✓
Incorporate smart technologies in sustainable transportation strategies		✗	✓

BARRIERS
Low cycling adoption: Currently, less than 1% of trips are made by bike, despite favorable weather conditions (excluding the hot summer months) and flat terrain. **Cycling infrastructure:** Many stakeholders express interest in cycling more, particularly if dedicated cycling infrastructure is provided. Global evidence shows increased cycling rates after the establishment of such infrastructure, yet the existing network in Limassol is minimal. **Bureaucracy:** Complex and lengthy bureaucratic processes can hinder urban development projects, causing delays and increasing costs.

PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC
SUMPORT Interreg Mediterranean project (2018-2019): The goal of this project was to study the construction of new cycle paths to promote the use of bikes within the city. The feasibility study was completed, and 2.5 km of cycle paths were implemented. This previous project constructed some of the necessary infrastructure needed for Limassol's use case. **DESTINATIONS (2016-2021):** This project added 11 e-bikes to Limassol's fleet. The project also provided the municipality of Limassol with the opportunity to make journeys by bike more attractive. **SUMP:** Shared e-bikes were also analysed by the SUMP and some suggestions were made in order to tackle its issues: (1) Increasing the number of locations of the bike rental system, some major bus stops and in Park & Ride places will be equipped. (2) Implementing free-flow e-bikes. (3) Increase e-bike offer in cultural and archaeological sites.

RELATED EXISTING SERVICES	BARRIERS / SOLUTIONS FROM CITY'S MOBIILITY STRATEGIES
Real time Bike Reservation System/Bike Sharing System web-portal managed and operated by a private operator, (Nextbike)	Barriers: Limited availability of e-bikes due to the absence of free-flow options and the existence of only 22 designated stations. There is no cooperation with the University. The system is not integrated or managed by the Public Works Department using the Traffic Management Control Centre (TMCC) in Cyprus. Solutions: To address these challenges, the SUMP proposes a comprehensive strategy that includes integrating free-flow e-bikes into the existing system and increasing the number of bike park stations. Collaborating with universities and Nextbike can enhance accessibility and promote usage. Additionally, constructing Park and Ride facilities near major bus stops can encourage multimodal commuting and alleviate congestion.

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public entities	Municipality
	Public schools
Private stakeholders /businesses /operators:	Transport infrastructure Operators
	Private schools

Mini-dialogue for Limassol UC02 (LI-UC02)

Two in-person meetings were held between NextBike and the municipality of Limassol in February and March 2024. These meetings took place at the municipality's office, where NextBike, the company offering shared bikes, presented its proposal for implementing shared e-bikes. During the meetings, they discussed the service with stakeholders and gathered feedback from the municipality. Each meeting lasted approximately one hour and was structured as a one-on-one discussion. The outcomes of these meetings were analysed using the Empathy Map methodology (see Chapter 3.1.2) and are summarized in the table below.

Table 26: Limassol Use Case 2 - empathy

STAKEHOLDER PERSPECTIVE	
Identification of real needs:	• Participants emphasized the need to install the docking stations at crucial locations in the city, such as tourist attractions. • They also expressed the opinion that rental bicycles should be installed in areas with gentle slopes.
Identification of early barriers/concerns:	• The main concern is that the complex and lengthy bureaucratic processes can slow down urban development projects, leading to delays and increased costs.
Specific opinions on the use case:	• Overall, participants showed positive feedback as cycling helps to reduce motorized traffic and in turn improves quality of life
PAIN	**GAIN**
1. The harmonization between the existing cycling paths and the docking stations is important. 2. Parking areas could be located a short distance from the shared bikes.	1. Overall, this service benefits the quality of cyclist's life. 2. Emissions reduction.

3.4.3.3. Multimodal passenger hub (LI-UC03)

Table 27: Limassol Use Case 3 – capability

LI-UC03	
Multimodal passenger hub	
USE CASE DESCRIPTION	A Mobility Hub will be implemented in Limassol. A Mobility Hub is a centralized location where different modes of transportation converge to provide seamless connectivity for travellers. This hub is designed to facilitate transfers between various transportation options, such as buses and bicycle paths. The Mobility Hub will enhance access to the public transport system from the road network and incorporate various amenities. Key elements include transit facilities, bike parking facilities and bike-sharing services, Park & Ride lots, electric vehicle charging stations, a real-time information system, bus fast-charging stations, docking stations for e-bikes, and other user amenities. This implementation will enhance the overall travel experience and encourage citizens to use public transport and other modes of transportation, such as cycling and walking.
AREA DESCRIPTION	The Mobility Hub will be located near the Tsirio Stadium. This location was chosen for several key reasons and benefits. It is strategically important, making it easily accessible from various parts of the city and region.

Additionally, it is well-connected by existing transportation infrastructure and already includes parking facilities.

OBJECTIVE Alignment with:	SUMP	CCC
Increase the modal share of walking, cycling, and public transport to reduce dependency on cars.	✓	✓
Enhance the attractiveness and accessibility of public transport to encourage greater usage.	✓	✓
Improve infrastructure and amenities for walking and cycling to promote these modes as viable alternatives.	✓	✓
Reallocate road space and urban areas to accommodate a more balanced use between motorized and non-motorized modes of transport.	✓	✓
Reduce noise and pollution, decreasing environmental and social costs	✓	✓
Develop parking policies and facilities that incentivize the use of alternative transportation modes over private car usage.	✓	✗
Increase the overall sustainability of the transportation system by reducing greenhouse gas emissions and congestion through mode shift initiatives.	✓	✓
Collaborate with stakeholders to implement comprehensive transportation policies that prioritize sustainable modes and enhance the overall quality of urban life.	✓	✗
Incorporate smart technologies in sustainable transportation strategies	✗	✓

BARRIERS

Bureaucracy: Complex and lengthy bureaucratic processes can slow down urban development projects, leading to delays and increased costs.

Resistance to change: Resistance from various stakeholders, such as residents, businesses, and property owners, can slow or block transformation efforts. People may be resistant to changes that affect their neighbourhoods or livelihoods.

PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC

SUMP: Limassol's SUMP studies the parking facilities in the city and foresees the construction of a Park and Ride.

RELATED EXISTING SERVICES

The real time **Bike Reservation System** anticipated in LI-UC02 is also relevant to this UC.

Bus Fleet Management System and **Bus Travellers' Information System** anticipated in LI-UC01 are also relevant to this UC.

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public entities	Ministry of Transport
	Municipality
Private stakeholders/businesses/operators:	Transport infrastructure Operators
	Owners of cafes and restaurants / canteens
	Research

Mini-dialogue for Limassol UC03 (LI-UC03)

Several online meetings took place in February and March 2024, involving the Department of Public Works of the Ministry of Transport of the Republic of Cyprus, the landowner of the land where the mobility hub will be constructed, the Limassol Municipality, and other stakeholders, including the public transport operator and representatives from the Professional Drivers' Union. Partners from Limassol LL metaCCAZE and MaaSLab also participated. Additionally, an in-person event was held on February 26, 2024, attended by the Minister of Transport of the Republic of Cyprus, who expressed commitment to supporting the construction of the mobility hub (see picture below).

Figure 9. *the metaCCAZE event for the "Mobility Hub" use case*

The results of the events were elaborated using the Empathy Map methodology (see Chapter 3.1.2) and are summarized in the following table.

Table 28: Limassol Use Case 3 - empathy

	STAKEHOLDER PERSPECTIVE
Identification of real needs:	• Participants expressed the need for good quality alternative transport modes for citizens. • They also highlighted the necessity of introducing a more reliable and efficient transport system in the city. • Other proposals included the construction of dashboards with real-time information for public transport.
Identification of early barriers/concerns:	• The main concern regarding the construction of the Mobility Hub is the agreements that must be made between the ministry and the ΓΣΟ/GSO (the responsible organization proposed as the location for the Mobility Hub)
Specific opinions on the use case:	• Overall, participants showed positive feedback on the construction of an innovative Mobility hub that will promote different transport modes in Limassol

PAIN	GAIN
1. Complex and lengthy bureaucratic processes 2. Citizens may not use public transport because of the prevailing attitude in Cyprus.	1. Reduce noise 2. Reduce emissions 3. Reduce traffic congestion

3.4.3.4. Trasport & Energy Integration and management (LI-UC04)

Table 29: Limassol Use Case 4 – capability

LI-UC04			
Transport & Energy Integration and Management			
USE CASE DESCRIPTION	An Internet of Things (IoT) will be implemented to integrate the demands of transportation, electric vehicle charging, and the electricity grid. This measure will support the city, the operators, the EV owners and the electricity authority in understanding and managing the demand for electric vehicle charging. The platform will facilitate guiding and incentivizing users to charge their vehicles during non-peak grid hours or when renewable energy sources power the grid. This integrated platform will consolidate data from various sources, including Bus-to-Infrastructure (V2I) connectivity, Vehicle-to-User (V2U) connectivity, traffic counts, smart bus stops, and charging stations.		
AREA DESCRIPTION	Citywide.		
OBJECTIVE	Alignment with:	**SUMP**	**CCC**
Reduce air pollution		✓	✓
Optimize charging grid increasing use during non-peak grid hours or when renewable energy sources power the grid.		✗	✓
Decrease the high car modal share (91.8%) by enhancing public transport appeal.		✓	✓
Align public transport strategies with emission reduction targets for 2030.		✓	✓
Diffusion of vehicle electrification strategies		✓	✓
Incorporate smart technologies in sustainable transportation strategies		✗	✓
BARRIERS			
Data: Absence of accessible data and digital systems, like a traffic model, hindering informed decision-making. **Societal acceptance:** Gaps in social knowledge, understanding, interest, and trust concerning the transition to sustainable practices. **Stakeholders' involvement:** Consideration needed for the traditional lack of involvement in public affairs and the need for improved stakeholder cooperation procedures.			
PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC			

There are no other previous projects that have studied this service.

RELATED EXISTING SERVICES	BARRIERS / SOLUTIONS FROM CITY'S MOBIILITY STRATEGIES
Traffic Detection - Permanent traffic counters	Traffic levels, average speed, traffic composition and travel times are monitored and stored in real-time. Data available by the TMCC in Nicosia. Barriers: The geographical coverage within the SUMP's Study Area is quite limited. The detectors do not record both directions. Solutions: not yet identified
Charging stations	Barriers: There are only nine charging stations for electric cars in Limassol. None of them are fast charging. Solutions: not yet identified
Bus Fleet Management System and **Bus Travellers' Information System** anticipated in LI-UC01 are also relevant to this UC.	

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public entities	Telecommunications
	Electricity Authority of Cyprus
Private stakeholders /businesses/operators	Transport infrastructure Operators
	Business drivers

Mini-dialogue for Limassol UC04 (LI-UC04)

This use case was discussed as part of a one-to-one discussion between MaaSLab, representative of Limassol's CCC and the Electricity Authority of Cyprus. It was an online workshop organized on the 27th of May 2024. The discussion was dedicated to presenting the usage of the AI data warehouse and the combination of grid, fleet, and demand. The presentation lasted for 15 minutes, followed by a discussion. The whole duration of this meeting was one hour, during which many factors that can contribute to these systems were discussed. The results of the discussion were elaborated using the Empathy Map methodology (see Chapter 3.1.2) and are summarized in the following table.

Table 30: Limassol Use Case 4 - empathy

	STAKEHOLDER PERSPECTIVE
Identification of real needs:	• Participants expressed the need to make the public transport system in the city more attractive. • They also believed that these systems would benefit the triangle of grid, fleet, and demand.
Identification of early barriers/concerns:	• Participants felt that gaps may appear due to the lack of digital systems.
Specific opinions on the use case:	• Overall, participants show positive feedback because of innovative approach

PAIN	GAIN
1. Necessary data from grid 2. Cooperations between different organizations	1. Upgrading Public Transport services 2. Promote the use of e-mobility

3.4.4. Data map

The following table provides a comprehensive overview of the various data categories, variables, and descriptions relevant to traffic and transportation analysis for Limassol. It includes the availability of these data types and their respective data sources, offering a detailed foundation for urban transportation planning and analysis. The table encompasses key areas such as public transport data, charging infrastructure, environmental impact, travel behaviour, energy grid data, public transport services, weather data, road service status, parking data, and mobility hub infrastructure.

Table 31: Limassol's LL available data

DATA CATEGORIES	DATA VARIABLES	DESCRIPTION	AVAILABILITY	DATA SOURCE
Public Transport Data	Ridership Statistics	Number of passengers using public transit services	Publicly available	PT office
	Frequency and Reliability	Frequency of public transit services and reliability	Publicly available	PT office
	Accessibility of Stops and Stations	Availability and accessibility of public transit stops and stations	Publicly available	PT office
Charging Infrastructure	Number and Locations of Charging Stations	Count and geographical distribution of electric vehicle (EV) charging stations	Available: EMEL: 2 stations at Ypsonas and Aiolou station. Discussion to be continued with municipality.	PT Office
	Charging Capacity and Compatibility	Charging rates and compatibility with different EV models	Available: Charger type and relevant details available from the municipality. Also, data about 8 mobile fast chargers will be made available from EMEL.	PT Office+ Municipality
	Utilisation Rates	Usage patterns and utilization rates of charging stations	Available: Will be provided by EMEL	PT office
	Availability of Fast Charging	Presence and distribution of fast charging stations	Available: EMEL: 2 stations at Ypsonas and Aiolou station. Discussion to be	PT office

			continued with municipality.	
Environmental Impact	Air Quality Monitoring Data	Pollutant concentrations, emissions	Available: Communication with Electricity Authority of Cyprus to collect data	Labor Inspection
	Noise Pollution Levels	Levels of noise pollution along transport corridors	Discussion to be continued with the Limassol Municipality	Ministry
	Greenhouse Gas Emissions Inventory	Emissions from transport sources	Available: Communication with Electricity Authority of Cyprus to collect data	Electricity Authority of Cyprus
Travel Behaviour	Commuting Patterns	Commuting modes and travel times	Available: from both EMEL and Nextbike	PT Office + Bike Sharing Office
	Ride-Sharing and Micromobility	Usage rates and preferences for ride-sharing, micromobility	Available: from both EMEL and Nextbike	PT Office + Bike Sharing Office
Energy Grid Data	Transition, distribution, renewable/conventional energy mix, energy price changes	Data on energy grid infrastructure and characteristics	Available: Communication with Electricity Authority of Cyprus to collect data	Electricity Authority of Cyprus
Public Transport Services Timetables	General Transit Feed Specification (GTFS) data, telematics, or other static data	Timetables and schedules for public transport services	Available: Telematics – EMEL, and/or real-time tracking, and/or GPS, and/or NextBike's application	PT Office + Bike Sharing Office
Public Transport Fleet Specification	Vehicle range, power capacity, energy consumption	Specifications of public transport fleet vehicles	Available: Data about 370 conventional bikes in 83 stations around Limassol region	PT Office + Bike Sharing Office
	Public Transport Ticketing Data	Data related to ticketing and fare collection on public transport	Available: from both EMEL and Nextbike	PT Office + Bike Sharing Office
	Existing Origin-Destination Analyses	Analyses of existing trip origins and destinations	Available: from both EMEL and Nextbike	Ministry +PT Office + Bike Sharing Office
	Weather Data	Meteorological data including temperature, precipitation, etc.	Discussion to be continued with municipality	Measure point

	Average Speed for Vehicles in Urban Environment	Average speed of vehicles in the urban environment	Available: To be provided by EMEL, for public transport vehicles	PT office
	Road Service Status	Data on traffic flow and signal states, historical or real-time	Discussion to be continued with the Limassol Municipality	
	Speed Regulations for the Road Network	Legal speed limits and regulations for road traffic	Publicly available	Traffic police
	Parking Data / Parking e-Smart Data	Information on parking availability, occupancy, and payment	Available by Nextbike and EMEL. Discussion to be continued with the Limassol Municipality	Ministry
Traffic	Traffic Flows Data and Traffic Lights/Signaling States	Data on traffic flow and signal states, historical or real-time	Discussion to be continued with the Limassol Municipality	Ministry
	Intersection Management	Management strategies and data for traffic intersections	Discussion to be continued with the Limassol Municipality/ Not sure if it still working	Ministry
Mobility Hub Infrastructure	Mobility Hub Infrastructure Specification	Specifications of mobility hub infrastructure	Publicly available	Municipality
Curbside Information	Curbside Information for the Urban Environment	GIS data related to curbside management in urban areas	Available by Nextbike and EMEL. Discussion to be continued with the Limassol Municipality	Bike Sharing Office
Demand for On-demand Mobility Services	Demand for On-demand Mobility Services	Data on demand for on-demand mobility services	Available: from both EMEL and Nextbike	PT Office + Bike Sharing Office

This information, along with the results of the capability and empathy map, will serve as the foundation for selecting KPIs for each UC to include in the Evaluation Framework that will be developed in the coming months. Further details about the characteristics of the available data in Limassol can be found in Annex II.

3.4.5. Communication channels

The following table provides a mapping of the media and other communication channels necessary for the successful implementation of LLs, and for the communication and dissemination of metaCCAZE activities.

Table 32. Communication channels of the city of Limassol

	COMMUNICATION CHANNELS	TARGET AUDIENCE	LINK
1	Local Channels	Pupils, Parents, Schools, Professional Drivers, students, Politicians, Owners of sport centres, Tourist agencies	https://www.sigmatv.com/live https://www.omegatv.com.cy/live/ https://capitaltv.cy/ https://www.ant1live.com/webtv/live https://tv.rik.cy/live-tv/rik-1/
2	Local newspapers	Pupils, Parents, Schools, Professional Drivers, students, Politicians, Owners of sport centres, Tourist agencies	https://www.cyprushighlights.com/
3	Local newspapers & online media	Pupils, Parents, Schools, Professional Drivers, students, Politicians, Owners of sport centres, Tourist agencies	https://www.elemesos.com/ https://politis.com.cy/ https://phileleftherosgroup.com/ https://dialogos.com.cy/haravgi/ https://mcmedia.com.cy/el/
4	Cyprus International Institute of Management	Authorities	https://www.ciim.ac.cy/
5	Local radio channels	Pupils, Parents, Schools, Professional Drivers, students, Politicians, Owners of sport centres, Tourist agencies	https://www.sppmedia.com/ https://kanali6.com.cy/ https://www.capitalradio.cy/ https://www.superfmradio.com/ www.cut-radio.org, https://www.choicefm.com.cy/ https://sfera.com.cy/live/
6	School websites	Parents with kids between 11 to 18, Parents association of schools	Websites which are constructed by parents, in order to be informed about issues for each school, like its actions.
7	Inscription or digital displays	Pupils, Parents, Schools, Professional Drivers, students, Owners of sport centres, Tourist agencies, Tourists	Mobility Hub – Tsireio stadium
8	Inscription on bus stops, shelters, terminals	Pupils, Parents, Schools, Students, Owners of sport centres, Tourist agencies, Tourists	

3.5. Status Quo Map for Tampere

Tampere is the third largest city in Finland with a population of over 250,000 inhabitants, and the biggest city in the region of Pirkanmaa, which has a total population of 500,000. As the largest city outside the capital region of Finland, Tampere has a special role as the centre node for many cities in Finland. 94.2% of Finland's population lives within 500 kilometres of Tampere. Tampere is one of the fastest growing cities in Finland, with the population projection reaching 300,000 inhabitants by the year 2040. Other important factor for this growth projection is Tampere's strong position as an attractive city for students. This has led to 20–29-year-olds being the largest age group in Tampere. The residents of Tampere are also well-educated.

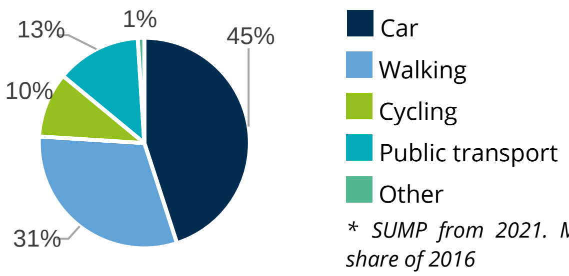
Tampere is the second largest economic region in Finland after the Helsinki capital area. Around two-thirds of Finland's economic activity is concentrated within a two-hour drive from Tampere. Strong connection with Tampere University community enables the availability of talented workforce. With a lot of different events, cultural experiences, and relaxed atmosphere, Tampere is an attractive tourist destination around the year. Good transport connections by land and air strengthen Tampere's role as a tourist destination.

Tampere is designated an urban node of the North Baltic TEN-T Core Corridor. This corridor connects Helsinki and Tallinn to Stockholm and Oslo, passing through Tampere. Priorities for Tampere as an urban node include improving multimodal connections, reducing congestion, and enhancing the sustainability of the transport system.

A FEW FACTS…

Tampere has already its EU MISSION LABEL

250,000 inhabitants



** SUMP from 2021. Modal share of 2016*

Key facts:
Third Finnish city # University centre # Fast growth # Tourist destination # Stream low temperatures # Difficult climate conditions

TEN-T Comprehensive network:
North Baltic corridor

Sustainable mobility goals:

- Tampere is one of the MISSION CITIES – committed to achieve climate-neutrality by 2030
- Has been awarded the "EU Mission Label" in March 2024
- Its SUMP was approved in 2021 and includes targets and objectives for 2024.

3.5.1. Sustainable mobility planning policies

The Tampere City Region is dedicated to sustainable and people-centred development and growth. By 2030, Tampere aims to become a vibrant city of around 300,000 inhabitants, prioritizing carbon neutrality and smart, sustainable mobility. Tampere is at the forefront of urban development, valuing nature, conserving resources, and reducing emissions to foster sustainable growth. The **city's strategic sustainable urban mobility plan**[15] focuses on enhancing quality of life by addressing people's mobility needs. Aligned with the SUMP model recommended by the European Commission, Tampere's plan is the first of its kind and reinforces objectives outlined in local master plans, the **Carbon Neutral Tampere 2030 roadmap**[16], and other development strategies. Beyond climate considerations, the plan also emphasizes equality, efficient use of space, environmental health, activity, and safety in urban transport planning.

Geographical scope:

SUMP considers the area of Tampere. SUMP reinforces, prioritises, and demonstrates the objectives set for mobility and transport in the local master plan, the Carbon Neutral Tampere 2030 roadmap, and other of the city's development plans.

Timing:

SUMP - Approved in 2021 towards 2024 objectives

Carbon Neutral roadmap - Approved in 2020 towards 2030 objectives

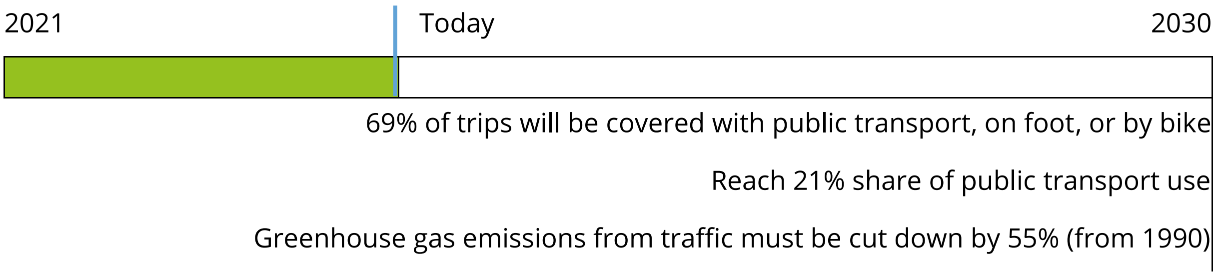


Figure 10. Sustainable mobility planning policies' main targets - Tampere

SUMP monitoring from its approval:

SUMP monitoring is not foreseen.

3.5.2. Climate City Contract policies and metaCCAZE alignment

The following table presents a list of the foreseen actions related to urban mobility included in the CCC. For each action, it has been indicated whether the metaDesigned UCs will contribute to their implementation.

[15] SUSTAINABLE URBAN MOBILITY PLAN of Tampere - LINK

[16] Carbon Neutral Tampere 2030 roadmap - LINK

Table 33. Policies contained in the CCC of Tampere

POLICIES CONTAINED IN THE CCC	UC
Public Transportation ○ Tramway expansion ○ More local trains ○ Ensuring sufficient funding for sustainable mobility infrastructure and public transport services	✓
Micro-mobility and Pedestrian Network ○ Improvements in walking and cycling infrastructure and bike parking ○ Enhanced winter maintenance of cycling and walking paths	✗
Freight Transportation ○ Finding ways to regulate city logistics to favor light vehicles and cleaner propulsion	✗
Transportation Demand ○ Urban planning practices that enable sustainable mobility and travel chain improvements ○ Climate-neutral action program created in cooperation with citizens	✓
Smart Technologies ○ Data platform on transport system situation ○ Urban planning considering EV charging network and biofuel stations ○ The mobility Carbon Footprint calculator	✓

3.5.3. Tampere's UCs - Resources and needs

As anticipated in Chapter 2, Tampere proposes two UCs that will be tested within metaCCAZE. For each UC, a summary of the key takeaways of the ***capability map*** and ***empathy map*** are presented.

Building on the information collected by Tampere Living Lab partners and Tampere University (TUNI), the Support Partner, the following sections provide, for each UC, a description of the measures to be implemented within metaCCAZE together with the preliminary barriers, existing services potentially related to each UC, and relevant projects, studies and past experiences that could be leveraged. In addition, the sections include the main outcomes of the mini dialogues hosted in Tampere during May 2024. The city of Tampere held a common webinar for both UCs on May, 14th with a small group of stakeholders. The event welcomed Tampere Public Transport and Tampere Transport Planning Offices, local consultants involved in ITS and mobility development and the Economic Development Agency of Tampere. The webinar was held in Finnish.

The discussed UCs were based on the tram-feeder services (feeder) and the autonomous e-shuttles with advanced remoted-control centre as an implementation concept. The webinar, however, brought the opportunity to discuss about the linked technologies to be considered for the successful implementation of both UCs, namely: the Remote-Control Centre management for AVs (control), Inductive charging (inductive), and the automated e-shuttle operations for traffic (traffic).

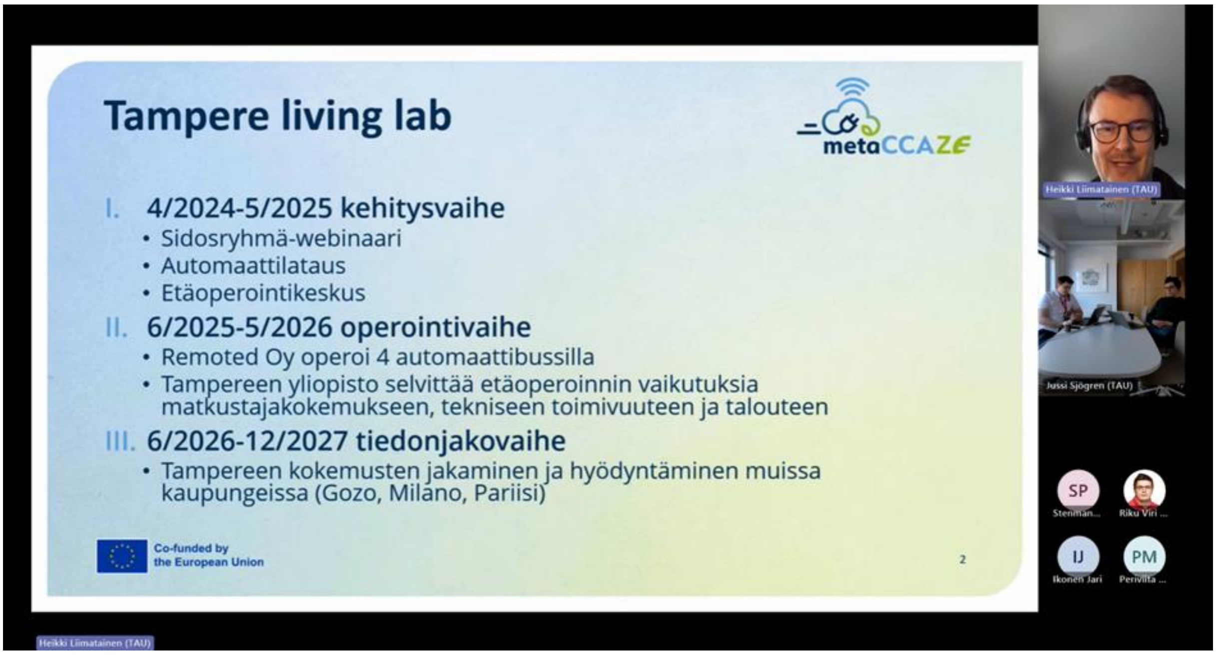


Figure 11. Tampere Mini-dialogues

3.5.3.1. Autonomous e-shuttles with advanced remote-control centre and inductive changing (TA-UC01)

Table 34: Tampere Use Case 1 – capability

TA-UC01	
Autonomous e-shuttles with advanced remote-control centre and inductive changing	
USE CASE DESCRIPTION	This use case aims to demonstrate the feasibility of remote operation for driverless vehicles and initiate the commercial deployment of automated buses, including ticketing, as part of the city's public transport system. This will be achieved through the development of a Remote-Control Centre to manage automated shuttle buses, which operate autonomously under normal conditions. In cases where the situation exceeds the vehicle's capabilities, a remote operator can intervene and take control. Specifically, the use case focuses on providing state-of-the-art situational awareness for remote management agents by integrating traffic lights, city traffic data, and incident data with existing third-party remote operational tools and automated inductive shuttle charging solutions. Expected physical infrastructure changes include the establishment of AV-safe turn points, stops, precise positioning systems, and automated charging facilities. Digital infrastructure improvements will involve the implementation of traffic light signals via V2X/LTE at selected intersections and vehicle positioning using RTK/GNSS and status updates to enable remote operations. The project will also analyse passenger experiences to enhance and develop a concept for urban living that relies on automated public transport. Additionally, the UC encompasses regulatory aspects to ensure compliance with forthcoming regulations for automated transport. REMOTED (partner in

	metaCCAZE) has been a member of a working group by the Ministry of Transport to address these regulatory requirements.
AREA DESCRIPTION	Routes are still in development; hence, no area has been chosen.

OBJECTIVES Alignment with:	SUMP	CCC
Demonstrate remote operation feasibility for driverless vehicles	✗	✓
improve the functionalities and situational awareness	✗	✓
Improve charging technologies by introducing Automated rapid charging solution (vehicles are currently charged manually)	✗	✓
Enhance passenger experience and develop urban living concept around automated public transport.	✓	✓

BARRIERS

The main challenge is identifying suitable public transportation lines to test an automated bus route with adequate demand. High-demand routes are already contracted to operators, making them difficult to change. Therefore, a new route with sufficient demand needs to be established.

Additionally, costs pose a challenge since e-shuttles are currently more expensive than regular buses. However, as metaCCAZE aims to remove the safety driver and transition to remote-control, this should help mitigate some of these cost issues.

PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC

Autonomous driving has been tested previously, remote operation and charging are novel for metaCCAZE.

SHOW - January 2020-January 2024: Automated Feeder Transport Services to Light Rail/Tramline in the Hervanta Suburb, Tampere. Tampere will use insights from SHOW to learn how to integrate test vehicles into the public transport system and display pilot information within route guidance and real-time mapping of public transport. The autonomous minibuses have been tested in Hervanta, but they drive more slowly than regular traffic, causing issues such as traffic congestion or risky overtaking maneuvers. These quick overtakes are often interpreted as hazards by the buses, leading to sudden stops. One lesson learned from this project is that buses need to drive faster to match the speed of other traffic. Additionally, buses should better interpret overtaking situations to avoid unnecessary safety stops or sudden braking.

IN2CCAM Re-shaping mobility for all - March 2022 – October 2025: Integration of traffic and CCAM fleet (last-mile mobility of people). Tampere is working on the implementation of a New Mobility Hub for public transport, connected fleet of CCAVs, micro-mobility devices, cyclists and pedestrians. Will use five SAE level 4 automated vehicles, fully equipped with environment perception sensors that can exchange ITS messages for manoeuvring or deviating. Tampere will use insights from IN2CCAM to continue exploring V2X and other methods of communication between vehicles and will use learnings of V2I communications for LL.

In Hervanta, bus pilots from the SHOW project operate partly on tram tracks. As part of IN2CCAM, tests have been conducted to synchronize tram and bus location data. If a tram approaches a shared path, the autonomous bus can be instructed to wait at a bus stop to avoid causing delays by cutting in front of the tram. Since the upcoming tram is not visible from the bus stop, this information is directly communicated to the safety driver.

Through IN2CCAM, which is still ongoing, the project aims to better understand communication possibilities and challenges. This will enable buses to use data from infrastructure and other vehicles to support driving decisions. Discussions are underway within the IN2CCAM group about potential collaborations with metaCCAZE.

RELATED EXISTING SERVICES	BARRIERS / SOLUTIONS FROM CITY'S MOBIILITY STRATEGIES
Automated buses as feeder services.	Many pilots along the last years have been conducted within different projects (es. SHOW and IN2CCAM) Barriers: Currently more challenging and expensive to operate compared to regular Solution: n.a.
Nysse - PT digital services. Ecosystem of applications to support the usage of Tampere public transport.	Digital services and routing apps that help customers with Tasks such as ticketing and routing. Barriers: n.a. Solution: n.a.
Park&Ride in intersections of highways and public transport trunk lines encouraging transfer to public transport outside the city centre.	Parking areas in convenient locations to allow mode transfer from cars to buses (and to the trams in the future) to centre-bound travel Barriers: Availability and attractiveness of Park&Ride spaces Solution: Development programme for Park&Ride spaces. In direct improvements come from the development of public transport network, expansion of tram and commuter train operations.
Data collection through Tampere.app.	Combines city services in one mobile phone application for citizens. Enables data collection if the user allows it. User mobility data is collected and used for their CO_2 calculation. Data can be used in city's decision making and transport planning. Barriers: Technical challenges and challenges to raise the number of users. Solution: n.a.

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public Entities	Public transport authority of Tampere
	Tampere Transport Planning Offices
	Economic Development Agency of Tampere
Private stakeholders/businesses/operators:	Local consultants involved in ITS
	Local consultants involved in mobility development

Mini-dialogue for Tampere UC01 (TA-UC01)

As previously mentioned, the webinar focused discussion on the autonomous e-shuttles with advanced remote-control centre as an implementation concept and brought the opportunity to discuss about the linked technologies to be considered for its successful implementation.

Table 35: Tampere Use Case 1 - empathy

STAKEHOLDER PERSPECTIVE

Identification of real needs:	• The role of a remote operator is crucial as a safety factor in emergency situations or encounters with other passengers who may cause worry. • The safety of passengers and the surrounding environment are important considerations. *Specific to the Remote-Control Centre Management for AVs* • The solution's cost-effectiveness is a significant consideration, influenced by the efficiency of operations. *Specific to the Operations for Traffic* • Changes to the service concept of public transport providers are necessary, along with innovations in road infrastructure to support autonomous driving.
Identification of early barriers/concerns:	• Concerns about whether the travel chain, including short headways, will be effective. • The behaviour of other vehicles, particularly issues caused by sudden braking near the slower-moving feeder vehicles, raises questions about how to enhance the speed of autonomous buses. • Social interactions on the vehicle can either foster community connections or be perceived negatively if they are unwanted. *Specific to the Remote-Control Centre Management for AVs* • Concerns about data security and maintaining a stable connection are prevalent. • Questions arise about how many vehicles one operator can manage effectively and whether there are any synergies between different remote-control centres. Stakeholders are interested in determining a "common idea" or an optimal scenario for the number of vehicles per operator.
Specific opinions on the use case:	• The role of the service in the travel chain may vary with different seasons and weather conditions, affecting user perceptions and experience. *Specific to the Remote-Control Centre Management for AVs* • There is considerable business potential, and remote operations could enable more cost-efficient operations. • The remote-control centre is crucial for safety and impacts the perceived safety of the system. *Specific to the Inductive charging* • The automated charging offers significant business potential and opportunities to optimize charging operations. *Specific to the Operations for Traffic* • Although the developments in vehicle technology are still uncertain, they hold considerable potential to revolutionize public transport.

PAIN	GAIN
1. Perceived safety 2. Speed of the vehicle compared to the traffic. 3. Uncertainty with technological development	1. Less day-to-day working resource needs 2. Optimized operations with developed battery technology

4. Coordination with different centres, noting data safety requirements 5. Actual benefits per used resources 6. Unknowns in battery development 7. Function in complex ODD 8. Infrastructure development needs	3. Scalability and business opportunity 4. More efficient public transport system 5. Larger areas served by PT

3.5.3.2. Tram-feeder service with advanced remote-control centre and inductive changing (TA-UC02)

Table 36: Tampere Use Case 2 – capability

TA-UC02			
Tram feeder service with advanced remote-control centre and inductive changing			
USE CASE DESCRIPTION	This UC aims to utilize the same technologies employed in TA-UC01, integrating them into a different service context. Specifically, automated shuttles will connect to a tram line, transporting passengers to and from the tram to expand the tram's coverage area and attract more riders. The use case will be supported by the Remote-Control Centre, necessary infrastructure changes, and inductive shuttle charging solutions. As with TA-UC01, this UC will also focus on analysing passenger experiences and addressing regulatory frameworks to ensure compliance with upcoming automated transport regulations.		
AREA DESCRIPTION	Routes are still in development, hence, no area linked to the tram chosen		
OBJECTIVES	Alignment with:	**SUMP**	**CCC**
Demonstrate remote operation feasibility for driverless vehicles working as feeder system for public transport		✗	✓
Expand the tram's coverage area and attract more riders		✓	✓
Enhance passenger experience		✓	✓
Implement rapid charging solution for electric shuttles		✓	✓
BARRIERS			
Identify a test area with sufficient passenger demand and a suitable distance where a driverless bus can effectively serve as a last-mile solution.			
PREVIOUS STUDIES, ANALYSIS OR TESTS OF POTENTIAL INTEREST FOR THIS UC			
Autonomous driving has been tested previously, remote operation and charging are novel for metaCCAZE. **SHOW (2020 – 2024)** and **IN2CCAM (2022 – 2025)** described in TA-UC01 also relevant in this UC.			
RELATED EXISTING SERVICES	**BARRIERS / SOLUTIONS FROM CITY'S MOBILITY STRATEGIES**		

Tram system. Light rail connection between City centre and large residential areas, main hospital, and university campuses	Started to operate in 2021 and will be expanding further in the following decades. Barriers: Capacity has been an issue sometimes. Solution: Capacity problems are being solved by shortening headways in the peak hours and by ordering additional tram cars. The SUMP also foresees the extension to the existing tramway

Automated buses as feeder services, Nysse - PT digital services and **Data collection through Tampere.app** presented in TA-UC01 are also relevant to this UC.

STAKEHOLDERS PARTICIPATING IN MINI-DIALOGUES	
Public Entities	Public transport authority of Tampere
	Tampere Transport Planning Offices
	Economic Development Agency of Tampere
Private stakeholders/businesses/operators:	Local consultants involved in ITS
	Local consultants involved in mobility development

Mini-dialogue for Tampere UC02 (TA-UC02)

As previously mentioned, the webinar focused discussion on the Tram feeder service with advanced Remote-Control Centre and inductive changing as an implementation concept, and brought the opportunity to discuss about the linked technologies to be considered for its successful implementation.

Table 37: Tampere Use Case 2 - empathy

	STAKEHOLDER PERSPECTIVE
Identification of real needs:	• Ensuring an effortless transition from feeder services to the main tram line is essential for user satisfaction. This includes effective travel chains, predictability of service, and sufficient vehicle speed. • Accessibility concerns are addressed, ensuring that all users can comfortably use the service. *Specific to the Remote-Control Centre Management for AVs* • The solution's cost-effectiveness is a significant consideration, influenced by the efficiency of operations. *Specific to the Operations for Traffic* • The automation could strengthen trunk lines by providing consistent feeder services.
Identification of early barriers/concerns:	• Numerous questions remain about the future of charging and battery technology, including the frequency and duration of charging, and whether overnight charging presents a viable business case compared to en-route charging. • There are concerns regarding the substantial investments required for automated charging systems and whether the benefits justify these costs.

Specific opinions on the use case:	• Questions about service reliability often arise, such as the adequacy of seating, the speed of the vehicle, its performance in severe weather conditions, and overall safety. • The novelty of riding an autonomous vehicle (AV) adds a fun element to the experience. *Specific to the Operations for Traffic* • Automated feeder traffic can make public transport viable in areas that are normally unprofitable, mainly because eliminating drivers reduces significant running costs.

PAIN	GAIN
1. Uncertainty or concerns related to the Automated vehicles 2. Suitable bus per operator ratio implementation 3. Interoperability between vehicles 4. Function in varying weather conditions	1. Sustainable last-mile solution 2. Serve new areas and customers 3. Makes public transport more attractive 4. Cost efficiency to serve new areas

3.5.4. Data map

The following table provides a detailed overview of the various data categories, variables, and descriptions relevant to traffic and transportation analysis for Tampere. It includes the availability of these data types and their respective data sources, offering a comprehensive foundation for urban transportation planning and analysis. The table encompasses key areas such as traffic KPIs, transport technology, environmental impact, economic impact, energy grid data, public transport services, weather data, road service status, parking data, and mobility hub infrastructure.

Table 38: Tampere's LL available data

DATA CATEGORIES	DATA VARIABLES	DESCRIPTION	AVAILABILITY	DATA SOURCE
Traffic KPIs	Origin-Destination Data	Origin and destination of trips, commuter and freight traffic	Limited	Traffic Models
	Peak Hour Traffic	Traffic volume and flow patterns during peak hours of the day	Available	Measure points
Transport Technology	Vehicle-to-Vehicle (V2V) Communication	Communication technologies between vehicles		
	Advanced Driver Assistance Systems (ADAS)	Adoption and prevalence of ADAS technologies		
Environmental Impact	Air Quality Monitoring Data	Pollutant concentrations, emissions	Available	Measure points

Economic Impact	Transportation Expenditures	Costs related to transportation, fuel, maintenance	Partly available	Models
	Economic Benefits of Transport Investments	Job creation, business growth resulting from investments	Available, if done	Calculation by city/third-party
	Cost-Benefit Analysis	Costs and benefits associated with transport projects	Available, if done	Calculation by city/third-party
Energy Grid Data	Transition, distribution, renewable/conventional energy mix, energy price changes	Data on energy grid infrastructure and characteristics	Limited	
Public Transport Services	Timetables	Timetables and schedules for public transport services	Available	PT Office
	Electric Vehicle Fleet Chargers' Types and Specification	Charger types and specifications for electric vehicle fleets		
	Number and Locations of Chargers	Count and geographical distribution of EV charging stations	Available	Charging operators
	Charging Schedule and Charging Stations Occupation Rates	Schedules and occupancy rates for charging stations	Limited	Charging operators
	Public Transport Fleet Specification	Specifications of public transport fleet vehicles	Limited, on request	PT Office
	Public Transport Ticketing Data	Data related to ticketing and fare collection on public transport	Limited, on request	PT Office
	Existing Origin-Destination Analyses	Analyses of existing trip origins and destinations	Might exist, subject to a request	
	Weather Data	Meteorological data including temperature, precipitation, etc.	Available	Measure points
	Average Speed for Vehicles in Urban Environment	Average speed of vehicles in the urban environment	Available on highways, limited on urban areas	

Road Service Status	Information on road conditions, maintenance, and construction	Available	
Speed Regulations for the Road Network	Legal speed limits and regulations for road traffic	Available	National road administration
Parking Data / Parking e-Smart Data	Information on parking availability, occupancy, and payment	Limited, through request to parking operators	
Traffic Flows Data and Traffic Lights/Signalling States	Data on traffic flow and signal states, historical or real-time	Available	Sensors
Intersection Management	Management strategies and data for traffic intersections	Limited through city	
Mobility Hub Infrastructure Specification	Specifications of mobility hub infrastructure		
Curbside Information for the Urban Environment	GIS data related to curbside management in urban areas	Not known	
Demand for On-demand Mobility Services	Data on demand for on-demand mobility services	Not generally available	

This information, along with the results of the capability and empathy map, will serve as the foundation for selecting KPIs for each UC to include in the Evaluation Framework that will be developed in the coming months. Further details about the characteristics of the available data in Tampere can be found in Annex II.

3.5.5. Communication channels

The following table provides a mapping of the media and other communication channels necessary for the successful implementation of LLs, and for the communication and dissemination of metaCCAZE activities.

Table 39. Communication channels of the city of Tampere

COMMUNICATION CHANNELS	TARGET AUDIENCE	LINK
1 Nysse Lab	First phase test of LL	https://www.nysse.fi/nysselab.html
2 ITS Factory/ ITS Finland	Business stakeholders	https://itsfactory.fi/ https://its-finland.fi/en/

3	Nysse/City of Tampere	General announcements	https://www.nysse.fi/en/front-page.html https://www.tampere.fi/en

3.6. Summary of the Status Quo Maps

The Status Quo Map has provided a robust foundation for understanding the existing landscape, identifying needs and challenges, and mapping available resources—such as data, knowledge, and technologies—across the T-LLs. The outcomes of the analysis have been consolidated into a final summary table that condenses the essential findings and drawn conclusions.

This table presents a holistic overview of the main parameters and insights derived from each city's Status Quo Map. It is structured to facilitate comparison and to provide a basis for future fertilization and cross-fertilization activities (Task 1.6). The table summarizes key aspects using standardized representations and keywords, covering the following:

Size: number of inhabitants

Modal Split: the percentage share of each mode of transport

TEN-T network: related corridors of interest

CCC: Climate City Contract status of advancement

UC: Use Case code

Identification of the UC area: identified or not when writing this deliverable

Objectives alignment with CCC: number of objectives aligned with the Climate City Contract

Experience from previous projects: learnings from related and relevant projects

Experience from existing services: learning from related and relevant existing services

Preliminary barriers: Use Case identified barriers

Objectives alignment with CCC: number of objectives aligned with the Climate City Contract

Common gains: Most common gains identified during Mini dialogues, common to all LLs

Common gains (Rank per LL): common gains identified during Mini dialogues by each LL

Common Pains: Most common pains identified during Mini dialogues, common to all LLs

Common Pains (Rank per LL): common pains identified during Mini dialogues by each LL

Availability of traffic-related data: Percentage of traffic-related data in relation to the total data variables identified in Chapter 3.1.3, according to the Data Map Methodology.

Spatial coverage: Spatial coverage of available data

Data quality/reliability: Data quality/reliability according to the Data Map Methodology.

Data sources: Most common data sources identified in Data Map.

Spatial resolution: Most common Spatial resolution identified in Data Map.

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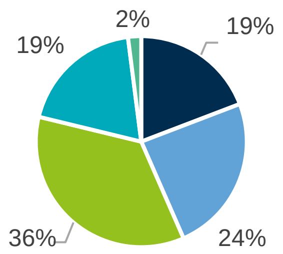
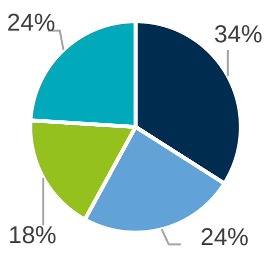
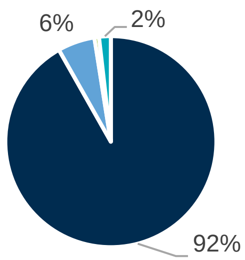
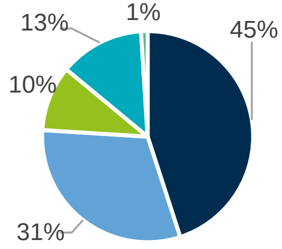
Table 40. Summary of the Status Quo Maps

	AMSTERDAM				MUNICH		LIMASSOL				TAMPERE	
Size	882,000 inhabitants				1,488,200 inhabitants		258,900 inhabitants				250,000 inhabitants	
Modal Split												
	Car Walking Cycling Public transport Other											
EN-T network	North Sea - Baltic - Rhine - Mediterranean				Scandinavian - Mediterranean - Rhine - Danube		Western Balkans				North Sea - Baltic	
CCC	Ongoing				Ongoing		Signed				Signed	
UC	AM-UC01	AM-UC02	AM-UC03	AM-UC04	MU-UC01	MU-UC02	LI-UC01	LI-UC02	LI-UC03	LI-UC04	TA-UC01	TA-UC02
Identification of the UC area	✓	✓	✗	✗	✓	✗	✗	✗	✓	✗	✗	✗
Objectives alignment with CCC	5/5	6/6	4/4	5/5	TBD	TBD	9/9	10/11	7/9	6/6	4/4	4/4
Experience from previous projects	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓
Experience from existing services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Preliminary barriers	#Regulatory Framework #Infrastructure #Public Acceptance				#Infrastructure #Tendering and construction		#Need for Subsidies #Public Acceptance #Infrastructure				#Infrastructure	

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	#Technological Readiness #Lack of political will		#Data availability	
Common gains	sustainable-mobility public-transport health autonomous-transport waste-logistics resource-efficiency			
Common gains (Rank per LL)	#1 A sustainable transport #2 Cycling & Pedestrian enhancement #3 Waste logistics improvement	#1 Logistic Hubs synergies #2 Transport advantages #3 Autonomous transport	#1 Transport impact #2 Health and quality of life #3 A sustainable mobility	#1 Resource efficiency and Scalability #2 Public Transport enhancement #3 A sustainable mobility
Common Pains	operational-efficiency costs safety infrastructure-concerns urban-safety accessibility			
Common Pains (Rank per LL)	#1 Transport Challenges #2 Urban Safety #3 Waste management	#1 Parcel Delivery Costs #2 Bicycle Infrastructure #3 Urban Safety	#1 Service Efficiency #2 Integration and Accessibility #3 Infrastructure Coordination	#1 Safety and Perception #2 Operational Efficiency #3 Technical Challenges
Availability of traffic-related data	68%	61%	73%	71%
Spatial coverage	National, Regional, Highway and Urban	Urban	National and Limassol region	National, Highways and Tampere region
Data quality/reliability	High, Medium	High, Medium	High	High
Data sources	VMA (Traffic model Amsterdam), Traffic counters, sensors, Traffic surveys, government records, Transportation planning agencies, Transit authority reports	Official government, Verified third party, Statistic Office, Mobility department, INRIX (external data provider), PT authority, Weather service	PT Office, Municipality, Electricity Authority of Cyprus, Bike Sharing Office, Measure point, Traffic police, Ministry, Labor Inspection	PT Office, Traffic Models, Calculation by city/third-party, Charging operators, National Road administration, Sensors

Spatial resolution	Road segment-level, Street-level, National level, regional level, Point-level, City-wide	Will be verified at a later time	Location-based, Measure points, Per route/Per docking station, Per charging station	Traffic light junctions, highway sensors, zone/location-based, measure points, per network

4. Prototype UCs and BIGMs

The development of the prototype Use Cases - UCs (Task 1.2) and prototypical Business Innovation and Governance Models – BIGMs (Task 1.3) followed a comprehensive and structured approach aimed at metaDesigning, with the involvement of citizens and stakeholders, the metaServices and metaInnovations that will then be implemented in each T-LL under WP3.

The primary goal of Task 1.2 is to develop prototype UCs detailing the operation of smart systems and services, user interactions, and technical requirements, while Task 1.3 aims to create BIGMs outlining the collaborative roles and value creation mechanisms for each UC.

These prototypes will then be refined through metaDesign activities in the T-LLs (Task 1.6 – LL's (cross-)fertilization and transferability activities), ultimately leading to the development of transferable UCs and BIGMs for wider implementation also outside metaCCAZE.

This chapter presents the methodology used to build the prototype UCs and prototype BIGMs, followed by a summary of the results for each T-LL.

4.1. Methodology

Under the framework of T1.6, guidelines on fine-tuning the co-designed UCs of smart systems and services have been drafted. Thanks to this, it has been possible to identify the interaction with the users, political/legislative and operational concerns, and to create a business model framework, as one of the key enablers for accelerating the uptake of metaCCAZE UCs in each Living Lab towards shared goals.

Each Living Lab organized its own workshop, one for each UC, following the set of guidelines developed under T1.6. These workshops were facilitated by factsheets tailored to each UC and defined by the results of the Status Quo Map and particularly, the mini dialogues. The guidelines served as guiding discussions and brainstorming sessions, ensuring that all relevant aspects were considered. The factsheets served as a structured tool to capture essential information regarding the UC, its objectives, target audience, key features, and potential challenges.

Table 41: MetaDesign activity LL2: MetaDesign use cases + BIGMS

CITY	FORMAT	ACHIEVED ON:
Amsterdam		• 30 July 2024
• UC01 & UC02	• Physical Workshop	
Munich		
• UC01 • UC02	• Physical Workshop • Physical Workshop	• 22 July 2024 • 27 June 2024
Limassol		
• UC01 • UC02 • UC03 • UC04	• 1:1 physical interviews & Physical Workshop • 1:1 physical interviews • Hybrid workshop • Hybrid workshop	• 4th & 22nd July 2024 • 19th July 2024 • 1st July 2024 • 23rd July 2024
Tampere		
• UC01 & UC02	• Physical Workshop	• 8 August 2024

The outcomes of these workshops were naturally heterogeneous, reflecting the unique contexts, challenges, and opportunities of each LL and each UC. Recognizing the need for harmonization, dedicated efforts were made to analyse and synthesize these diverse results. This involved identifying common patterns across the LLs, while also acknowledging and respecting their individuality. This analysis led to the creation of the prototype UCs and BIGMs while the insights gained from this process will inform the subsequent refinement and iteration of the validation of final UCs and BIGMs, ensuring their adaptability and transferability across different cities.

4.1.1. Prototype UCs methodology

The methodology described above enabled a more detailed definition of the prototype UCs that will be validated and implemented in WP3 and will also guide the innovations to being developed in WP2.

Each one of the UCs has already been preliminarily addressed on the Status Quo Map. From this, cities have pre-identified certain barriers, connected projects (whose lessons learned will serve as a foundation), existing services that should be considered to refine the UCs further, etc.

As noted, the workshops were designed to encourage open discussions and gather as many insights as possible from participant interactions. However, to ensure that the minimum required inputs and information were obtained from each event, a common structure was applied across all UCs.

Table 42: Minimum required inputs from Prototyping Use Cases (metaDesing activity number LL2)

INTERACTION WITH THE USERS	POLITICAL/LEGISLATIVE CONCERNS	OPERATIONAL CONCERNS
how the users will perform each task	training and other skills/knowledge requirements	
how the system behaves to users' requests	soft measures connected (i.e. incentives)	operational and technical dependencies and restrictions
user experience aspects		how the systems and services will operate
user acceptance risks		

The results from the workshops were fine-tuned and finalized by the city partners, in collaboration with the support partners, and harmonized with the outputs from other T-LLs for easier interpretation.

The next paragraphs will showcase the outcomes received and analysed by the 4 T-LLs per UC. The reader will identify a) a brief summary of the outcomes from the empathy map described per UC in Chapter 3 followed by b) the inclusion of the most relevant aggregated outcomes from the fine-tuning exercise carried out during the workshops (starting from the outcomes of the mini-dialogues) together with citizens and stakeholders, and c) a conclusion populated from both exercises (mini-dialogues and metaDesign workshop)

4.1.2. Prototype BIGMs methodology

The BIGMs are crucial for the successful implementation of the metaCCAZE project. They serve to define the collaborative roles, responsibilities, dependencies, and tasks of each actor involved in demonstrating each UC in each T-LL. They provide a structured approach to understanding how the different cities and various organizations involved in providing shared zero-emission services create, deliver, and capture value, not just economically but also socially, culturally, and within other relevant contexts. This allows the LLs to be aware from the beginning regarding how they should operate and collaborate for the demonstrations. In addition, the initial Prototype BIGMs will be subject to iterative refinement based on further analysis, feedback from stakeholders, and insights gathered during the validation process to create transferable BIGMs.

The BIGMs in the metaCCAZE project comprise two key components:

1. **Prototypical Governance Model**: This model defines the collaborative framework for each UC, identifying key stakeholders, their roles and responsibilities, and the overall governance structure. It provides a clear picture of how different entities will interact and collaborate.
2. **Prototypical Business & Innovation Model**: This model outlines the economic and value creation aspects of the UC. It details the value proposition, customer segments, key activities, resources, channels, customer relationships, partnerships, cost structure, and revenue streams. It provides a comprehensive understanding of how the use case will generate and capture value, ensuring its financial sustainability and potential for wider adoption.
    a. **Model representation:** There are different types of Business & Innovation Models, however for the specific UCs the following were considered
        i. Original Business Model Canvas (or Classic Business Model Canvas) developed by Alexander Osterwalder (2010). It was used where a single service provider is providing the service of the use case. Examples in following Figure.
        ii. Service-Dominant Business Model Radar Canvas by Egon Lüftenegger (2014). Examples in following Figure 13. It was used where multiple service providers need to cooperate for a service and emphasizes the co-creation of value among different actors in the ecosystem. The actors are categorized in:
            1. Focal Organisation: The central actor, often leading and coordinating the value co-creation process.
            2. Customer: The ultimate beneficiary of the co-created value, actively participating and giving feedback.
            3. Core Partners: Crucial contributors to the essential elements of the solution, significantly shaping the value proposition.
            4. Enriching Partners: Provide additional value, enhancing the core offering and customer experience.
            5. Other Actors: May include suppliers, complementors, governmental bodies, and communities, contributing to the value network in various ways.

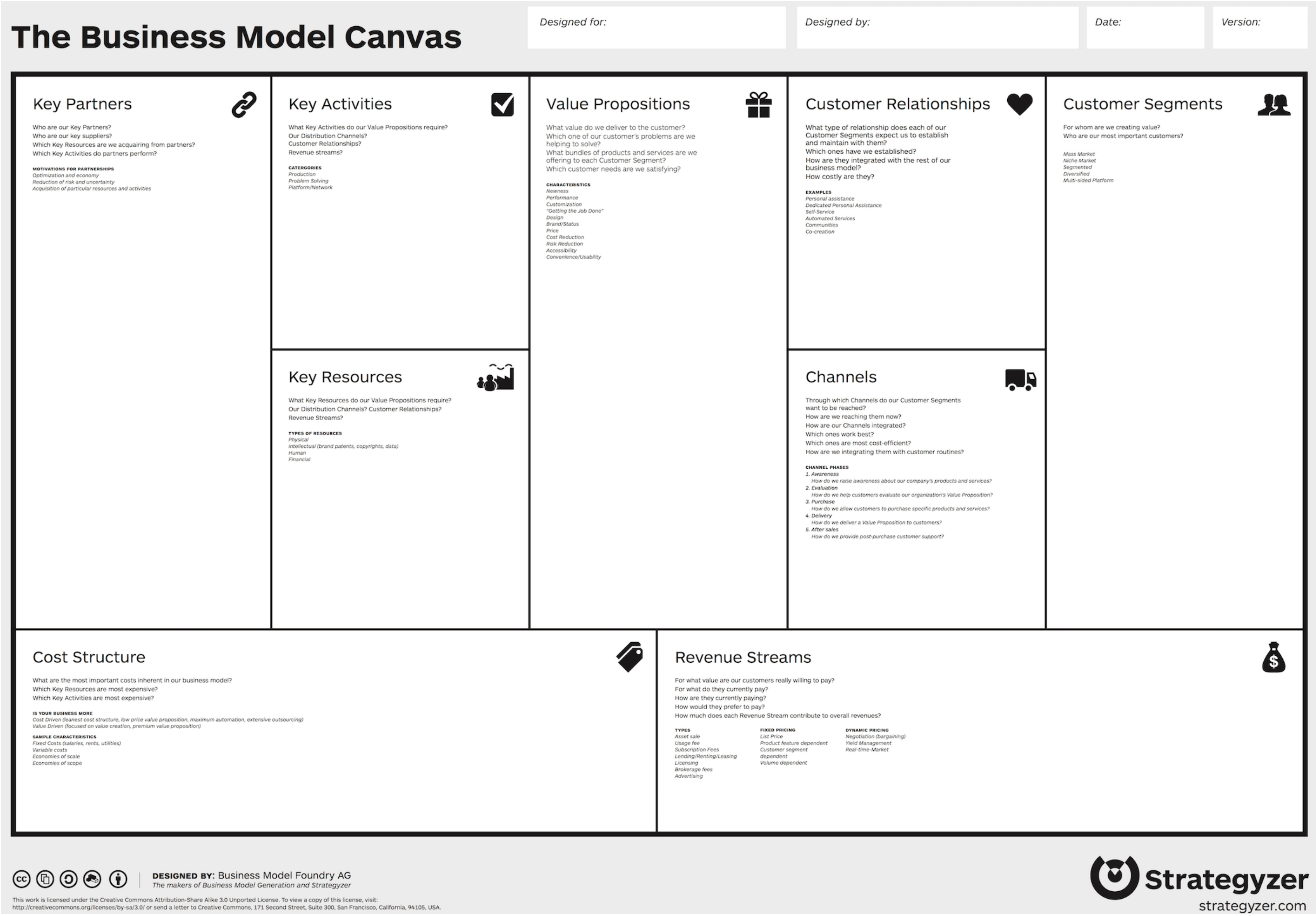

Figure 12: The Classic Business Model Canvas (https://www.strategyzer.com/)

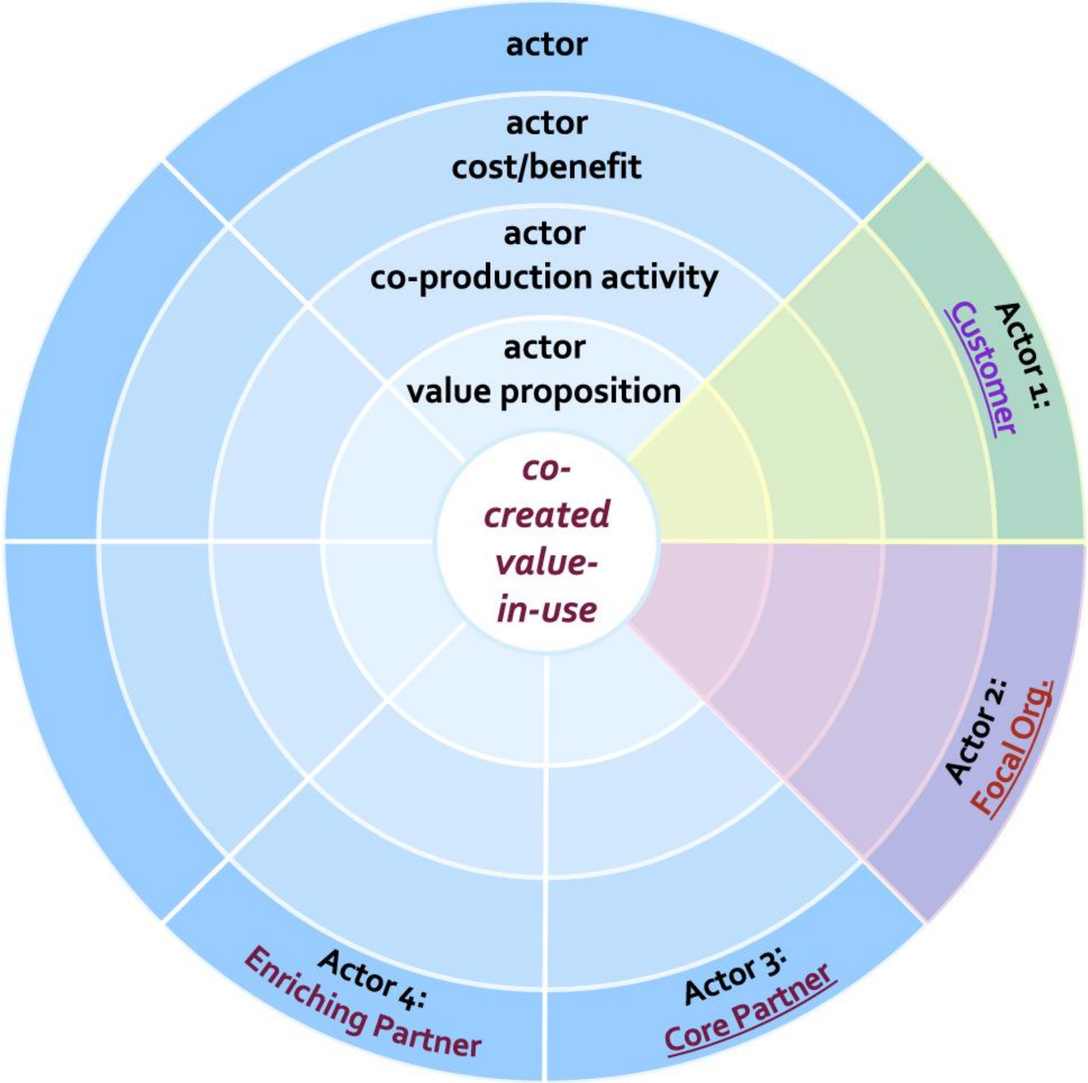

Figure 13: The Service-Dominant Business Model Radar Canvas (Oktay Turetken, 2019)

The process begins with the documentation and analysis of the outputs generated during the MetaDesign workshops, referencing the Status Quo Map for any necessary context or clarification. Subsequently, any missing information in the proposed business models and governance structures are identified and addressed by seeking further details from the MetaDesign workshop organizers. The development of the BIGMs then proceeds with the creation of the two distinct models for each Use Case (Prototypical Governance Model & the Prototypical Business & Innovation Model).

The Prototypical Governance Model is crafted by first identifying and categorizing key stakeholders into four groups: **Operational**, **Beneficiary**, **Regulatory and Support**, and **Infrastructure**. The appropriate governance structure is then determined, outlining the roles and responsibilities of each stakeholder. Finally, the governance structure is visually represented through a diagram, showcasing the relationships and interactions between the various stakeholders.

The Prototypical Business & Innovation Model is shaped by selecting the suitable Business Model Canvas, based on the nature of the use case and the number of service providers involved. The chosen canvas is then completed during the workshop, capturing key elements such as value proposition, customer segments, key activities, and other relevant components. The completed canvas is then presented visually to highlight the business model's structure and the interconnections between its elements.

By following this structured methodology, it was ensured that the Prototype BIGMs are comprehensive, well-defined, and aligned with the needs and expectations of the stakeholders involved in each UC.

The next paragraphs will showcase the outcomes received and analysed by the four T-LLs divided by UC.

4.2. Amsterdam Living Lab

On Tuesday, 30 July, the Amsterdam ecosystem partners (City of Amsterdam, AMS Institute and TU Delf) hosted a public workshop to gather community feedback on the living lab's use cases aimed at accelerating smart and shared zero-emission mobility in the city.

The event was designed to hear residents' questions, concerns, and suggestions and to raise awareness about the metaCCAZE project. It was held at the Marineterrein, a vibrant area dedicated to collaborating, experimenting and learning about (future) cities. This area is home to the City of Amsterdam's Innovation team and the AMS Institute.

Figure 14. Amsterdam's LL2 and LL3 workshops

The outdoor setting of the Amsterdam municipal innovation office provided an inviting atmosphere, with balloons and large metaCCAZE banners. Attendees, including metaCCAZE partners from the Amsterdam LL, experts from Amsterdam Smart City, the software engineering school CODAM, and AMS Institute, as well as curious passers-by, were encouraged to participate through interactive whiteboards displaying the four future UCs.

The event successfully collected valuable questions, concerns, and suggestions from the community. These insights will be instrumental in refining the UC ideas as the metaCCAZE project continues to develop innovative solutions for a more sustainable and liveable Amsterdam.

Although all workshop material was created in Dutch with the objective of including local residents, the language quickly switched to English as many residents of Amsterdam are non-native Dutch speakers. This was no problem for the native Dutch speakers attending.

4.2.1. AM-UC01 Autonomous electric waterborne vessels for logistics

A - Workshop(s) description

During Tuesday's 30 July event, some of the discussions were about waterborne Logistics: ZoevCity and Roboat aim to shift logistics from road to water using electric and autonomous vessels, reducing pressure on infrastructure and emissions.

The number of attendees varied throughout the workshop, as passers-by did not always stay throughout the whole sessions. The core group was about 15 people.

The team was challenged with interesting questions and valuable inputs were collected that will help us in finetuning the prototype use case ideas.

Figure 15. Amsterdam's LL2 and LL3 workshops

B - Prototype and co-designed Use Case

⬇ Prototype Use Case – Mini-dialogue preliminary outcome ⬇

AM-UC01 - Autonomous electric waterborne vessels for logistics
Stakeholders for AM-UC01 highlighted concerns about the high cost of water transport, the risk of damage to quays from heavy goods, and safety risks associated with large vessels near roads and canals. Regulatory challenges, such as the requirement for a captain on autonomous vessels and the limited availability of electric boats were also noted. Despite these issues, there is optimism about reducing emissions, improving efficiency, and advancing Amsterdam's sustainability goals through innovative water transport solutions.

⬇ Fine-tunning ⬇

Co-designed use case
INTERACTION WITH THE USERS
🌐 Communication and Safety: Stakeholders are concerned about how autonomous vessels will communicate with other ships, especially in the busy and crowded waterways of Amsterdam. Ensuring effective communication methods and safety protocols is essential to gain user trust and acceptance. 👨‍✈️ User Acceptance: There is a need for users to feel confident in the technology, particularly as the transition from human-operated to autonomous vessels raises concerns about reliability and safety. Engaging users through demonstrations and pilots, such as with the Roboat project, will be crucial for building confidence.
POLITICAL/LEGISLATIVE CONCERNS
⚖️ Regulatory Hurdles: The most significant legislative challenge is the current restriction on autonomous vessels in Amsterdam's city centre, where the biggest environmental and spatial benefits could be realized. Stakeholders emphasized the need for legal adjustments to allow these vessels to operate in critical areas. 🌳 Environmental Impact: Aligning the deployment of autonomous vessels with Amsterdam's sustainability goals is critical. Regulatory bodies must provide clear guidelines to ensure that these innovations contribute to reducing emissions and protecting the city's historic quays and canals.
OPERATIONAL CONCERNS
🔧 Technical Reliability: The operational success of autonomous vessels depends heavily on their ability to navigate complex waterways without traditional markers like lane indicators or traffic lights. Concerns were raised about the need for a control room with remote oversight to manage these vessels, particularly in emergency situations. 🔋 Resource Availability: The limited availability of electric vessels is a significant operational bottleneck. Ensuring a sufficient fleet to meet demand while maintaining the sustainability goals is a key challenge that stakeholders identified.

⬇ Conclusions ⬇

The workshop identified critical concerns about the operational, legislative, and user interaction aspects of deploying autonomous electric waterborne vessels in Amsterdam. Stakeholders emphasized the need for strong communication and safety protocols, regulatory adjustments to allow operations in the city centre, and overcoming technical challenges related to navigation and resource availability. The co-designed UC now includes strategies to address these issues, focusing on user engagement, legislative alignment, and ensuring operational reliability to support Amsterdam's sustainability goals.

Co-funded by
the European Union

C - Prototype BIGM

The prototypical governance model of AM-UC01 emphasizes a collaborative approach involving diverse stakeholders, from logistics companies to the Municipality of Amsterdam, all working together to enable the successful operation of autonomous electric waterborne vessels. The prototypical business model highlights key activities like vessel operation and maintenance, with the value proposition of providing efficient, eco-friendly transportation and waste management solutions. Revenue streams include fees from logistics companies and potential subsidies, aiming for financial sustainability.

The identified stakeholders are:

- **Logistics Companies**: Utilize autonomous vessels for efficient and sustainable goods transportation.
- **Local Businesses**: Receive supplies via autonomous vessels, reducing reliance on road-based logistics.
- **Municipality of Amsterdam**: Supports urban sustainability goals and utilizes vessels for waste transportation.
- **Public Transport Operators**: Potential integration of vessels into the public transport system.
- **Residents and Tourists**: Benefit indirectly from reduced traffic and improved urban environment.
- **Technology Providers**: Supply technology and systems for autonomous operation.
- **Infrastructure Providers**: Provide physical infrastructure (charging stations, docks).
- **Waste Management Companies**: Collaborate in waste transportation.
- **Regulatory Authorities**: Develop and enforce regulations.
- **Environmental and Urban Planning Agencies**: Assess environmental impact and ensure alignment with urban planning.
- **Insurance Companies**: Provide coverage for vessels and operations.

Figure 16 provides a visual representation of the prototypical governance structure, illustrating the relationships and interactions between the different stakeholders.

Since mutable service providers were identified, the Service-Dominant Business Model Radar (SDBM/R) was used to visualize the Business & Innovation Model. Figure 17 below illustrates the key components of the Prototypical Business and Innovation Model.

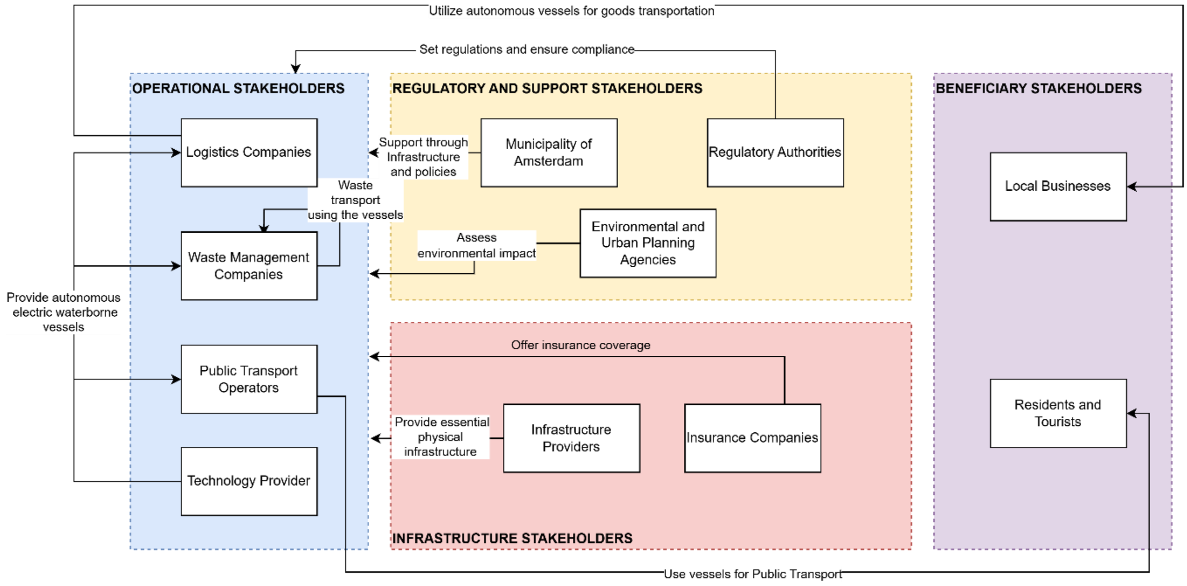

Figure 16: Prototypical Governance Model of AM-UC01

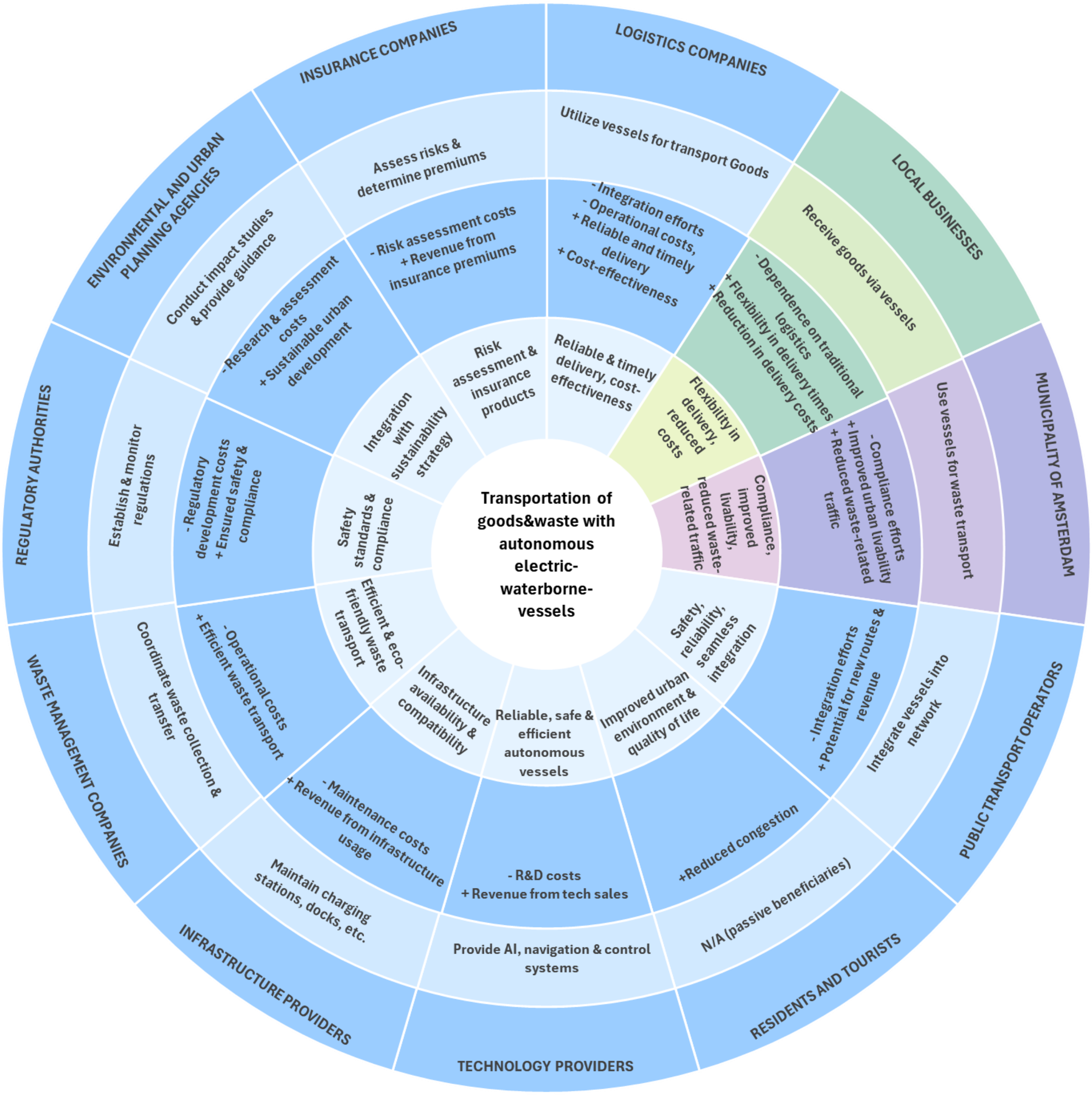

Figure 17: Prototypical Business and Innovation Model of AM-UC01

In the context of the SDBM/R, the focal organization is the entity that initiates and orchestrates the business model. In the case of AM-UC01, **the Municipality of Amsterdam** is considered the **focal organization**

The other roles, as identified in the provided information, can be categorized as follows:

- **Core Partners**: Logistics Companies, Technology Providers, Infrastructure Providers.
- **Customers**: Local Businesses
- **Enriching Partners**: Waste Management Companies, Regulatory Authorities, Environmental and Urban Planning Agencies, Insurance Companies.
- **Other Actors:** N/A

4.2.2. AM-UC02 Adaptive Speed Governance of connected e-bikes

A - Workshop(s) description

From onsite engagement with citizenry and municipal staff, as well as the workshop conducted on the 30th of July, the following discussions occurred about Townmaking Institute's Adaptive Speed Governance Program. The Townmaking Institute provides commons-based infrastructure for traffic governance, focusing on place-based speed adaptation.

The Adaptive Speed Governance environment is facilitated by the Townmaking Institute with Sovereign Digital Infrastructure Providers and Network Operators to ensure government capabilities for Societal Resilience with Commons to complement Market-based Engagement and Public Administration activities.

B - Prototype and co-designed use Case

⬇ *Prototype Use Case – Mini-dialogue preliminary outcome* ⬇

AM-UC02 - Adaptive Speed Governance of connected e-bikes
Stakeholders expressed concerns about the increasing speeds of e-bikes and the resulting rise in accidents, particularly involving minors and older adults. There is a need to govern e-bike speeds and manage conflicts in denser urban areas like Vondelpark. Cyclists may resist speed-reduction measures as they value their personal autonomy over the collective needs of everyone else on the bicycle path. Additionally, infrastructure changes could be challenging in certain areas of the city that carry heritage or monument status, such as parks. However, reducing speeds either through prompting the user through a user interface or actively cutting power supply to the motor could improve safety, cycling experiences, and pedestrian safety.

⬇*Fine-tunning*⬇

Co-designed use case

INTERACTION WITH THE USERS

🚴 Citizens Resistance: Cyclists may resist speed-limiting technology, viewing it as a loss of autonomy and suspicion of being tracked or surveillance. Stakeholders are concerned about how to encourage compliance and acceptance, especially when the system limits freedom on popular routes like Vondelpark.

📱 Usability Concerns: Users are also concerned about whether they will need to interact with screens or other devices while cycling. The system must be intuitive and non-distracting, allowing cyclists to focus on the road rather than technology.

📶 Tracking concerns: Citizens express concerns over their movements being tracked and often make implicit assumptions about how their movement data may be used if retained. The importance of Zero-data and Real-time must be made clear to citizenry.

POLITICAL/LEGISLATIVE CONCERNS

⚖️ Regulatory Alignment: There's a risk of applying car-based narratives to bike governance, such as "bicycle highways," which might not align with cycling culture. Additionally, privacy concerns arise from the potential for data retention related to tracking and how that data may be used for regulation such as speed violations, with stakeholders stressing the need for transparency and clear policies.

🌍 Policy Support: The effectiveness of speed governance will depend on aligning it with broader environmental and transportation policies. Public and educational campaigns to demonstrate how the technology can lead to better urban liveability as well as generating more local economic activity will be crucial to establishing its adoption.

OPERATIONAL CONCERNS
🔧 Implementation Challenges: The practical implementation of speed control on e-bikes is a concern, particularly how it will function in real-world conditions without conventional traffic signs or signals. Stakeholders often resort to more conventional solutions like signage, which is currently a challenge given the density of existing signage in cities.
🔋 Integration with Existing Systems: The integration of this technology into existing cycling infrastructure and ensuring it operates reliably without frequent maintenance or disruptions are key operational challenges that need addressing.

⬇Conclusions⬇

The workshop and the onsite research conducted at the Vondelpark identified key concerns related to user resistance, regulatory alignment, and the operational challenges of implementing adaptive speed governance for e-bikes. Stakeholders emphasized the importance of making the system intuitive and non-intrusive while ensuring it aligns with broader transportation policies. The co-designed use case now incorporates strategies to address these issues, focusing on user engagement, transparent regulation, and reliable system integration.

C - Prototype BIGM

The prototypical governance model of AM-UC01 emphasizes collaboration and shared responsibility amongst diverse stakeholders.

The identified stakeholders are:

- **Park Managers**: Officials responsible for overseeing and maintaining parks, ensuring safety and addressing concerns related to e-bike speeds.
- **Citizen-driven Communities involved in Park Safety**: Groups of residents actively participating in maintaining park safety and advocating for solutions to address e-bike related issues.
- **Micromobility Drivers:** These are the individuals who use e-bikes and would directly interact with the Adaptive Speed Governance (ASG) system and include:
    - Minors (under the age of 18 on an eBike, especially fatbikes): Young e-bike riders who might require additional safety considerations due to their age and experience.
    - Commuters (eBikes, Speed Pedelecs): Individuals using e-bikes for their daily commute, likely valuing efficiency and speed.
    - Older adults (eBikes): Older e-bike users who might have specific needs related to accessibility and safety.
    - Parents and carers (eBikes, Cargobikes): Adults transporting children or cargo on e-bikes, prioritizing stability and safety.

  - Delivery Riders (eBikes, Cargobikes): Individuals using e-bikes for delivery services, who might have specific requirements related to navigation and efficiency.

- **Technology Facilitator** (**Townmaking**): Commons-based organization responsible bringing together the necessary technology providers for developing and maintaining the ASG technology and infrastructure, ensuring its functionality and reliability.
- **Local Government**: Municipal authorities responsible for setting transportation policies and regulations, playing a crucial role in the implementation and adoption of the ASG system.
- **Law Enforcement**: Agencies responsible for enforcing traffic laws and ensuring compliance with speed regulations, potentially collaborating with the ASG system to address violations.
- **eBikes & Light Electric Vehicles (LEVs) manufacturers:** Responsible for manufacturing the eBikes and LEVs as well as needing to cooperate with Townmaking to integrate the ASG.
- **Telecommunications Network Operators**: Responsible for connectivity Specification Development and Zero-data/Low-latency Connectivity.
- **Sovereign Digital Infrastructure Operator:** Identified as Commons Workers within the Adaptive Speed Governance (ASG) ecosystem. They play a crucial role in the Total Urban Management System environment. Their primary responsibility lies in building and maintaining the digital infrastructure that supports the ASG system, ensuring it aligns with the principles of sovereignty and data privacy.
- **General Public**: Residents and visitors who use the park and could be indirectly affected by the ASG system, even if they do not ride e-bikes themselves. Their perception and acceptance of the system are important for its success.

The following Figure 18 provides a visual representation of the prototypical governance structure, illustrating the relationships and interactions between the different stakeholders.

A single service provider, Townmaking, was identified, therefore, the Classic Business Model canvas could be used to visualize the Prototypical Business and Innovation Model. However, this should be balanced with the Business Model Canvas' shortcomings in non-value chain models, such as Societal Assets for Safety that transcend business models.

Accordingly, since the specific use case is based on a community-driven project that leverage shared resources or "commons", a different approach was used by considering the "Social Good" in the "Value Proposition", changing the Revenue streams to "Contribution Models", the "Cost Structure" to "Resources / Commons Cost Structure", the "Customer Segments" to "Citizens Categories", and the "Customer Relationships" to "Citizen Relationships". The canvas is visualised in Figure 19.

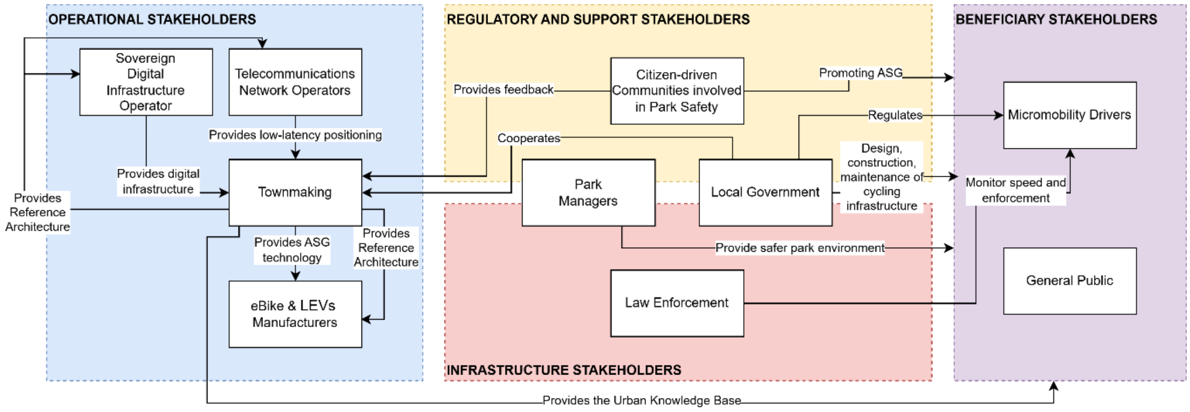

Figure 18: Prototypical Governance Model of AM-UC02

Key Partners	Key Activities	Value Propositions	Citizen Relationships	Citizens Categories
-Municipalities -Technology providers	- Developing Narrative Record of the Park - Conducting Place-based Safety Studies and testing Safety Scenarios on Test Rig -Deploying Adaptive Speed Governance to Public and Private Assets - Operating Adaptive Speed Governance and Low-latency Mobile Network	**Park managers / E-bike riders** -Real-time, zero-data digital experiences for regulating speed safety -Nudges to alert individuals of safe behavior -Nannies to alter vehicle behavior if needed Citizen-driven communities -Safer speeds in the park	-Direct interaction with e-bike riders through the technology -Engagement with stakeholders through Narrative Records and workshops	-E-bike riders (minors, commuters, elderly, parents/carers, delivery riders) -Park managers -Citizen-driven communities involved in park safety
	Key Resources -Commons-based infrastructure for traffic governance -Place-based information -Narrative Records from stakeholders		**Channels** -Connected e-bikes -Possibly audio cues or other non-visual interfaces	
Cost Structure -Development and maintenance of the technology -Implementation of the system in urban environments -Stakeholder engagement and research			**Revenue Streams** -Not explicitly mentioned	

Figure 19: Prototypical Business and Innovation Model of AM-UC02

4.2.3. AM-UC03 Optimizing intermodality of waste collection in the urban systems

A - Workshop(s) description

The event on Tuesday, 30 July, had the opportunity to hold some discussions about the optimization of the intermodality of waste collection. Alike the previous UCs, the number of attendees varied throughout the workshop, as passers-by did not always stay throughout the whole sessions. The core group was about 15 people.

B - Prototype and co-designed use Case

⬇ Prototype Use Case – Mini-dialogue preliminary outcome ⬇

AM-UC03 - Optimizing intermodality of waste collection in the urban systems
Stakeholders are concerned about the inefficiency and high costs of current waste collection methods in Amsterdam's city centre. Trucks are too heavy for quays and bridges, and space for waste collection vehicles is limited. There is a need to reduce illegal littering and optimize waste collection and transshipment between road and water. Additionally, not all citizens want waste collection near their homes, and there is a pressing need to develop a sustainable, long-term waste management solution that integrates with existing city infrastructure.

⬇Fine-tunning⬇

Co-designed use case

INTERACTION WITH THE USERS

🗑️ User Participation: Stakeholders are concerned about how residents will interact with the new waste collection system, particularly with time slots for waste disposal. There is a need to ensure that these time slots don not inconvenience residents and that the system is intuitive and easy to use, encouraging public cooperation and acceptance.

🌍 Community Engagement: Replacing heavy trucks with lighter vehicles improves safety perceptions in the city centre, but engaging the community is essential to ensure they understand and support the new system, especially in densely populated or historic areas.

POLITICAL/LEGISLATIVE CONCERNS

⚖️ Regulatory Compliance: There are concerns about the increased number of trips required by light electric vehicles (LEVs) and whether these will offset environmental benefits. The integration of these vehicles into crowded urban environments, particularly on bike paths, raises safety and legislative challenges that need to be addressed.

🚚 Sustainable Logistics: The system's success relies on aligning with Amsterdam's environmental goals, but there's a need for policies that support sustainable waste logistics, possibly through incentives for using eco-friendly vehicles and methods.

OPERATIONAL CONCERNS

🔧 Technical and Resource Challenges: The new system will require significant operational adjustments, including managing a larger fleet of smaller vehicles. There are concerns about the privacy of waste data and the need for sufficient staffing and financial resources to maintain the system.

📊 Efficiency and Scalability: Operational efficiency is a key concern, particularly in terms of optimizing the waste transshipment between road and water. Stakeholders are worried about whether the system can scale effectively without causing congestion or compromising service quality.

⬇Conclusions⬇

The workshop highlighted key concerns regarding user interaction, legislative alignment, and operational challenges in implementing a new waste collection system in Amsterdam. Stakeholders emphasized the *need for user-friendly, intuitive systems and policies that support environmental goals while addressing safety and logistical challenges. The co-designed use case now includes strategies to enhance community engagement, ensure regulatory compliance, and optimize operational efficiency to create a sustainable and scalable solution for waste management in the city centre.*

C - Prototype BIGM

The prototypical governance model for AM-UC03, emphasizes collaboration and adaptability. The model recognizes that the effectiveness of the waste collection system relies on the coordination and cooperation of various stakeholders. It also acknowledges the need for flexibility to accommodate the dynamic nature of waste generation and urban environments.

The identified stakeholders are:

- **Waste Collection Company**: Collect and transport waste from households and businesses.
- **Barge Operators**: Transport waste from cargo bikes to processing facilities.
- **Municipality**: Oversee waste management, set regulations, and provide infrastructure.
- **Citizens**: Generate household waste and adopt proper disposal practices.
- **Technology Providers**: Develop and maintain the real-time rerouting system

Figure 18 provides a visual representation of the prototypical governance structure, illustrating the relationships and interactions between the different stakeholders.

Since a single service provider was identified (Waste Collection Company), the Classic Business Model Canvas was used to visualize the Business & Innovation Model, was used to visualize the Business & Innovation Model. Figure 19 below illustrates the key components of the Prototypical Business and Innovation Model.

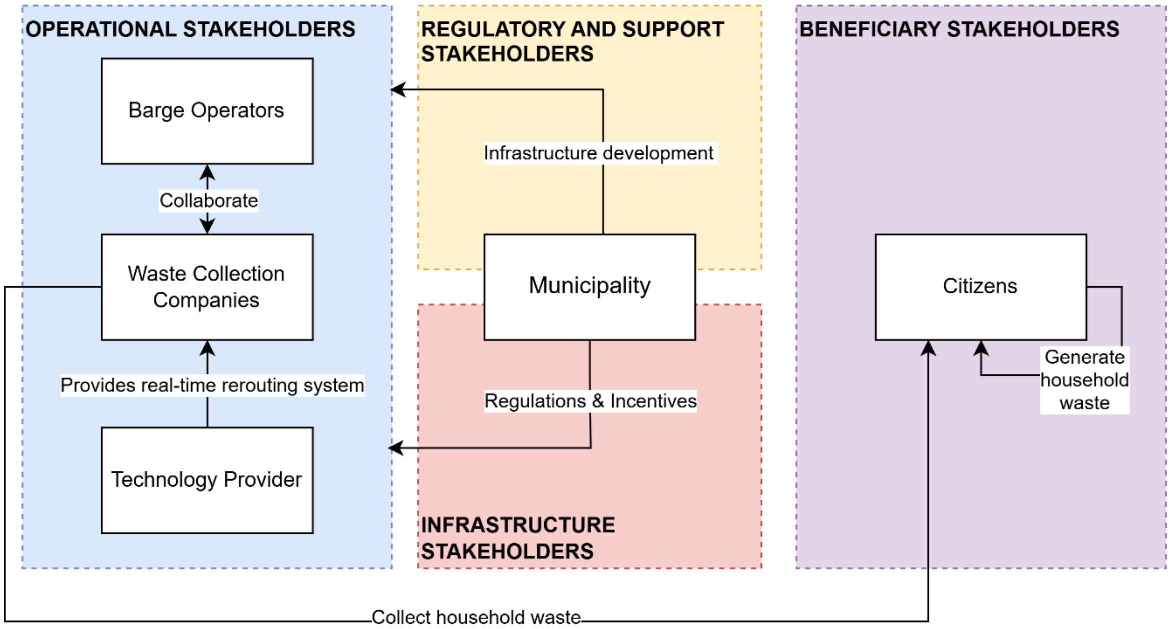

Figure 18: Prototypical Governance Model of AM-UC03

<table>
<tr>
<td rowspan="2">Key Partners
-Barge operators
-Cargo bike suppliers
-Municipalities
-Waste processing companies
-Technology providers</td>
<td>Key Activities
-Waste collection and transportation
-Route planning and optimization
-Infrastructure maintenance
-Stakeholder communication and collaboration</td>
<td rowspan="2">Value Propositions
Households
-Reduced emissions
-Improved safety

Businesses
-Reduced emissions
-Improved safety

Municipality
-Improved safety
-Reduced emissions
-Preservation of infrastructure
-Enhanced efficiency
-Potential for cost savings
-Community engagement</td>
<td>Customer Relationships
-Transparent communication
-Responsive customer service
-Community engagement initiatives</td>
<td rowspan="2">Customer Segments
- Households
- Businesses
- Municipality</td>
</tr>
<tr>
<td>Key Resources
-Cargo bikes
-Barges
-ICT infrastructure
-Skilled personnel
-Partnerships and collaborations</td>
<td>Channels
-Direct collection
-Waterborne transport
-Digital platforms</td>
</tr>
<tr>
<td colspan="2">Cost Structure
-Vehicle acquisition and maintenance
- Personnel costs
- ICT infrastructure
- Fuel and energy costs
- Waste processing fees</td>
<td colspan="3">Revenue Streams
- Service fees
- Municipal contracts</td>
</tr>
</table>

Figure 19: Prototypical Business and Innovation Model of AM-UC03

4.2.4. AM-UC04 Tradable Mobility Credits (TMC) scheme

A - Workshop(s) description

As Technolution and TU Delft are creating a cap-and-trade system to manage traffic and mitigate its negative impacts, the workshop was an opportunity to hold discussions and raise interesting questions about the subject, explained below.

B - Prototype and co-designed Use Case

⬇ Prototype Use Case – Mini-dialogue preliminary outcome ⬇

AM-UC04 - Tradable Mobility Credits (TMC) scheme
Stakeholders expressed concerns about the trustworthiness of the proposed mobility credit system (TMC) and its side-effects. They noted that citizens may resist a system that reduces spontaneity, a valued aspect of urban living. Additionally, there is a worry that the system may be more effective at a neighbourhood level where sharing is easier. Despite these concerns, stakeholders see potential in using TMC to steer mobility choices towards sustainability, accessibility, and efficiency, particularly in logistics.

⬇Fine-tunning⬇

Co-designed use case
INTERACTION WITH THE USERS
User Trust and Accessibility: Stakeholders are concerned that the Tradable Mobility Credits (TMC) system might be seen as too complex or restrictive, potentially limiting spontaneous

travel and deterring use. The concept of "credits" associated with money may also create confusion or resistance, especially among those who value spontaneous urban mobility.

🧑🦼 Inclusion: The system must be designed to consider users with disabilities, who may face additional challenges in managing and using mobility credits, both physically and mentally.

POLITICAL/LEGISLATIVE CONCERNS

⚖️ Regulatory Fairness: Balancing the need to encourage sustainable mobility without making movement feel like a financial transaction is a key concern. The system should ensure fairness by accommodating the basic mobility needs of all citizens, while still incentivizing desired behaviors. Legislators need to carefully craft policies that do not disproportionately affect vulnerable populations.

🌍 Sustainability Alignment: There is also concern about aligning TMC with broader environmental goals, ensuring that the system genuinely contributes to reducing emissions and congestion rather than simply creating a new layer of bureaucracy.

OPERATIONAL CONCERNS

🔄 System Integrity: Stakeholders worry about the potential for users to "game" the system, undermining its effectiveness. Learning from past failures in carbon markets, the TMC system needs robust safeguards to prevent exploitation.

⚙️ Complexity and Usability: The system's success will depend on its ease of use and clear communication. Overly complex systems might fail to gain traction, especially if users find it difficult to understand how to earn, spend, or trade their mobility credits.

⬇Conclusions⬇

The workshop revealed significant concerns around user acceptance, regulatory fairness, and operational integrity of the Tradable Mobility Credits (TMC) system. Stakeholders emphasized the need for a user-friendly, inclusive system that aligns with sustainability goals while avoiding the pitfalls of commodifying movement. The co-designed use case now incorporates strategies to address these challenges, focusing on transparency, fairness, and operational robustness to ensure the system is both effective and equitable.

C - Prototype BIGM

The prototypical governance model of AM-UC04 emphasizes the role of a **Central Authority** in setting the cap on credits and ensuring the system's overall functionality. The users play a crucial role by actively participating in the system, utilizing credits for travel, and engaging in credit trading. The business model centres around incentivizing sustainable transport choices, rewarding users with extra credits for opting for greener options, which they can then sell.

The identified stakeholders are:

- **Central Authority**: Sets credit cap, oversees market prices, ensures system functionality.
- **Users**: Use credits for travel, engage in credit trading, incentivized for sustainable choices.

- **Mobility Service Providers**: Ride-sharing, car-sharing, and other services integrated with the credit system.
- **Technology Providers**: Develop and maintain the digital twin platform and credit trading marketplace.
- **Research Institutions**: AMS Institute and TU Delft support decision-making on pilot creation.
- **City of Amsterdam**: Supports the creation of this use case.

The governance structure primarily revolves around the Central Authority's regulatory role and the users' active participation within the system. Figure 20 provides a visual representation of the prototypical governance structure, illustrating the relationships and interactions between the different stakeholders.

The business model aims to create a sustainable system that promotes greener transport choices through a market-based mechanism. The collaborative efforts of the Central Authority and users are pivotal in achieving the desired outcomes of reduced traffic congestion and increased adoption of greener transport options. Since a single service provider was identified (Central Authority), the Classic Business Model Canvas was used to visualize the Business & Innovation Model, was used to visualize the Business & Innovation Model. Figure 21 below illustrates the key components of the Prototypical Business and Innovation Model.

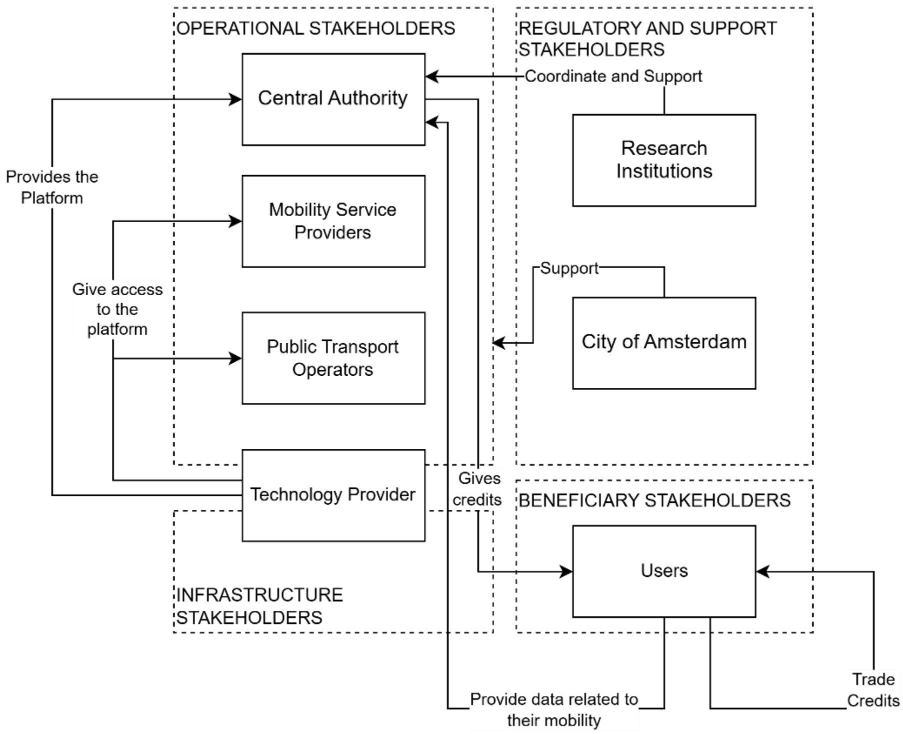

Figure 20: Prototypical Governance Model of AM-UC04

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
-Technology Providers (Technolution, Argaleo) - Research Institutions (AMS Institute - coordinates Living Lab) & TU Delft (support decision making on pilot creation - Public Transport Operators - Mobility Service Providers - City of Amsterdam (support the UC creation)	- Credit Management - Platform Development and Maintenance - User Engagement and Education - Data Analysis and System Optimization	**For Users**: - Incentivized sustainable travel choices - Reduced traffic congestion and improved air quality - Potential financial gains	- Transparent Communication - User Support - Feedback Mechanisms	- Users / Individuals
	Key Resources - Digital Twin Platform - Credit Trading Marketplace - Data Analytics Capabilities - Partnerships and Collaborations		**Channels** - Digital Twin Platform - Mobile Applications - Public Awareness Campaigns	
Cost Structure - Technology Development and Maintenance - Data Management and Analysis - User Support and Education - Administrative and Operational Costs		**Revenue Streams** - Potential Partnerships		

Figure 21: Prototypical Business and Innovation Model of AM-UC04

4.3. Munich Living Lab

Unlike Amsterdam, Munich has organized two separate events that will be explained under the corresponding UC.

4.3.1. MU-UC01 - Dynamic Curbside Management

A - Workshop(s) description

The dynamic curbside management Use Case workshop took place on Monday 22 July 2024, at the offices of the City of Munich's Mobility Department, with over 30 participants attending in person. Invitations were sent out via email one month prior, and participants confirmed their attendance through an Eventbrite form. The invitation also included a short online survey–that was part of the metaCCAZE mini-dialogues–and its responses were used during the design of the LL2/LL3 workshop.

The attendees represented a diverse group of stakeholders, including various departments of the municipality, logistics companies of different sizes and business models, representatives from the Chamber of Commerce and hotel association, supermarket chains, and representatives of mobility-impaired citizens.

The event began at 13:00 with a brief welcome and presentation round by municipal representatives. Then, the mobility department gave a short overview of the status quo of parking and curbside management in Munich, introduced past related projects, and then presented the EU metaCCAZE project. Afterwards, the LL partner Stadtraum presented their technical solution (SmaLa) and shared their experience in a similar project in Hamburg.

Figure 22. Munich's LL2 and LL3 workshops

After a coffee break, the workshop continued with a so-called World Café activity in which participants were divided into three groups. Each of these groups was assigned to a large table with two thematic canvases and a team of moderators. For approximately 20 minutes, the participants addressed the content of the canvases, building on the responses of the previous groups, before moving to the next table. After this interactive session, an online real-time survey (mentimeter) was conducted. The event concluded with some closing remarks and a recap of the discussion by the LL team. Finally, the participants were thanked for their participation and received information on the next steps of the project.

The event concluded around 16:00. In the week after the event, participants received a follow-up email summarizing the main results of the workshop, including canvases, and pictures.

Organization: City of Munich, Technical University of Munich, Stadtraum. Also, participation from other LL partners.

B - Prototype and co-designed Use Case

↓ *Prototype Use Case – Mini-dialogue preliminary outcome* ↓

MU-UC01 - Dynamic Curbside Management *Stakeholders expressed concerns about the challenges of booking public spaces, such as potential regulatory restrictions and social acceptance. They worry about the burden of downloading specific apps and the stability of IT infrastructure. Ensuring booked spaces are genuinely available and enforcing curbside regulations are also key issues. They acknowledge the need for large-scale implementation for effective adoption and emphasize the difficulty of adapting to the new system.*

↓*Fine-tunning*↓

Co-designed use case

INTERACTION WITH THE USERS
📱Accesible API: Interest in booking slots via API from logistic companies, which can also be necessary for the future use of the zones by automated vehicles
📱User-friendliness and availability: Reservation should be possible via smartphone and connected to the official parking app of the city. Available across the city or nation-wide. The app should be available in multiple languages. The status of the zone (available, booked, not usable due to technical failure) should be shown in an intuitive way on the app.
💵Instant Payment System: to be applied for better clearness and proper usage of the system
✅Reliability of reservation: Proved necessary, completed by physical barriers and/or surveillance
⚠️Risks: It is important to avoid "dying of success" (as the system might be adopted by many companies). Lack of anticipation may jeopardize hotel users, for example.

POLITICAL/LEGISLATIVE CONCERNS
▯Data storage: In EU servers, to be handled in a privacy-conform way
🅿️Parking regulation to be modified for the reservation of stop areas. The enforcement of the regulations should start earlier than now
👮Involvement of agents: If a vehicle is occupying the zones without permission, it should be automatically notified to the police and towing service. Both the police and the towing services should have access to a digital overview of the system state.

OPERATIONAL CONCERNS
The zones should be barrier-free and safe for couriers and passengers. This includes smooth transitions to the sidewalk to facilitate the movement of freight by the delivery companies.
🔌Charging facilities could be also provided (standard or wireless).
🅿️The zones should be able to accommodate vehicles of up to 12 tons. A minimum of two spots should be provided for each zone.
▯Access to data: Users request that the data are findable and interoperable.
🧑🏫Training: In the case of the use via API, each company would define the exact integration in their system and, therefore, should provide training to their employees. For the access via App, explanatory video tutorials and a FAQ section in the app/website should be sufficient for most users. In case further assistance is needed, the call centre could provide help.
🚫Undefined: The allowed duration of the stops and the anticipation of the reservations should be further discussed.

⬇Conclusions⬇

Stakeholders are concerned about the operational, legislative, and user interaction aspects of the proposed solution. Operatively, they stress the need for reliable and accessible zones that accommodate large vehicles and ensure barrier-free, safe environments, with potential charging facilities. Legislatively, there's concern about data storage within EU servers, adapting parking regulations for reservations, and ensuring that unauthorized use is promptly managed by authorities. User interaction concerns include ensuring a user-friendly, multilingual app that's integrated with the city's official parking system, with *real-time status updates and reliable reservation systems supported by physical barriers or surveillance. Additionally, stakeholders highlight the need to manage the risk of system overuse, potential service disruptions, and emphasize the importance of accessible training materials and support. Uncertainty remains regarding stop duration and reservation timing, which require further discussion.*

C - Prototype BIGM

The MU-UC01 Prototypical Governance Model places a strong emphasis on cooperation and open communication amongst a variety of stakeholders, from users to operators. The prototypical business model aims to deliver a sustainable solution by outlining important operations, value propositions, and revenue streams. This creative strategy aims to improve curbside management for the good of all parties involved and make the city a more liveable place.

The identified stakeholders are:

- **Dynamic Curbside Management (DCM) Operator Entity**: Primary responsibility for managing the system, including operations, customer service, technical support, and new company recruitment.
- **Enforcement (Police, Towing Company):** Enforces regulations and ensures compliance.
- **Municipality**: Oversees transportation, logistics, and inclusion aspects.
- **AWM (Garbage Collection)**: Coordinates with the system for waste management.
- **Logistics Companies**: Utilize the system for deliveries.
- **Supermarkets, Craftspeople & Suppliers**: Manage supplier deliveries.
- **Hotels & Suppliers**: Manage guest and supplier pickups/drop-offs.

The following Figure 23 provides a visual representation of the prototypical governance structure, illustrating the relationships and interactions between the different stakeholders.

Since a single service provider was identified (DCM Operator), the Classic Business Model Canvas was used to visualize the Business & Innovation Model. The Figure 24 **Error! Reference source not found.**below illustrates the key components of the Prototypical Business and Innovation Model.

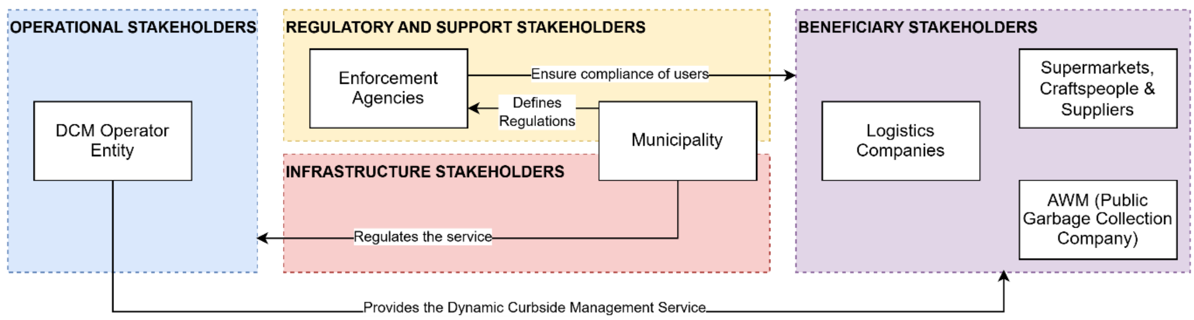

Figure 23: Prototypical Governance Model of MU-UC01

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
- Municipality - Enforcement Agencies (Police, Towing Company) - AWM (Garbage Collection Company) (User) - Logistics Companies (User) - Supermarkets and Suppliers (User) - Hotels, Craftspeople and Suppliers (User) - Car-Sharing Companies (User) - Technology Providers: Develop and maintain the digital platform (app/API), sensors, and other technologies.	- Platform Development & Maintenance - Infrastructure Development - Enforcement & Monitoring (Ensuring compliance with regulations) - Customer Service & Support - Data Management & Analytics - Stakeholder Engagement - Marketing & Promotion **Key Resources** - Digital Platform (App and API) - Curbside Infrastructure: Designated zones with sensors, signage, and potentially physical barriers. - Enforcement Personnel: Parking police or other entities to ensure compliance. - Data & Analytics - Customer Support Team	- For **Users** (Logistics Companies, Suppliers, etc.): - Reliable Access to Curbside Space - Reduced Operational Costs: Savings on fuel, time, and potential fines. - Improved Customer Service: Ability to plan deliveries and pickups more accurately. - Enhanced Accessibility: Designated spaces for restricted-mobility users and their caregivers. For **Municipality & Society**: - Improved Traffic Flow & Reduced Congestion - Reduced Emissions - Optimized Space Utilization: Better management of curbside space. - Increased Safety: Designated zones for loading/unloading and passenger pick-up/drop-off.	- User-Friendly Interface: Easy-to-use app - Communication: Real-time information on zone availability and potential disruptions. - Responsive Customer Support - Clear and fair pricing structure. - Feedback Mechanisms **Channels** - Mobile App: For users to access the system and make bookings. - API: Integration with logistics companies' systems. - Website: Information and support resources for users. - Physical Signage (curbside zones) - Email, phone, and potentially in-app chat	- Logistics Companies: Courier, express, and parcel services; B2B logistics operators. - Suppliers: Companies delivering goods to businesses and supermarkets. - Supermarkets: Managing deliveries from suppliers and customer pickups. - Hotels: Managing guest and supplier pickups/drop-offs. - Restricted-Mobility Users & Caregivers: Requiring accessible curbside spaces. - Potentially Car-Sharing Companies: For short-term charging of vehicles. - Municipality & Public Entities: Utilizing the system for waste management and other services.

Cost Structure	Revenue Streams
- Technology Development, Installation & Maintenance: (platform, sensors, and other tech infrastructure) - Infrastructure Installation & Maintenance - Enforcement Costs: Salaries and operational expenses for enforcement personnel. - Customer Support: Salaries and resources for the customer service team. - Marketing & Promotion: Costs for raising awareness	- User Fees: Charges for booking and using curbside zones. - Potential Partnerships: Revenue sharing with car-sharing companies for charging services or other partners. - Potential for Fines: Revenue from enforcing violations, though this should not be the primary focus.

Figure 24: Prototypical Business and Innovation Model of MU-UC01

4.3.2. MU-UC02 – Establishment and operation of multimodal logistics hubs

A - Workshop(s) description

The workshop took place on Thursday, June 27, 2024, at the City of Munich's Mobility Department offices, with approximately 30 participants attending in person and 10 joining online. Invitations were sent out via email one month prior, and participants confirmed their attendance through an Eventbrite form. The attendees represented a diverse group of stakeholders, including various departments of the municipality, transport and logistics consultants, logistics companies ranging from local last-mile providers to international networks, and representatives from the chamber of commerce. The event commenced with a brief introduction by municipal representatives, who introduced the metaCCAZE project and outlined the topic of bike logistics in the city of Munich. This was followed by a presentation and discussion on the learnings from the first bike logistics hub in the city (Viehhof). After a coffee break, the workshop transitioned into an interactive session designed to gather the necessary inputs for the metaCCAZE factsheet content. A Business Model Canvas was used to guide the discussion; participants used sticky notes and the canvas to capture ideas and information. Additionally, a printed map of Munich was provided, enabling them to suggest and debate potential locations for future logistics hubs. Following the interactive activity, another coffee break was held, which led to the final wrap-up of the canvas session. Afterwards, the citizen's activity took place, with the participants sharing their overall concerns and how to maximize the uptake of the logistics hubs. Finally, the organizers of the workshop shared some closing remarks, thanked the participants for their attendance, and invited them to be engaged in future activities of the Living Lab. Some participants stayed for more than an hour afterward, engaging in further informal discussions. In the two weeks after the event, participants received a follow-up email summarizing the main results of the workshop, including canvases and map, pictures, and a brief description of the event. The workshop was organized by the City of Munich and the Technical University of Munich, with participation from other Living Lab partners.

B - Prototype and co-designed use Case

⬇ *Prototype Use Case – Mini-dialogue preliminary outcome* ⬇

MU-UC02 – Establishment and operation of multimodal logistics hubs

Stakeholders expressed concerns about the feasibility and safety of using rickshaw vehicles for logistics. Key issues include the lack of clear regulations for their operation on roads or bike paths, weather conditions, and potential conflicts with cyclists. The higher cost per parcel compared to traditional methods, potential for increased traffic risks, and uncertainty about the effectiveness of autonomous driving technology are also significant barriers. Moreover, there's skepticism about the overall impact on city mobility and safety.

⬇*Fine-tunning*⬇

Co-designed use case

INTERACTION WITH THE USERS

📅 User Coordination: Coordination among different delivery companies within hubs is crucial to avoid infrastructure saturation. Temporal slots for loading/unloading can help manage peak times effectively.

💻 User Experience: There is a need for a simple, user-friendly portal for small retailers to interact with the logistics system.

⚠️ User Acceptance Risks: Financial risks are a major concern, especially if the system fails to deliver the expected demand or operational efficiency. Users worry about incurring in substantial losses.

POLITICAL/LEGISLATIVE CONCERNS

🛑 Regulatory Hurdles: Slow administrative approval and fragmented municipal coordination pose significant challenges. A single, coordinated "desk" for approvals is suggested to streamline processes.

🚀 City's Role: Stakeholders emphasize the need for proactive city leadership to implement the system and reduce market uncertainty. The city's role in providing loan guarantees and subsidies could also be crucial.

📢 Visibility and Public Support: Strengthening the visibility of bike logistics through public awareness campaigns is necessary to gain support for ambitious projects.

OPERATIONAL CONCERNS

🔌 Infrastructure Needs: Sufficient power capacity for charging e-bikes, reliable internet, and surveillance systems are essential for smooth operations.

📏 Standardization: Standardized processes, vehicles, and parcel sizes, along with automation, are vital to make the system attractive and efficient.

🏢 Scaling and Hub Efficiency: The right size and number of hubs are crucial. There's a debate between a denser network of smaller hubs versus fewer, larger hubs. Scalability is key to reducing operational costs.

🚴 Cycling Infrastructure: Improved cycling infrastructure, like wider lanes and more cycling streets, is necessary for the system's success.

⬇Conclusions⬇

Stakeholders are focused on the operational, legislative, and user interaction challenges of implementing a bike logistics system using e-bikes and hubs. Operatively, they emphasize the need for sufficient charging capacity, reliable infrastructure, and scalable hubs to ensure efficiency. Legislatively, they call for streamlined approval processes and coordinated municipal support to reduce delays and uncertainty. User interaction concerns include the necessity of a user-friendly interface, coordinated scheduling to avoid congestion, and strategies to enhance public visibility and acceptance. Additionally, stakeholders stress the importance of managing financial risks and ensuring the solution's scalability to foster broader adoption and long-term viability.

C - Prototype BIGM

Since the use case involves the establishment and operation of multimodal logistics hubs, which include e-cargo bikes for last-mile delivery, Munich also aims to test the use of semi-autonomous Rickshaws. The conducted workshop focused on last-mile delivery with e-cargo bikes. To collect data specific to the Rickshaw UC, the results from the mini-dialogues survey were utilized to identify the different stakeholders and visualize them in an additional BIGM to highlight the differences between the two (sub)-use cases.

In the following sections, two different prototypical BIGMs are presented:

1. BIGM-MU-UC02/1 Establishment and operation of a multimodal logistic hubs with last mile distribution in e-cargo-bikes
2. BIGM-MU-UC02/2 Establishment and operation of a multimodal logistic hubs with last mile distribution in Rickshaw

C1 – Prototype - BIGM-MU-UC02/1

This section outlines the governance and business models for the MU-UC02/1, focusing on a collaborative approach involving stakeholders like logistics companies, hub operators, and last-mile providers using e-cargo-bikes. The prototypical business model for last-mile zero-emissions delivery involves multiple actors collaborating to provide sustainable and efficient delivery services. Logistics companies use electric vans to deliver goods to hubs, whereas last-mile providers use e-cargo bikes for final delivery, reducing the carbon footprint.

The Key Stakeholders and Roles identified are:

- **Logistics Companies**: Deliver goods to the hubs using electric vans.
- **Logistics Hub Operators**: Manage the hubs and ensure efficient operations.
- **Last-mile Providers**: Use electric cargo bikes to deliver goods to customers.
- **Consumers**: Receive goods delivered in an environmentally friendly manner.
- **Retailers**: Offer a convenient and sustainable delivery option to their customers.
- **Public Administrators**: Promote sustainable practices through regulations and incentives.
- **City Authorities**: Finance the hubs and cycling infrastructure to reduce emissions and congestion.

- **Battery-exchange Service Companies**: Ensure a reliable power supply for the cargo bikes.
- **Real Estate Companies**: Provide suitable locations for the hubs.
- **Power Network Providers**: Supply electricity to charge the e-bikes, benefiting from increased demand.
- **Public**: Indirectly involved, ensuring their needs are considered during validation activities.

The Figure 25 provides a visual representation of the prototypical governance structure, illustrating the relationships and interactions between the different stakeholders.

Since a multiple stakeholders need to work together to provide this service, the Service-Dominant Business Model Radar was used to visualize the Business & Innovation Model. The Figure 26 illustrates the key components of the Prototypical Business and Innovation Model.

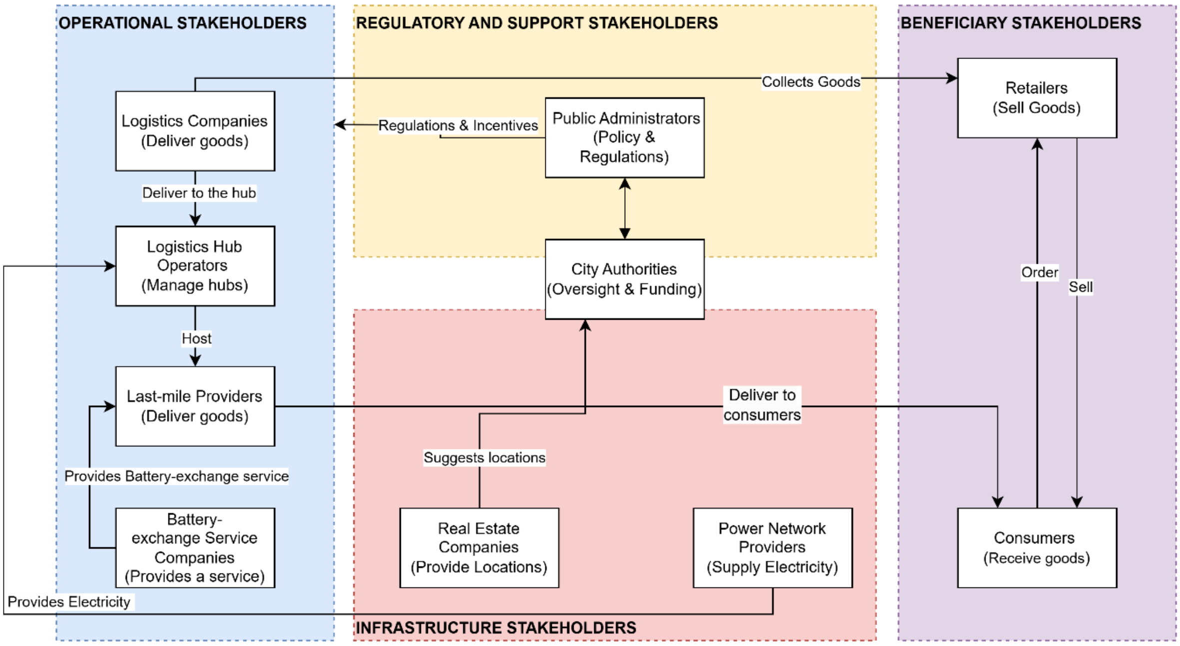

Figure 25: Prototypical Governance Model of MU-UC02/1

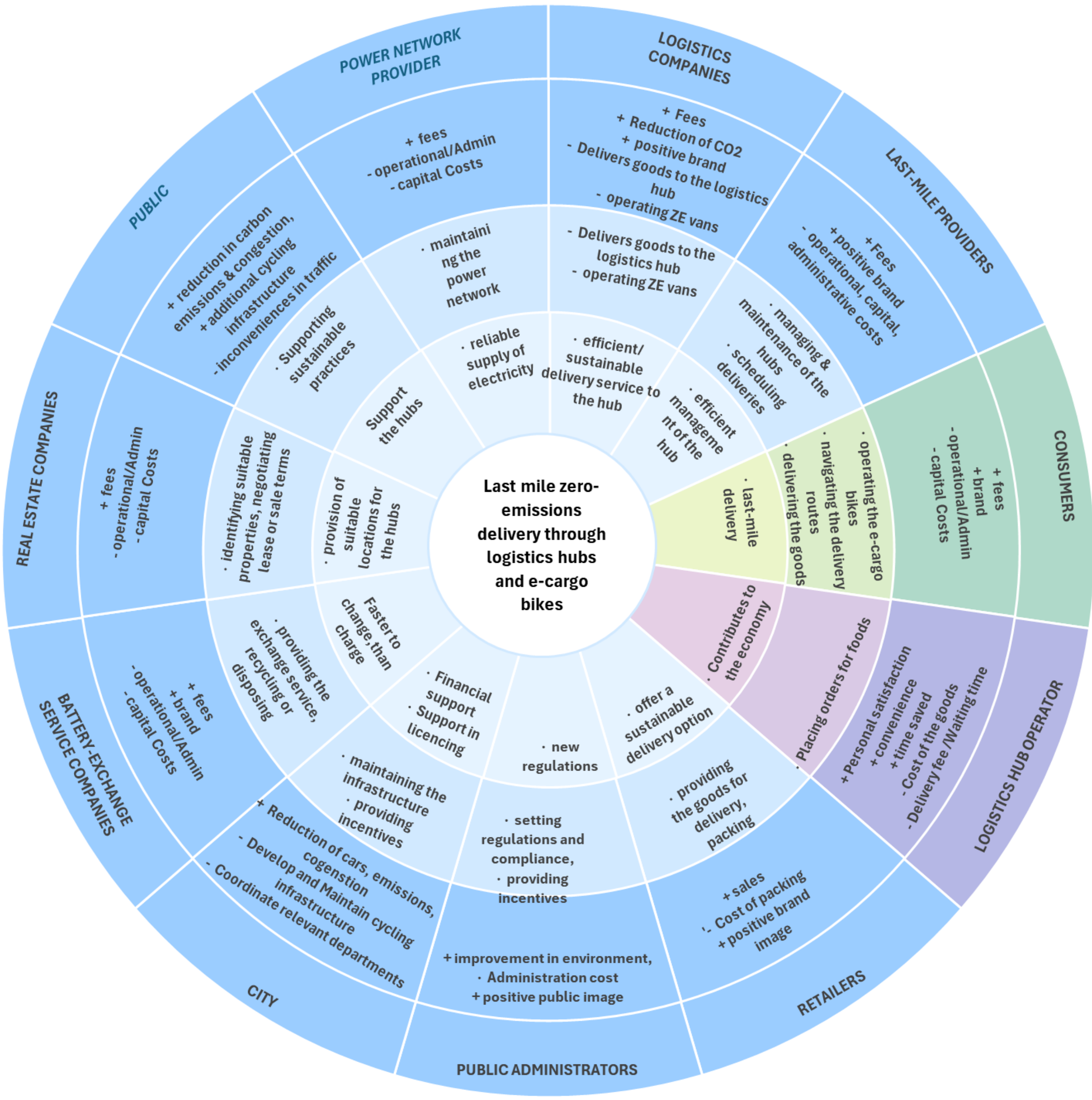

Figure 26: Prototypical Business and Innovation Model of MU-UC02/1

In the context of the SDBM/R, the focal organization is the entity that initiates and orchestrates the business model. In the case of MU-UC02/1, **the Logistics Hub Operator** is considered the **focal organization**

The other roles, as identified in the provided information, can be categorized as follows:

- **Core Partners**: Logistics Companies, Last-mile providers, Retailers, City, Power network provider
- **Customers**: Consumers
- **Enriching Partners**: Public Administrators, Real Estate Companies, Battery-exchange service Companies, Public.
- **Other Actors:** N/A

C1 – Prototype - BIGM-MU-UC02/2

The following chapter outline the prototypical governance and business models for the MU-UC02/2, focusing on a collaborative approach involving stakeholders like logistics companies, hub operators, and last-mile providers. A key distinction from MU-UC02/1 is the use of semi-autonomous electric rickshaws for deliveries and the involvement of technology providers.

The identified stakeholders are.

- **Logistics Companies**: Deliver goods to the hubs using electric vans.
- **Logistics Hub Operators**: Manage the hubs and ensure efficient operations.
- **Last-mile Providers**: These providers utilize semi-autonomous electric rickshaws to deliver goods from the hubs to customers.
- **Consumers**: Receive goods delivered in an environmentally friendly manner.
- **Retailers**: Offer a convenient and sustainable delivery option to their customers.
- **Public Administrators**: Promote sustainable practices through regulations and incentives.
- **City Authorities**: Finance the hubs and cycling infrastructure to reduce emissions and congestion.
- **Technology Providers:** They develop and maintain the technology behind the semi-autonomous rickshaws.
- **Real Estate Companies**: Provide suitable locations for the hubs.
- **Power Network Providers**: Supply electricity to charge the e-bikes, benefiting from increased demand.
- **Public**: Indirectly involved, ensuring their needs are considered during validation activities.

The primary differences between MU-UC02/2 and MU-UC02/1 lie in their key stakeholders and the technology employed for last-mile deliveries. In MU-UC02/2, Technology Providers replace Battery-Exchange Service Companies, taking on the responsibility for developing and maintaining the semi-autonomous rickshaw technology. Furthermore, Last-Mile Providers in MU-UC02/2 utilize these semi-autonomous electric rickshaws instead of e-cargo bikes for deliveries. It's worth noting that the prototypical governance model for MU-UC02/2 remains consistent with MU-UC02/1, adopting a Collaborative Governance Model with Multi-Stakeholder Partnerships as illustrated in Figure 25**Error! Reference source not found.**.

These variations are visually represented in Prototypical Business and Innovation model using the Service-Dominant Business Model Radar illustrated in Figure 27

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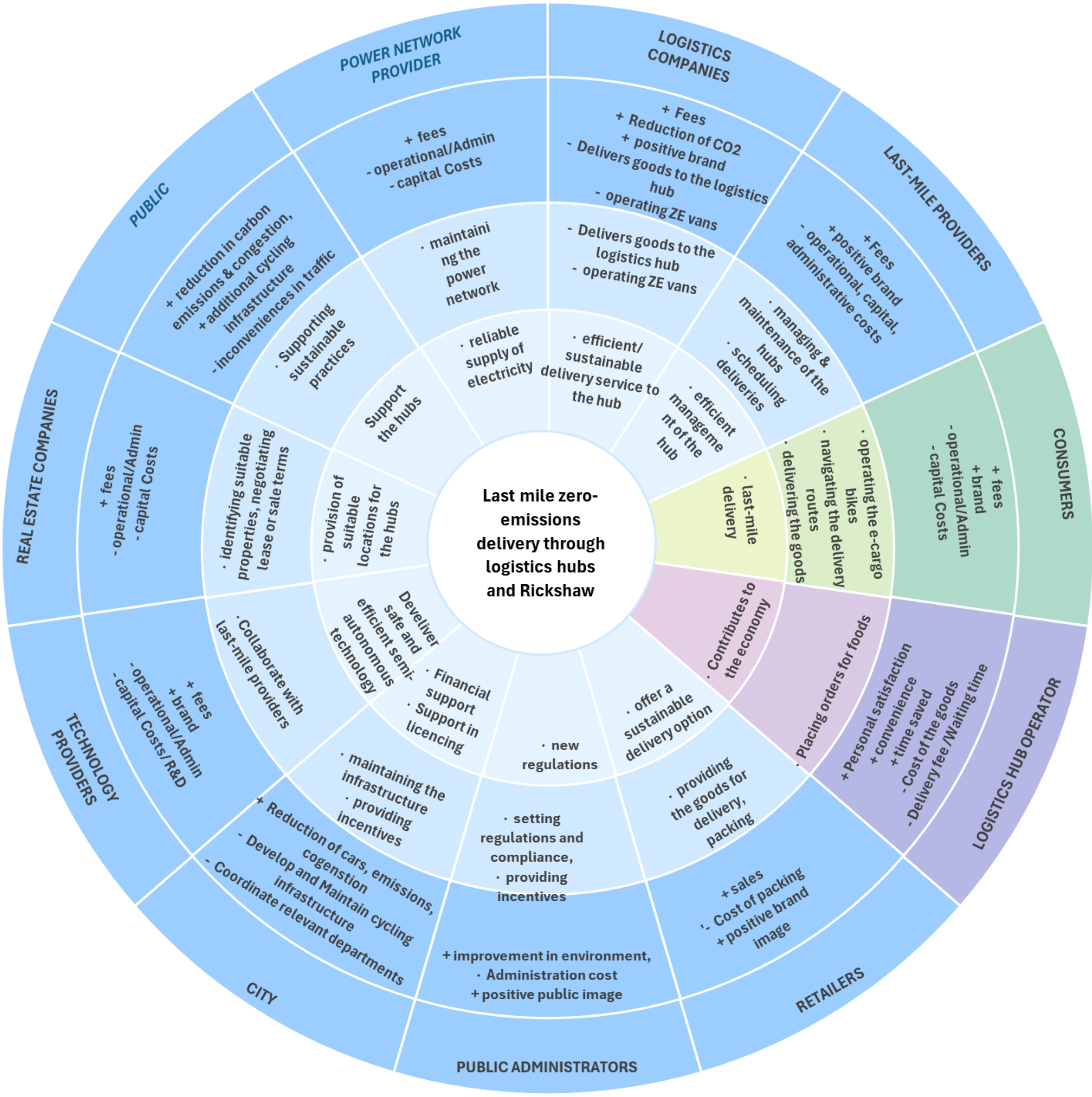

Figure 27: Prototypical Business and Innovation Model of MU-UC02/2

In the context of the SDBM/R, the focal organization is the entity that initiates and orchestrates the business model. In the case of MU-UC02/1, **the Logistics Hub Operator** is considered the **focal organization**

The other roles, as identified in the provided information, can be categorized as follows:

- **Core Partners**: Logistics Companies, Last-mile providers, Retailers, City, Power network provider
- **Customers**: Consumers
- **Enriching Partners**: Public Administrators, Real Estate Companies, Technology Providers, Public.
- **Other Actors:** N/A

4.4. Limassol Living Lab

As in the case of Munich, Limassol has organized four separate events that will be explained under the corresponding UC.

4.4.1. LI-UC01 - On-demand mini-buses services

A - Workshop(s) description

This UC was explored through in-depth, one-on-one interviews conducted in Greek with professional drivers (representing both public and private fleets) and parents' organizations. These interviews took place in Limassol on July 4th and July 22nd, 2024.

Each interview began with a project overview and a focus on the Limassol Living Lab. Interview locations varied based on participant convenience. In total, four professional drivers/private fleet owners and two focus groups of parents engaged. Participants encompassed professional drivers, mobility stakeholders, and a representative from Limassol's public transport authority. The professional drivers represented a range of sectors, hailing from EMEL, P. Panayides Coaches Ltd, and the private company “Marios Mixail.” In the case of P. Panayides Coaches Ltd, a company stakeholder also participated.

Also, interviews were conducted with parents' organizations from schools that will participate in this specific service. These organizations were linked to the Grammar School (Private) and Laniteio (Public).

B - Prototype and co-designed use Case

↓ ***Prototype Use Case – Mini-dialogue preliminary outcome*** ↓

LI-UC01 On-demand mini-buses services

Stakeholders expressed concerns about the service's ability to compete effectively with private car use, emphasizing that it must be highly efficient and attractive to persuade users to switch. They also highlighted concerns about the actual utilization of shared space by "cars-attached" users in Cyprus. There was a preference for integrating the service with existing platforms like Google Maps, rather than developing a separate app, to increase user adoption and attractiveness.

↓***Fine-tunning***↓

Co-designed use case

INTERACTION WITH THE USERS

🚌 Accessibility and Ease of Use: The new on-demand minibus service introduces a novel system requiring careful user guidance and training to ensure smooth adoption. Users expect a clean, intuitive app interface, real-time booking confirmations, and immediate responses to queries. Accessibility for individuals with disabilities is essential, as is ensuring data privacy and compliance with GDPR.

📱 User Experience Risks: The success of the service hinges on a seamless user experience. Challenges may arise from app complexity, technical issues, or initial unfamiliarity with the system. Providing comprehensive training, real-time support, and clear communication will be critical to overcoming these risks.

POLITICAL/LEGISLATIVE CONCERNS

📜 Legislative Support: There's a need for strong legislative backing, including subsidies for fares, infrastructure enhancements like dedicated lanes for minibuses, and alignment with national transportation and environmental goals. Incentives that promote sustainable transportation and attract users are crucial.

⚖️ Regulatory Compliance: Ensuring that the system adheres to existing laws and regulations, particularly those related to accessibility and data privacy, is vital. Stakeholders also highlighted the importance of integrating the service with other public transportation systems to enhance its effectiveness.

OPERATIONAL CONCERNS

🔧 Infrastructure and Technical Dependencies: Reliable internet connectivity and compatibility with existing infrastructure, such as bus stops and dedicated lanes, are necessary for the system's success. Technical issues, such as limited operating hours or geographic restrictions, could impact the service's appeal and usability.

🔄 System Maintenance and Support: Regular system maintenance and quick resolution of technical failures are crucial. Users expect timely communication about downtimes and updates, preferably during off-peak hours. Continuous training for operators and clear communication channels are also necessary to maintain service quality.

⬇*Conclusions*⬇

The workshop for LI-UC01 (On-Demand Mini-Buses) revealed significant concerns regarding the system's operational viability, legislative support, and user interaction. Stakeholders emphasized the need for a seamless, intuitive user experience, with strong legislative backing to ensure the service's attractiveness and alignment with national goals. Reliable infrastructure and regular system maintenance are essential for success.

C - Prototype BIGM

The prototypical governance model of LI-UC01 emphasizes collaboration and shared responsibility amongst diverse stakeholders, ranging from the public transport provider (EMEL) to the users (students and parents). The prototypical business model outlines key activities such as operating electric minibuses and an online platform, with the value proposition of providing a flexible, eco-friendly transport option. Revenue streams include fees and potential subsidies, aiming to provide a sustainable solution. This innovative approach seeks to enhance student transportation, benefiting all stakeholders and contributing to a greener city.

The identified stakeholders are:

- **Public Transport Provider (EMEL):**
  - Responsible for day-to-day operations, driver training.
- **Municipality of Limassol:**
  - Provides infrastructure support, permits, and licenses.
  - Promotes the service to the public.
- **Ministry of Transport:**
  - Offers regulatory oversight and ensures compliance with transportation laws.
  - Supports infrastructure development and may provide financial incentives.
- **Technology Provider (MaaSLab):**
  - Develops and maintains the online booking platform and driver's interface.

  - Provides training materials for using the platform and customer service
- **Users (Students and Parents):**
  - Utilize the service and provide valuable feedback for improvements.
  - Their satisfaction and needs are central to the initiative's success.

Figure 28**Error! Reference source not found.** outlines the collaborative governance structure for the on-demand mini-bus service, highlighting the shared responsibilities of stakeholders like EMEL, the Municipality, the Ministry, the technology provider, and the users themselves.

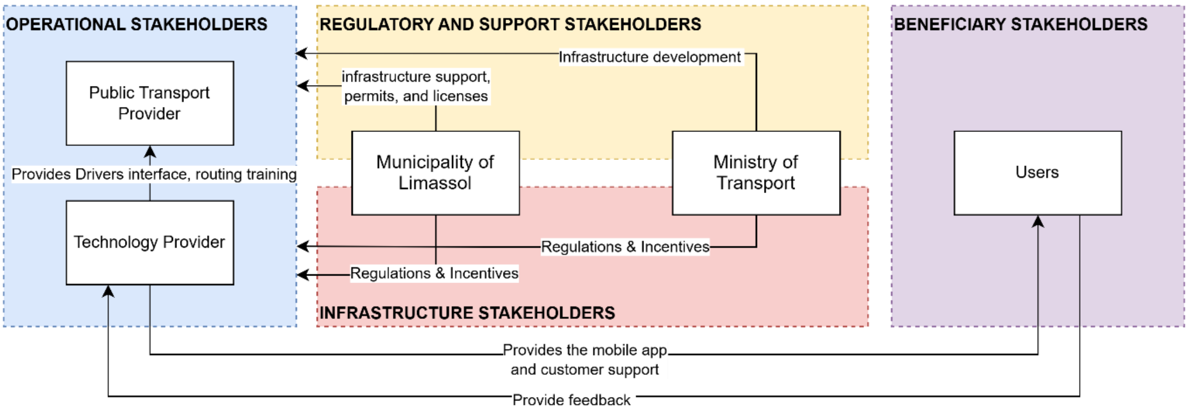

Figure 28: Prototypical Governance Model of LI-UC01

Since a single service provider was identified (**MaaSLab**), the Classic Business Model Canvas was used to visualize the Prototypical Business & Innovation Model which is visualised in the next figure.

Key Partners	**Key Activities**	**Value Propositions**	**Customer Relationships**	**Customer Segments**
-EMEL (Electric Minibuses Provider) -IT Experts (Platform Developers) -Municipality -Ministry of Transport	-Development and maintenance of the online booking platform -Operation of electric minibuses -Training for EMEL personnel -Marketing and promotion of the service -Continuous improvement based on user feedback	**Studentds:** -Flexible and convenient transportation for students **Parents**: -Easy-to-use Online booking system - Save them time (no need to use their cars to get their children to -Safe and reliable service for their kids **Schools:** -Support for various extracurricular activities	- User-friendly app interface -Real-time assistance and customer support -Online tutorials and training materials -Feedback system for continuous improvement -Priority access during peak hours -Reward programs for frequent users	-**Students** participating in extracurricular activities -**Parents** looking for safe and reliable transportation for their children -**Schools** and activity centers
	Key Resources -Electric minibuses -Online booking platform -Trained personnel -Financial support from Municipality and Ministry of Transport -Infrastructure support		**Channels** -Mobile app and website for bookings -Social media and online marketing -Partnerships with schools and extracurricular activity centers -Community outreach programs	

Cost Structure	**Revenue Streams**
-Development and maintenance of the booking platform -Operational costs of minibuses (maintenance, charging, etc.) -Personnel training and salaries -Marketing and promotional expenses -Infrastructure improvements	-Service fees from bookings -Potential subsidies or grants from government bodies -Advertising and sponsorship opportunities

Figure 29: Prototypical Business and Innovation Model of LI-UC01

4.4.2. LI-UC02 Shared e-bikes

A - Workshop(s) description

A physical workshop was held to design the Use Case for the 'Shared Bikes' initiative. This meeting was a one-on-one discussion between MaaSLab, the private company 'NextBike' (which will demonstrate this service), the Municipality of Limassol, and a representative from the city's Climate Contract. The discussion, conducted in Greek, took place on July 19, 2024, in the conference room of the Municipality of Limassol.

The meeting was attended by five participants from 'NextBike' and the Municipality of Limassol. Additionally, the attendees are also involved in another European project, LC3, in which Limassol participates. Therefore, the meeting included representatives from local authorities, mobility stakeholders, and related European projects focused on urban mobility and reducing greenhouse gas emissions.

B - Prototype and co-designed use Case

⬇ ***Prototype Use Case – Mini-dialogue preliminary outcome*** ⬇

LI-UC02 Shared e-bikes

Stakeholders expressed concerns about the complex and lengthy bureaucratic processes that could delay urban development, particularly in installing docking stations for rental bicycles. They emphasized the need for these stations at key city locations, like tourist spots, and in areas with gentle slopes. Additionally, the harmonization between existing cycling paths and docking stations is crucial, and parking areas should be close to shared bikes to ensure accessibility. Despite these concerns, stakeholders believe the service will improve cyclists' quality of life and reduce emissions.

⬇***Fine-tunning***⬇

Co-designed use case

INTERACTION WITH THE USERS

🚸 Infrastructure Challenges: Users emphasize the need for enhanced bicycle infrastructure to ensure safety and encourage adoption. The lack of proper cycling paths and docking stations is a significant barrier.

📱 User Experience: The mobile application for renting bikes needs to be simple, intuitive, and accessible to all users, including those with disabilities. Real-time feedback and updates are crucial for a positive user experience.

POLITICAL/LEGISLATIVE CONCERNS

🏛 Bureaucratic Hurdles: The complex and lengthy bureaucratic processes could delay the installation of necessary infrastructure, such as docking stations. Streamlining these processes is essential to avoid project delays and increased costs.

📉 Incentive Alignment: Stakeholders highlight the importance of aligning incentives, such as financial discounts or free parking, with local and national transportation policies to make the service more appealing.

OPERATIONAL CONCERNS
🔧 Technical Dependencies: The system's success relies heavily on reliable internet connectivity and 24/7 availability. Any technical issues, such as software glitches or limited service areas, could significantly impact user adoption and satisfaction. 🚴 Seamless Operation: The service must be operationally efficient, with frequent maintenance and updates to ensure optimal performance. Integration with other transport services and clear communication about service availability are crucial for daily operations.

↓Conclusions↓

The workshop highlighted significant concerns regarding the need for improved infrastructure, streamlined bureaucratic processes, and a user-friendly experience. Stakeholders emphasized the importance of aligning incentives with transportation policies and ensuring reliable, round-the-clock service to make the solution effective and attractive.

C - Prototype BIGM

The prototypical governance model of LI-UC02 emphasizes collaboration amongst stakeholders, prioritizing user needs and sustainability. Meanwhile, the prototypical business model focuses on key activities like app development and infrastructure, offering value through convenience and cost savings, with revenue generated from rental fees and partnerships. This initiative aims to enhance urban mobility and promote a more sustainable and liveable city.

The identified stakeholders are:

- **Government and Authorities**: Responsible for creating and improving e-bike infrastructure, offering incentives, and promoting the service through marketing and communication efforts.
- **Municipality**: Collaborates with the government to implement and maintain e-bike infrastructure, conducts workshops and educational programs for citizens.
- **Transportation Service Provider (NextBike*)**: Ensure efficient operation and maintenance of the e-bike service.
- **Technology Provider (NextBike*)**: Develop and maintain innovative solutions for e-bike rentals and management, including mobile applications and real-time tracking systems.
- **Users** (Commuters, Students, Tourists): Actively utilize the service, provide feedback, and contribute to its success through responsible usage.

*NextBike already offers services in Limassol and their app/platform is called "NextBike". They will incorporate the e-bikes in their service and continue offering the service via their existing app.

The figure bellow**Error! Reference source not found.** provides a visual representation of the p rototypical governance structure, illustrating the relationships and interactions between the different stakeholders.

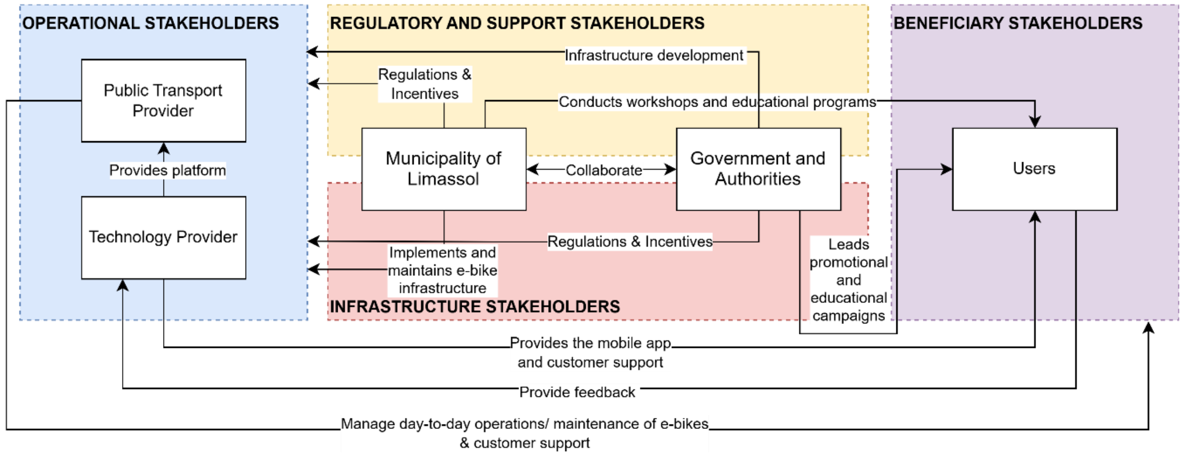

Figure 30: Prototypical Governance Model of LI-UC02

Since a single service provider was identified (**NextBike**), the Classic Business Model Canvas was used to visualize the Business & Innovation Model. The next figure provides a visual representation of the key components of the Prototypical Business and Innovation Model, as discussed during the workshop.

Key Partners	Key Activities / Key Resources	Value Propositions	Customer Relationships / Channels	Customer Segments
-Government and Authorities -Municipality -Technology Providers -Bike Manufacturers -Local Businesses	**Key Activities** -Infrastructure Development -Technology Development -Fleet Management -Marketing and Promotion -User Education **Key Resources** -E-Bike Fleet -Docking Stations -Mobile App -Technical Support -Marketing and Communication Channels	**Users (All)**: -Convenience: Easy access to e-bikes for short trips and commutes. -Cost Savings: Affordable alternative to owning a car or using taxis. -Health Benefits: Promotes physical activity and a healthier lifestyle. -Environmental Impact: Contributes to reducing emissions and traffic congestion.	**Customer Relationships** - User-friendly app interface -Real-time assistance and customer support -Online tutorials and training materials -Feedback system for continuous improvement -Priority access during peak hours -Reward programs for frequent users **Channels** -Mobile App -Website -Social Media -Physical Locations -Partnerships	-Commuters -Students -Tourists

Cost Structure	Revenue Streams
-E-Bike Purchase and Maintenance -Infrastructure Development -Technology Development -Marketing and Promotion -Personnel -Experts for consulting	-Rental Fees -Subscription Fees -Government Subsidies

Figure 31: Prototypical Business and Innovation Model of LI-UC02

4.4.3. LI-UC03 Multimodal passenger hub

A - Workshop(s) description

To design the use case for the multimodal passenger hub, two hybrid metaDesign workshops were held in July. Six participants attended, representing various organizations: the Municipality of Limassol, the private company 'NextBike,' the public transport operator 'EMEL,' the Ministry of Transport, Communications and Works, and the private organization ΓΣΟ/GSO, which owns the land where the multimodal passenger hub will be constructed.

All participants play an active role in demonstrating this service, and their contributions were significant for the successful implementation of the use case.

B - Prototype and co-designed use Case

⬇ ***Prototype Use Case – Mini-dialogue preliminary outcome*** ⬇

LI-UC03 Multimodal passenger hub

Stakeholders for LI-UC03 expressed concerns about the complex and lengthy bureaucratic processes that could delay the construction of a Mobility Hub in Limassol. They also noted that public transport is underused due to the current inadequate system. The need for agreements between the ministry and the ΓΣΟ (the responsible organization proposed as the location for the Mobility Hub) is critical for the project's success. Despite these concerns, stakeholders are optimistic about the Mobility Hub's potential to reduce noise, emissions, and traffic congestion.

⬇***Fine-tunning***⬇

Co-designed use case

INTERACTION WITH THE USERS

User Engagement and Experience: The Mobility Hub should provide a user-friendly experience, especially for those unfamiliar with digital tools or multimodal transit. Simplified applications, real-time assistance, and comprehensive accessibility features are crucial for ensuring inclusivity and ease of use. The hub should also serve as a community space with amenities like greenery, cafes, and social areas, making it more than just a transit point.

Accessibility and Real-Time Information: Users expect seamless integration of transportation modes, supported by real-time information and updates through apps. This will improve convenience and encourage the adoption of the hub, especially if it aligns with daily routines and reduces waiting times.

POLITICAL/LEGISLATIVE CONCERNS

Bureaucratic and Legislative Challenges: The main legislative concern is the ongoing delay in agreements between the ministry and the GSO, which owns the land for the Mobility Hub. Streamlining these agreements is crucial for timely project completion. Additionally, stakeholders emphasize the need for incentives, such as reduced fares for multi-modal use, to align with national environmental and transportation policies and make the hub more attractive.

Government Support and Collaboration: Effective collaboration among local government, transportation operators, and other stakeholders is essential. The government's role in providing financial incentives, support for infrastructure, and promotional efforts will be critical in making the Mobility Hub a success.

OPERATIONAL CONCERNS
🔧 Technical and Operational Dependencies: Reliable internet connectivity, accurate GPS, and secure online payments are vital for the Mobility Hub's operation. Users expect 24/7 availability of services, and any technical failures must be addressed immediately to maintain trust and usability. 🚦 Integration with Existing Systems: The hub must integrate seamlessly with existing public transportation and other mobility services, like bike-sharing and car parks. Regular maintenance, updates, and operational efficiency during peak and off-peak hours are essential to meet user expectations and ensure the hub's functionality.

⬇Conclusions⬇

The workshop identified key challenges, including complex bureaucratic processes and the need for strong government collaboration. Stakeholders emphasized the importance of a user-friendly Mobility Hub that integrates various transportation modes with real-time information and community amenities. The prototype evolved to address these concerns by streamlining legislative processes, enhancing user experience, and ensuring operational reliability with 24/7 service availability. The co-designed use case is now well-equipped to meet Limassol's mobility needs.

C - Prototype BIGM

During the workshop the factsheet was used to guide the participants to identify the main stakeholders. The Prototypical governance model of LI-UC03 emphasizes collaboration and shared responsibility amongst diverse stakeholders, ranging from the government to the users. The business model focuses on key activities like integrating various transport modes and ensuring user satisfaction, offering value through convenience and sustainability. Revenue streams include user fees and potential government incentives, aiming to provide a financially viable solution. This initiative aims to enhance urban mobility and promote a more sustainable city.

The identified stakeholders are:

- **Government and authorities**: Responsible for offering financial incentives, providing financial support to the organization that owns the land, and offering cheaper tickets for public transport.
- **Municipality of Limassol**: Arrange physical or online workshops to inform citizens. Secure land for the construction of the mobility hub.
- **Landowner (GSO or ΓΣΟ)**: The landowner of the identified location where the mobility hub will be constructed which will also act as the operator.
- **Hub Operator (GSO or ΓΣΟ)**: The operator of the hub.
- **Marketing company**: Promote the service to increase its popularity
- **Transportation Operators**: Integrate their services within the hub, offering seamless connectivity and multi-modal options to users
- **Technology providers**: innovate, maintain, ensure data security, unified ticketing system
- **Educational Institutes**: research, develop, share knowledge.
- **Users (Commuters, Students, Tourists, Older people, Disabled people):** Actively utilize the service, provide feedback, and contribute to its success through responsible usage.

The prototypical governance model emphasizes cooperation and shared responsibility among stakeholders. This approach fosters a sense of ownership and encourages active participation from all involved parties. The figure below provides a visual representation of the prototypical governance structure, illustrating the relationships and interactions between the different stakeholders.

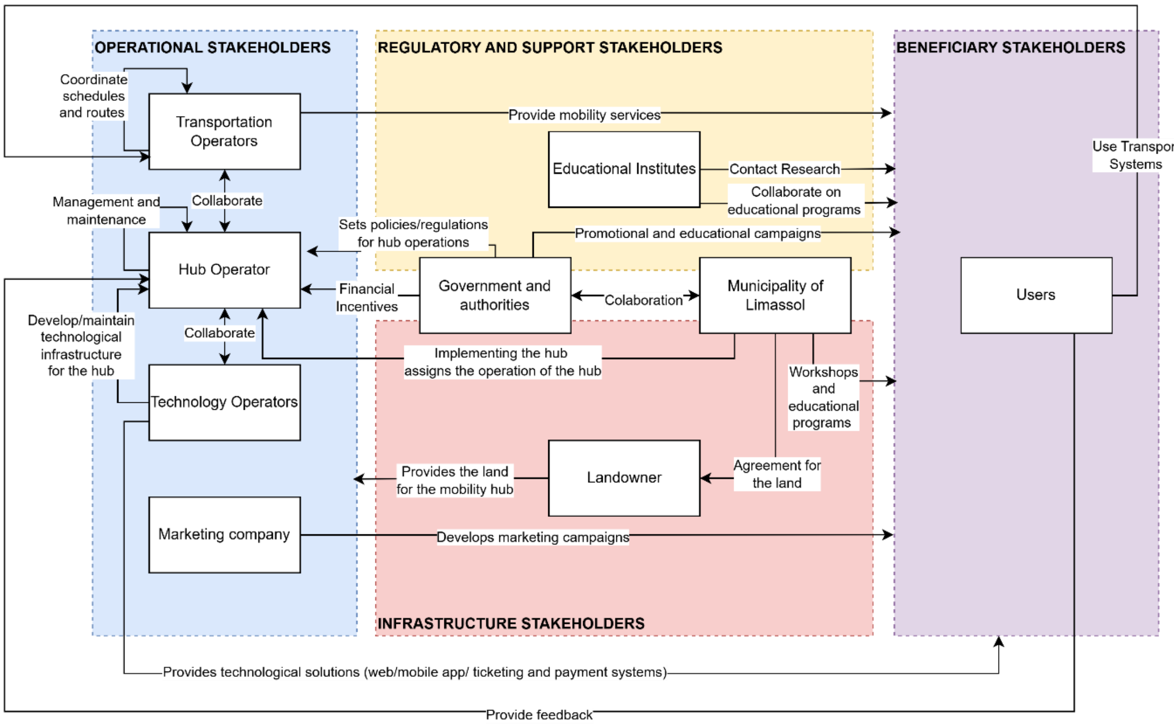

Figure 32: Prototypical Governance Model of LI-UC03

The hub's success relies on collaboration among several key actors, therefore, the Multimodal Passenger Hub in Limassol prototypical business and innovation model, guided by the Service-Dominant Business Model Radar (SDBM/R), is visualized in the next figure.

Figure 33: Prototypical Business and Innovation Model LI-UC03

In the context of the SDBM/R, the focal organization is the entity that initiates and orchestrates the business model. In the case of LI-UC03, **the Hub Operator** is considered the **focal organization**

The other roles, as identified in the provided information, can be categorized as follows:

- **Core Partners**: Transportation Operators, Landowner, Municipality of Limassol
- **Customers**: Users
- **Enriching Partners**: Government and authorities, Technology Providers, Educational Institutes.
- **Other Actors:** N/A

4.4.4. LI-UC04 Transport and Energy Integration and Management

A - Workshop(s) description

The metaDesign workshop for the LI-UC04 was done through a hybrid discussion involving MaaSLab, the Municipality of Limassol, and the Electricity Authority of Cyprus. A total of seven participants attended. Representatives from the Municipality and the Electricity Authority of Cyprus also participated as citizens and future users of the service, given they are residents of Limassol. Their perspectives were influenced by their dual roles as both officials and citizens.

B - Prototype and co-designed use Case

⬇ ***Prototype Use Case – Mini-dialogue preliminary outcome*** ⬇

LI-UC04 Transport and Energy Integration and Management
Stakeholders emphasized the need to make public transport in Limassol more attractive, noting that integrating digital systems could help manage the "triangle of grid, fleet, and demand." However, concerns were raised about potential gaps due to the current lack of digital infrastructure. Cooperation between different organizations and access to necessary data from the grid were identified as crucial for success. Overall, participants are optimistic about the innovative approach to upgrading public transport and promoting e-mobility.

⬇***Fine-tunning***⬇

Co-designed use case

INTERACTION WITH THE USERS
📱 User Experience: Users may find the platform complex due to the need for real-time data and system integration. Simplified interfaces, real-time assistance, and accessible features for those with disabilities are crucial for ensuring a positive user experience. Training and ongoing support will help users navigate the platform effectively.

POLITICAL/LEGISLATIVE CONCERNS
📊 Data and Incentives: Legislative support is vital, especially for accessing necessary grid data and implementing financial incentives like reduced EV charging costs. These incentives should align with national environmental and transportation policies to encourage widespread adoption of the platform. 🤝 Collaboration: Effective cooperation between various organizations, including public transport operators, the electricity authority, and government agencies, is essential to manage the grid-fleet-demand triangle and ensure the platform's success.

OPERATIONAL CONCERNS
🔧 Technical Reliability: The platform relies heavily on real-time data collection and processing. Any technical failures, such as software glitches or limited operating hours, could disrupt service. Continuous monitoring, frequent updates, and immediate response to technical issues are critical for maintaining operational reliability. 🌐 Integration with Infrastructure: The platform must integrate seamlessly with existing transport and energy infrastructure, requiring robust technical solutions and regular updates. The system's scalability and responsiveness during peak hours are key operational challenges.

⬇***Conclusions***⬇

The workshop highlighted the importance of making the public transport system more attractive by integrating digital systems to manage energy and transport demand. Stakeholders emphasized the need for simplified user interfaces, strong legislative support, and effective collaboration among various organizations. Addressing technical challenges and ensuring reliable data access are crucial for the platform's success. The co-designed use case now incorporates these insights, focusing on user experience, operational reliability, and strategic cooperation.

C - Prototype BIGM

The prototypical governance model of LI-UC04 emphasizes collaboration and data sharing amongst diverse stakeholders, ranging from the electricity authority to EV owners. The prototypical business model focuses on key activities like data analysis and platform maintenance, offering value through cost savings and environmental benefits. Revenue is generated through charging fees and potential subsidies. This initiative aims to enhance energy efficiency and promote a more sustainable transportation sector.

The identified stakeholders are:

- **Electricity Authority**: Manages the power grid, ensures stable energy supply, and implements policies for renewable energy integration
- **EV Owners**: Utilize the platform to optimize charging schedules and participate in demand response programs
- **Public Transport Operators**: Integrate their fleet operations with the platform to optimize energy usage and reduce costs & utilize the platform to optimize charging schedules
- **Technology Providers**: Develop and maintain the platform and other technological solutions, ensuring data security and real-time information
- **Local government/ Regulators**: Oversee the implementation and ensure compliance with relevant policies and regulations

The governance structure emphasizes collaboration and data sharing among stakeholders. The model prioritizes efficiency, sustainability, and user-centricity and it is visualized in the next figure.

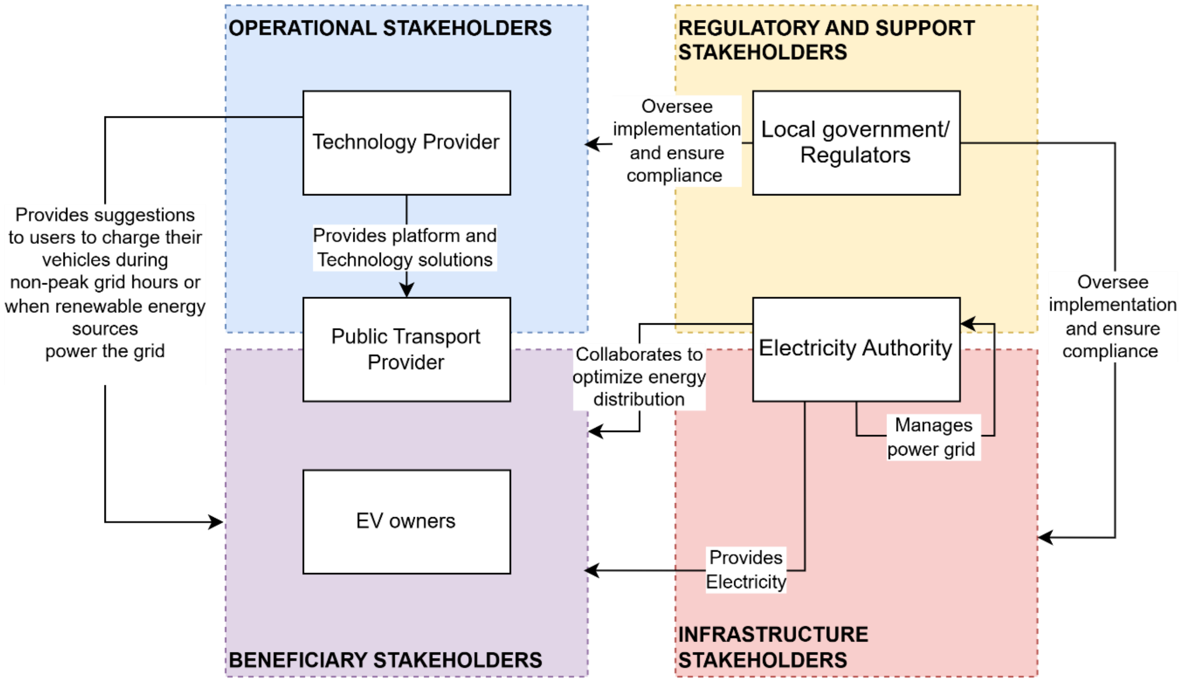

Figure 34: Prototypical Governance Model of LI-UC04

The results from the factsheet indicate that the "Transport and Energy Integration and Management" project has multiple stakeholders but a single service provider. Therefore, the Classic Business Model Canvas was decided to be the most appropriate one to describe the Prototypical Business and Innovation Model of the UC Trasport and Energy Integration and Management in Limassol (see the following figure).

<table>
<tr>
<td rowspan="2">Key Partners
-Electricity Authority
-Public Transport Operator.
-Technology Providers
-EV Charging Infrastructure Providers
-Research Institutions and Universities: Collaborate on data analysis and develop advanced algorithms for optimization.</td>
<td>Key Activities
-Data Collection and Analysis
-Platform Development and Maintenance
-Algorithm Development
-Stakeholder Engagement
-User Support and Education</td>
<td rowspan="2">Value Propositions
Users (EV Owners & PT Operators)
- Cost Savings / Improved route planning
- Reduction of Environmental Impact
- Incentives and Rewards: Access to demand response programs
Grid Operators (Electricity Authority)
- Grid Stability / Optimize energy distribution and avoid peak load stress.
- Low-carbon energy system.
Local Government
- Reduced Traffic Congestion/ Improved Air Quality:
- Economic Development: Foster innovation and attract investments in sustainable technologies.</td>
<td>Customer Relationships
- User-Friendly Platform
- Personalized Recommendations to users
- Support: Online tutorials, FAQs, and live chat assistance
- Regular updates on platform developments, policy changes, and incentives.
- Community Building</td>
<td rowspan="2">Customer Segments
- EV Owners: Individuals who own electric vehicles and want to optimize charging and reduce costs.
- Public Transport Operators: Companies operating bus fleets or other public transport services seeking to improve energy efficiency.
- Grid Operators (Electricity Authority): Entities responsible for managing the power grid and ensuring energy supply.
- Local Government: Authorities interested in promoting sustainable transportation and energy policies.</td>
</tr>
<tr>
<td>Key Resources
- Technology Platform
- Data (energy consumption, vehicle data, and grid information)
- Algorithms and Analytics
- Skilled personnel in data science, energy management, and transportation.
- Partnerships: Strong relationships with key stakeholders.</td>
<td>Channels
- Online Platform & Mobile App
- APIs: Application Programming Interfaces for integration with other systems and services.
- Direct Communication: Workshops, webinars, and other communication channels for user engagement and education.</td>
</tr>
<tr>
<td colspan="3">Cost Structure
- Platform Development and Maintenance: Costs for building, hosting, and updating the platform.
- Hardware and Infrastructure: Expenses for sensors for data acquisition, servers, data storage, and other necessary equipment.
- Data Acquisition and Management: Expenses related to collecting, storing, and processing large amounts of data.
- Personnel / Marketing and Communication</td>
<td colspan="2">Revenue Streams
- Charging Fees: Charging users (EV owners, fleet operators)
- Government Subsidies or Grants: Potential financial support for developing and implementing the platform.</td>
</tr>
</table>

Figure 35: Prototypical Business and Innovation Model of LI-UC04

4.5. Tampere Living Lab

A common workshop for both UCs was held on August 8, 2024, at Tampere University Hervanta Campus from 9:00 AM to 1:00 PM. The event was conducted in Finnish and catered to attendees with coffee before the start and a lunch break from 11:00 AM to 12:00 PM, both provided by the organizers. Invitations were extended through various methods: emails were sent to key stakeholders, including personnel from the City of Tampere, the Tampere Public Transport Office, members of the Tampere City Transport Committee, and the ITS Factory management team, which includes about 25 stakeholders in the region. Additionally, citizens were invited through posters in Remoted-operated buses, a post in the local newspaper *Lempäälän-Vesilahden Sanomat*, and WhatsApp messages circulated within a residential group in the Lintuhytti area. Further promotion was carried out via a LinkedIn post by Remoted and a speech at the Mobility event of Tampere Metaverse 2024.

Figure 36. Tampere's LL2 and LL3 workshops

4.5.1. TA-UC01 - Autonomous e-shuttles with advanced remote control centre and inductive changing

A - Workshop(s) description

The workshop held on August the 8th, explained above followed a structured agenda, starting with coffee at 8:45 AM, followed by introductions, use case presentations, and workshop sessions divided into groups. One of the groups was devoted to the Autonomous e-shuttles. Despite a limited number of citizens attending, the organizers were satisfied with the feedback received, as most stakeholders were also representative of end users.

B - Prototype and co-designed use Case

⬇ Prototype Use Case – Mini-dialogue preliminary outcome ⬇

TA-UC01 Autonomous e-shuttles with advanced remote-control centre and inductive changing
Stakeholders raised concerns about the effectiveness and safety of autonomous vehicle (AV) operations, particularly regarding remote control management and data security. They highlighted issues with vehicle speed relative to traffic, social interactions on board, and the complexity of coordinating multiple remote centres. Additionally, concerns about technological uncertainties, infrastructure needs, and the potential impact of seasonal changes on service performance were noted. Ensuring reliable, secure operations and addressing safety perceptions are critical for success.

⬇Fine-tunning⬇

Co-designed use case
INTERACTION WITH THE USERS

🧓 Accessibility Challenges: Older passengers and those with special needs may find the system challenging due to new technology and lack of driver assistance.

📲 User Interface Concerns: Difficulty boarding, validating travel cards, and understanding the system without driver support could hinder user experience.

💬 Communication Needs: Passengers might face issues interacting with the remote operator, especially in emergencies or when needing assistance.

POLITICAL/LEGISLATIVE CONCERNS

🔒 Data Security: Concerns about stable and secure data connections between the shuttle and remote operation centres are paramount.

⚖️ Legislative Alignment: There is a need for clear regulations surrounding the operation and management of autonomous shuttles to ensure public safety and service reliability.

OPERATIONAL CONCERNS

⚙️ Remote Operations: Effective management of multiple vehicles by a remote operator is crucial. Concerns include data connection stability, emergency handling, and vehicle speed compared to traffic.

🔋 Autonomous Charging: Ensuring reliable and efficient charging processes is essential. There are worries about what happens if the vehicle runs out of power mid-trip or if charging delays affect service timing.

⬇*Conclusions*⬇

The workshop highlighted key concerns around the operational reliability, user interaction, and legislative framework necessary for the successful implementation of autonomous e-shuttles. Stakeholders emphasized the importance of ensuring stable and secure remote operations, particularly in managing multiple vehicles and handling emergencies. Accessibility and ease of use for passengers, especially those with special needs, emerged as critical factors, necessitating a user-friendly interface and clear communication channels. The need for reliable autonomous charging and a robust legislative framework to support these new technologies was also underscored.

C - Prototype BIGM

The prototypical governance model of TA-UC01 emphasizes collaboration amongst diverse stakeholders, ranging from the operator to the end-users. The prototypical business model focuses on key activities like operating autonomous e-shuttles and ensuring seamless integration with the public transport network, offering value through safe, reliable, and efficient transport. Revenue streams could include fares and potential subsidies, aiming to provide a financially sustainable solution. This initiative aims to enhance urban mobility and promote a more technologically advanced and user-friendly public transport system.

The identified stakeholders are:

- The **End User/Passengers** is a key stakeholder, and their needs and concerns (safety, accessibility, ease of use) should be central to decision-making.

- The **Operator** will be responsible for day-to-day operations, requiring clear operational guidelines and performance metrics.
- **Consultants** likely play an advisory role, providing expertise on public transport planning and user experience.
- **Public transport authority (Nysse)**, oversee integration with the existing network and ticketing systems. Providing data related to their service and organizing marketing campaigns and advertising for the PT services.
- **Standardization bodies** will ensure compliance with technical and safety standards.
- **Technology providers** create the technology of the autonomous e-shuttles, advanced remote control centre and inductive changing
- **Finnish Transport and Communications Agency Traficom**: Provide regulatory framework for autonomous vehicles.
- **City of Tampere**: Support by granting necessary permits, assisting with infrastructure modifications, and potentially providing financial backing or subsidies.

Following figure provides a visual representation of the prototypical governance structure, illustrating the relationships and interactions between the different stakeholders.

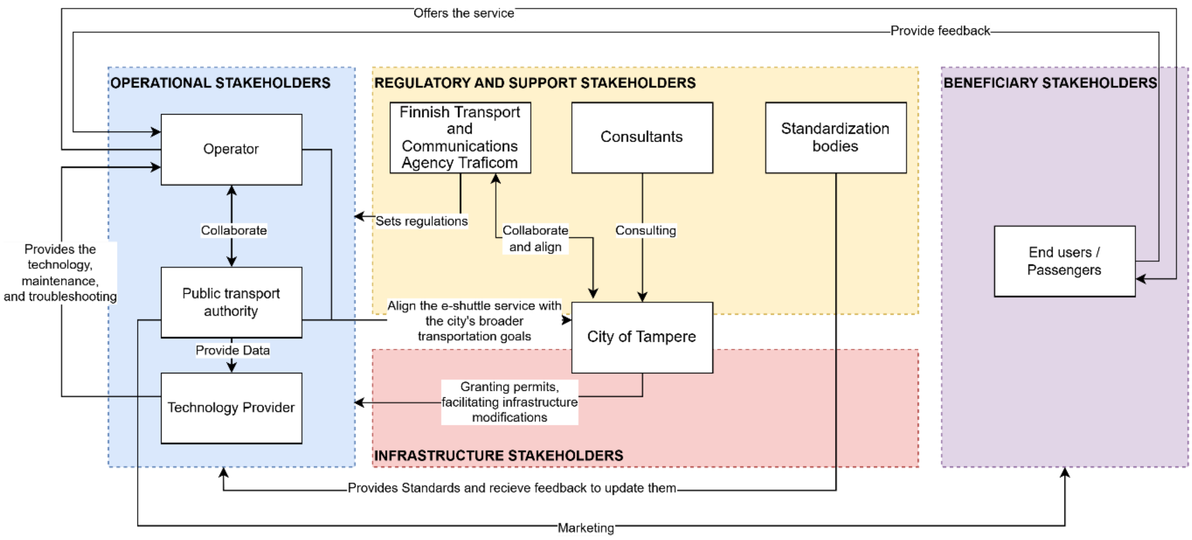

Figure 37: Prototypical Governance structure of TA-UC01

The results from the factsheet indicate that the “Autonomous e-shuttles with advanced remote-control centre and inductive changing” UC has only one service provider. Therefore, it was decided that the Classic Business Model Canvas was the most appropriate one to describe the Prototypical Business and Innovation Model (figure below).

<table>
<tr>
<td rowspan="2">Key Partners
-Technology providers (autonomous vehicle manufacturers, charging infrastructure providers, remote operation software developers)
-Public transport authorities (Nysse)
-Consultants and experts in urban planning and transportation
-Standardization bodies
- Finnish Transport and Communications Agency Traficom</td>
<td>Key Activities
- Development/operation of autonomous e-shuttles
- Management of the Remote-Control Centre
- Integration of traffic and infrastructure data
- Deployment/maintenance of inductive charging infrastructure
- Feedback analysis / Marketing
- Regulatory compliance</td>
<td rowspan="2">Value Propositions
End users:
- Enhanced accessibility and convenience for all users, including those with special needs
- Improved safety and reliability of public transport
- Potential for 24/7 operation and shorter headways
- Integration with existing public transport networks</td>
<td>Customer Relationships
- User-friendly interfaces and clear communication
- Real-time information and updates through mobile apps or displays
- Responsive customer support
- Feedback collection and continuous improvement</td>
<td rowspan="2">Customer Segments
End users:
- Commuters daily travelers
- Tourists and visitors
- People with special needs, mobility limitations & Elderly individuals
- Students and young people</td>
</tr>
<tr>
<td>Key Resources
- Autonomous e-shuttle fleet
- Remote-Control Centre infrastructure and technology
- Inductive charging stations
- Traffic and infrastructure data integration systems
– Partnerships/collaborations</td>
<td>Channels
- Physical stops and stations
- Mobile applications for booking and information
- Online platforms for ticketing and customer support
- Integration with existing public transport ticketing systems
- Public awareness campaigns and marketing efforts</td>
</tr>
<tr>
<td colspan="2">Cost Structure
- Vehicle acquisition and maintenance
- Infrastructure development / maintenance
- Personnel costs
- Technology development and licensing fees
- Marketing and promotion expenses
- Energy costs for charging
- Insurance and regulatory compliance costs</td>
<td colspan="3">Revenue Streams
- Fare collection from passengers
- Government subsidies or grants</td>
</tr>
</table>

Figure 38: Prototypical Business and Innovation Model of TA-UC01

4.5.2. TA-UC02 - Tram-feeder service with advanced remote-control centre and inductive changing

A - Workshop(s) description

Alike the previous Use Case described above, the outcomes of this Use Case were gathered during the workshop held on August the 8th.

B - Prototype and co-designed use Case

⬇ Prototype Use Case – Mini-dialogue preliminary outcome ⬇

TA-UC02 Tram-feeder service with advanced remote-control centre and inductive changing
Stakeholders for TA-UC02 express concerns about the operational reliability of automated feeder services, particularly regarding the future of battery technology, the frequency and viability of charging, and substantial investments required for automated systems. They also highlight doubts about vehicle performance, especially in varying weather conditions, and the need for effective interoperability between vehicles. Ensuring smooth transitions between feeder services and main tram lines is crucial for user satisfaction and system efficiency.

⬇Fine-tunning⬇

Co-designed use case
INTERACTION WITH THE USERS
🚶 Seamless Integration: Ensuring a smooth connection between trams and shuttles, particularly regarding headways and parking, is crucial for user satisfaction.

🚨 System Reliability: Passengers are concerned about missing connections due to potential system delays, especially during on-call services.

POLITICAL/LEGISLATIVE CONCERNS
🏛 Infrastructure and Regulation: Stakeholders emphasize the importance of adapting parking regulations and infrastructure to support seamless tram and shuttle integration.

OPERATIONAL CONCERNS
🔄 Consistent Service: The operation of the entire travel chain, including parking and shuttle-to-tram connections, must be reliable, especially in varying weather conditions. 🚧 Infrastructure Challenges: Upgrades may be needed to ensure the system operates smoothly, particularly during detours or unexpected road maintenance.

⬇***Conclusions***⬇

The workshop brought to light significant concerns regarding the operational feasibility and reliability of the automated tram feeder services. Stakeholders emphasized the critical need for dependable battery technology and charging systems, highlighting uncertainties around the frequency and viability of charging, particularly overnight versus on-route options. There were also concerns about the substantial investments required for these systems and whether the benefits justify the costs. Additionally, the performance of the vehicles, especially under varying weather conditions, and the importance of ensuring smooth transitions between feeder services and main tram lines were underscored as essential for user satisfaction.

C - Prototype BIGM

The prototypical governance model of TA-UC02 emphasizes collaboration amongst diverse stakeholders, ranging from the operator to the end-users. The prototypical business model focuses on key activities like operating the tram-feeder service and ensuring seamless integration with the tram line, offering value through improved accessibility and efficiency. Revenue streams could include fares, partnerships, and potential subsidies, aiming to provide a financially sustainable solution. This initiative aims to enhance urban mobility and promote a more integrated and user-friendly public transport system.

The identified stakeholders are:

- **The End User/Passengers group** is a key stakeholder, and their needs and concerns (safety, accessibility, ease of use) should be central to decision-making.
- **The Operator** will be responsible for day-to-day operations, requiring clear operational guidelines and performance metrics.
- **Consultants** likely play an advisory role, providing expertise on public transport planning and user experience.
- **Public transport authority** (Nysse), oversee integration with the existing network and ticketing systems. Providing data related to their service and organizing marketing campaigns and advertising for the PT services. Oversees the both buses and trams.
- **Standardization bodies** will ensure compliance with technical and safety standards.

- **Technology providers** create the technology of the autonomous e-shuttles, advanced remote control centre and inductive changing
- **Finnish Transport and Communications Agency Traficom**: Provide regulatory framework for autonomous vehicles.
- **City of Tampere**: Support by granting necessary permits, assisting with infrastructure modifications, and potentially providing financial backing or subsidies.
- **Tampere Tramway Ltd**: Operating the tram

The following figure provides a visual representation of the prototypical governance structure, illustrating the relationships and interactions between the different stakeholders.

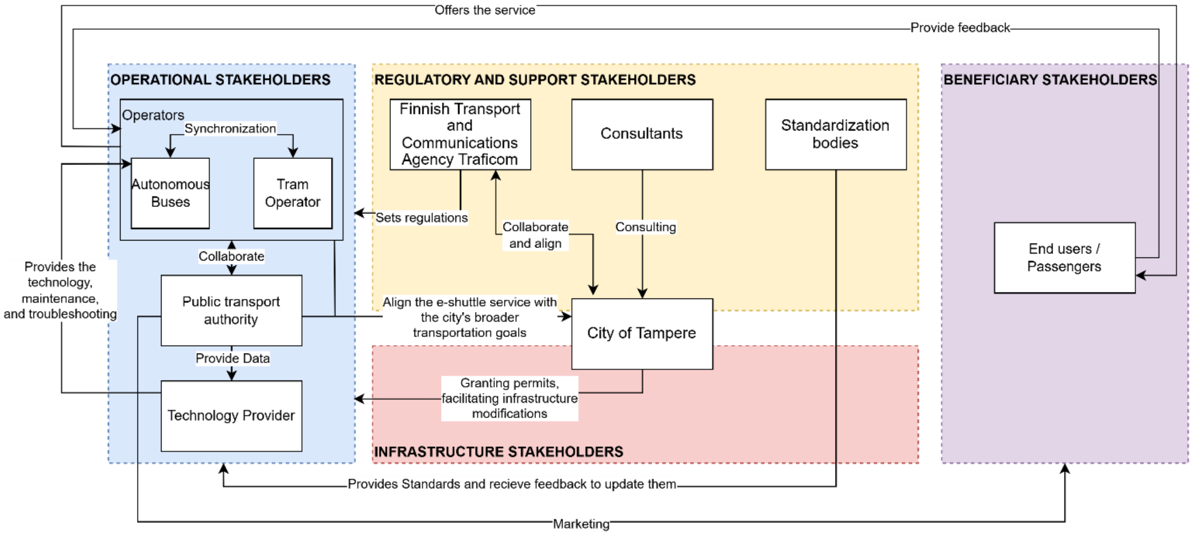

Figure 39: Prototypical Governance structure of TA-UC02

The results from the factsheet indicate that the "Tram-feeder service with advanced remote-control centre and inductive changing" UC has only one service provider (the autonomous buses operator). Therefore, it was decided that the Classic Business Model Canvas was the most appropriate one to describe the Prototypical Business and Innovation Model (figure below).

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
-**Technology providers** (autonomous vehicle manufacturers, charging infrastructure providers, remote operation software developers) -**Public transport authorities** (Nysse) -**Consultants** and experts in urban planning and transportation -**Standardization bodies** **- Parking service providers** **- Finnish Transport and Communications Agency Traficom** **- Tramway ltd**	- Development/operation of autonomous e-shuttles - Management of the Remote-Control Centre - Integration of traffic and infrastructure data - Deployment/maintenance of inductive charging infrastructure - Feedback analysis / Marketing - Regulatory compliance	**End users**: - Enhanced accessibility and convenience for all users, including those with special needs - Improved safety and reliability of public transport - Potential for 24/7 operation and shorter headways - Integration with existing public transport networks	- User-friendly interfaces and clear communication - Real-time information and updates through mobile apps or displays - Responsive customer support - Feedback collection and continuous improvement	**End users:** - Commuters daily travelers - Tourists and visitors - People with special needs, mobility limitations & Elderly individuals - Students and young people
	Key Resources - Autonomous e-shuttle fleet - Remote-Control Centre infrastructure and technology - Inductive charging stations - Traffic and infrastructure data integration systems – Partnerships/collaborations		**Channels** - Physical stops and stations - Mobile applications for booking and information - Online platforms for ticketing and customer support - Integration with existing public transport ticketing systems - Public awareness campaigns and marketing efforts	

Cost Structure	Revenue Streams
- Vehicle acquisition and maintenance - Infrastructure development / maintenance - Personnel costs - Technology development and licensing fees - Marketing and promotion expenses - Energy costs for charging - Insurance and regulatory compliance costs	- Fare collection from passengers - Government subsidies or grants

Figure 40: Prototypical Business and Innovation Model of TA-UC02

4.6. UCs and BIGMs next steps

The development of the prototype UCs and BIGMs was a critical step towards creating the smart, shared, zero-emission mobility solutions that will be implemented and demonstrated in WP3 for the four T-LLs. The methodologies employed, primarily within the metaDesign activities LL2/LL3 (co-creative workshops), have provided a solid foundation for these prototypes, ensuring they are tailored to the unique needs and challenges of each T-LL.

Moving forward, the next steps will involve building on the outcomes of these workshops to fine-tune and prepare more detailed technical descriptions of both the UCs and BIGMs. For the UCs, Task 1.2 will focus on refining the prototype and co-designed UCs, using insights gained from the Status Quo and the initial workshops and elaboration during these nine initial months of the project (January 2024 to September 2024). This will involve developing each UC in greater detail, identifying crucial operational elements such as system description and operation, breaking down initial UC descriptions into more detailed actions, including metaServices and metaInnovation, as well as defining how users will interact with the services and technologies. It will also define technical dependencies and training requirements for successfully implementing the UCs. This refinement process is essential to ensure the UCs are fully prepared for implementation.

In parallel, Task 1.3 will continue the validation of BIGMs, with the aim of more precisely defining the collaborative roles, responsibilities, dependencies, and tasks of each actor involved in demonstrating the UCs. The refinement of BIGMs will also focus on ensuring the smooth integration of metaInnovations (electrification, automation, and connectivity) within the metaServices (smart systems and services). It will also describe how value will be created, delivered, and captured across economic, social, and cultural contexts.

The progress made so far has provided a strong baseline for the continued development of the metaCCAZE LLs. The upcoming steps are crucial for ensuring that the UCs and BIGMs are robust, adaptable, and ready for successful implementation and demonstration in WP3 starting in 2025.

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Annexes

Annex I - Data Map Summary

The content described in the tables below depicts mobility and traffic-related data availability in the T-LLs. Mobility data (see Table 1 of this annex) encompass a broader range of metrics that include various modes of transportation, shared mobility options, infrastructure support, and innovative vehicle technologies. These data aim to measure the effectiveness, efficiency, and integration of different mobility solutions within a city. In contrast, traffic-related data (see Table 2 of this annex) focus more narrowly on specific aspects of vehicular movement and road usage. The list provided includes a wide range of metrics that can be classified as traffic data and other related transportation metrics. These metrics highlight critical areas such as traffic flow patterns, vehicle classifications, origin-destination data, traffic volume and density, average and free flow speeds, congestion levels, and queue lengths at intersections. Additionally, traffic data cover aspects of public transport data, charging infrastructure, transport network characteristics, transport technology, travel behavior, and the environmental, social, and economic impacts of transportation systems.

The data map summary for the four trailblazer cities can be summarized as follows:

Table 1. Mobility related data

DATA TO BE PROVIDED	AMSTERDAM	MUNICH	LIMASSOL	TAMPERE
Percentage of trips by car, bus, bicycle, etc.	Available	Available	Available	Available
Average travel time between specific locations	Not Available	Available	Available	Limited/No access
Number of vehicles on highway segments	Available	Available	Available	Available
Average number of passengers per vehicle	Not Available	Available	Not Available	Available
LOS rating (A to F) at various locations	Not Available	Limited/No access	Available	Available
Average wait time at traffic signals	Available	Limited/No access	Available	Available
Standard deviation of travel times	Not Available	Limited/No access	Available	Limited/No access
Number of accidents per month, injuries, fatalities	Available	Available	Available	Available
CO2 emissions, NOx emissions, etc.	Available	Available	Available	Available
Percentage of accurate predictions	Not Available	Limited/No access	Not Available	Not Available

Survey ratings or feedback scores	Not Available	Available	Available	Limited/No access
Average turnaround time for buses	Not Available	Limited/No access	Available	Limited/No access
Transfer time between bus and train	Not Available	Limited/No access	Not Available	Limited/No access
Total revenue generated, operating expenses	Not Available	Limited/No access	Available	Limited/No access

Table 2. Traffic related data

DATA CATEGORIES	DATA VARIABLES	AMSTERDAM	MUNICH	LIMASSOL	TAMPERE
Traffic Data	Average Daily Traffic (ADT)	Available	Available	Available	Available
	Traffic Flow Patterns	Available	Available	Available	Available
	Vehicle Types and Classifications	Available	Available	Available	Available
	Origin-Destination Data	Available	Available	Available	Available
	Traffic Volume	Available	Available	Available	Available
	Traffic Density	Available	Limited/No access	Not Available	Limited/No access
	Average Speed	Available	Available	Available	Available
	Free Flow Speed	Available	Available	Not Available	Available
	Congestion Index	Not Available	Not Available	Not Available	Available
	Queue Length (Intersections / Bottlenecks)	Not Available	Not Available	Not Available	Not Available
	Lane Utilization - Lane Capacity	Not Available	Not Available	Not Available	Available
	Delay Time	Not Available	No Available	Not Available	Available
	Flow Distribution	Not Available	Available	Available	Available
	Peak Hour Traffic	Not Available	Available	Not Available	Available
Public Transport Data	Ridership Statistics	Not Available	Available	Available	Available
	Frequency and Reliability	Available	Available	Available	Available

	Accessibility of Stops and Stations	Available	Limited/No access	Available	Available
Charging Infrastructure	Number and Locations of Charging Stations	Available	Available	Available	Available
	Charging Capacity and Compatibility	Available	Not Available	Available	Available
	Utilisation Rates	Not Available	Not Available	Available	Limited/No access
	Availability of Fast Charging	Available	Available	Available	Available
Transport Network	Road Network Characteristics	Available	Available	Available	Available
	Bicycle and Pedestrian Infrastructure	Available	Available	Available	Available
	Freight Routes and Distribution Centres	Available	Not Available	Available	No Available
	Public Transport Stops and Stations	Available	Available	Available	Available
Transport Technology	Intelligent Transport Systems (ITS)	Available	Not Available	Available	Limited/No access
	Vehicle-to-Infrastructure (V2I) Communication	Not Available	Not Available	Available	Limited/No access
	Vehicle-to-Vehicle (V2V) Communication	Not Available	Not Available	Available	Limited/No access
	Advanced Driver Assistance Systems (ADAS)	Not Available	Not Available	Not Available	Not Available
Travel Behaviour	Travel Survey Data	Available	Available	Not Available	Available
	Commuting Patterns	Available	Available	Available	Limited/No access
	Ride-Sharing and Micromobility	Available	Available	Available	Limited/No access
Environmental Impact	Air Quality Monitoring Data	Available	Available	Available	Available
	Noise Pollution Levels	Available	Available	Available	Available

	Greenhouse Gas Emissions Inventory	Available	Available	Available	Available
Social Impact	Demographic Profiles	Available	Available	Available	Available
	Accessibility for Vulnerable Populations	Not Available	Not Available	Not Available	Limited/No access
	Public Perception Surveys	Available	Available	Available	Limited/No access
Economic Impact	Transportation Expenditures	Available	Limited/No access	Available	Available
	Economic Benefits of Transport Investments	Not Available	Not Available	Not Available	Available
	Cost-Benefit Analysis	Not Available	Available	Available	Available

Annex II - Data Map for each T-LL

The following pages present comprehensive data maps for four T-LL cities. Each city is analyzed using the same structure to facilitate easy comparison and analysis.

For each city, a table is provided that includes data categories, specific variables, and descriptions of each variable. Detailed information is also given about the availability of data, sources, types, formats, and collection methods for each variable. Additionally, information on data access and usage restrictions, data quality, last updated dates, spatial and temporal coverage, aggregation levels, and the reliability of data sources is included.

Amsterdam

Table 3. Data Categories, Variables, Sources, and Quality for Amsterdam

Data Categories	Data Variables	Description	Availability	Data Source	Data Type	Format	Data Collection Method	If other:	Data Access Restrictions	Data Usage Restrictions	Data Quality	Last Updated (Date)	Spatial Coverage	Spatial Resolution	Temporal Resolution	Data Aggregation Level	Data Source Reliability
Traffic Data	Vehicle Types and Classifications	Distribution of vehicle types (e.g., cars, trucks, buses, bicycles)	Limited availability	Traffic counters, sensors	Limited availability	XML	Video analytics	VMA (Verkeersmodel Amsterdam)	Restricted	Privacy restrictions	High	Real-time	Urban	Road segment-level	Real-time	Aggregated by minute	Official government
	Origin-Destination Data	Origin and destination of trips, commuter and freight traffic	Limited availability	Traffic counters, sensors	Limited availability	XML	Automated data logging	VMA (Verkeersmodel Amsterdam) / TomTom Move	Restricted	Privacy restrictions	High	Real-time	Urban	Road segment-level	Real-time	Aggregated by minute	Official government
	Average Speed	Mean speed of vehicles along a road segment or corridor	Limited availability	Traffic management agencies	Publicly available	XML	Traffic monitoring stations	VMA (Verkeersmodel Amsterdam) / NDW	Restricted	Privacy restrictions	High	Real-time	Urban	Road segment-level	Real-time	Aggregated by minute	Official government
	Peak Hour Traffic	Traffic volume and flow patterns during peak hours of the day	Limited availability	other	Publicly available	XML	Traffic monitoring stations	VMA (Verkeersmodel Amsterdam)	Subscription required	License agreement	High	Real-time	Urban	Road segment-level	Real-time	Aggregated by minute	Official government
	Bicycle intensity	Traffic count of bicycles	Publicly available	Traffic surveys, government records	Publicly available	XML	Traffic monitoring stations	NDW (Dexter)	Open access	None	Medium	Real-time	Urban	Road segment-level	Real-time	Aggregated by minute	Official government
	Cycling speeds	Speed	Publicly available	Traffic counters, sensors	Tabular	XML	Video analytics	NDW (Dexter)	Open access	None	Medium	Real-time	Urban	Road segment-level	Real-time	Aggregated by minute	Official government
Transport Technology	Intelligent Transport Systems (ITS)	Technologies used for traffic management and control	Publicly available	Transportation planning agencies	Spatial	Shapefile	Traffic monitoring stations	NDW	Open access	None	High	2023	National	Street-level	Monthly	other	Official government
Travel Behaviour	Travel Survey Data	Mode choice, trip purposes, trip lengths	Limited availability	Traffic surveys, government records	Tabular	XML	Survey questionnaires	KiM	Open access	Copyright restrictions	Low	2019	National	National level	Project-based	Aggregated by year	Official census data
	Travel pattern data	Travel motives	Publicly available	Traffic surveys, government records	Tabular	XML	Survey questionnaires	KiM / CBS	Open access	Copyright restrictions	Low	2019	Regional	Regional	Project-based	Aggregated by year	Official census data
	Ride-Sharing and Micromobility	Usage rates and preferences for ride-sharing, micromobility	Limited availability	Ride-sharing company data	other	XML	Automated sensors	e.g. Felix, Go	Restricted	Privacy restrictions	High	2024	Urban	Point-level	Real-time	Aggregated by minute	Verified by third party
Public Transport Services	Public Transport Ticketing Data	Data related to ticketing and fare collection on public transport	Publicly available	Transit authority reports	Textual	PDF	Automated sensors	Translink / GVB / NS / OV-chip	Open access	Copyright restrictions	Medium	2023	National	National level	Annual	Aggregated by year	Official public transport data
	Existing Origin-Destination Analyses	Analyses of existing trip origins and destinations	Limited availability	other	Tabular	other	GPS tracking	TomTom Move	Subscription required	License agreement	High	Real-time	National	Street-level	Real-time	Aggregated by minute	Verified by third party
	Average Speed for Vehicles in	Average speed of vehicles in	Limited availability	Traffic management agencies	Tabular	XML	Traffic monitoring stations	VMA (Verkeersmodel	Restricted	Privacy restrictions	High	Real-time	Urban	Street-level	Real-time	Aggregated by minute	Official government

	Urban Environment	the urban environment						Amsterdam)									
	Road Service Status	Information on road conditions, maintenance, and construction	Publicly available	Traffic management agencies	Spatial	XML	Machine learning models	RWS / NDW / TBL	Open access	None	Medium	2024	Urban	Street-level	Monthly	Aggregated by month	Official government
	Speed Regulations for the Road Network	Legal speed limits and regulations for road traffic	Publicly available	Transportation planning agencies	other	XML	GIS mapping	NDW	Open access	None	Medium	2023	Regional	Regional	Annual	Aggregated by year	Official census data
Traffic more	Curbside Information for the Urban Environment	GIS data related to curbside management in urban areas	Publicly available	Transportation planning agencies	other	XML	Automated sensors	NDW	Open access	None	High	Real-time	Local (Parking facilities)	Point-level	Real-time	Aggregated by minute	Verified by third party
	Number of accidents	Data on number of traffic accidents where an ambulance was called in Amsterdam	Publicly available	other	Tabular	XML	Field surveys	GGD Amsterdam / NDW / SWOV	Open access	None	High	2023	National	National level	Annual	Aggregated by year	Verified by third party
	Cycling safety perception	Survey on cyclists' perception of safety (in Amsterdam)	Limited availability	other	Textual	XML	Manual surveys	SWOV / interviews performed within metaccaze project	Open access	Copyright restrictions	High	date	other	Road segment-level	Project-based	Aggregated by survey	Official census data
	High risk cycling safety locations	Analysis of cycling safety at various locations in Vondelpark	Limited availability	other	Textual	other	Manual surveys	interviews performed within metaccaze project	Open access	Copyright restrictions	High	date	other	Road segment-level	Project-based	Aggregated by survey	other
Logistics	Number of logistics vehicles and movements in Amsterdam	Counts of number of logistic vehicles entering the environmental zone in Amsterdam daily	Limited availability	other	Tabular	XML	Video analytics	environmental zone camera data	Restricted	Privacy restrictions	High	Daily	Urban	City-wide	Project-based	Aggregated by day	other
Environmental Impact	Air Quality Monitoring Data	Pollutant concentrations, emissions	Publicly available	Traffic counters, sensors	Textual	CSV	Traffic monitoring stations	14 stations of City of Amsterdam	Open access	None	Medium	Real-time	Urban	City-wide	Real-time	Aggregated by minute	Official government
	Noise Pollution Levels	Levels of noise pollution along transport corridors	Publicly available	Traffic counters, sensors	WCS	other	Automated sensors	Reference points (data available through WMS)	Open access	None	Medium	Real-time	Highway	National level	Real-time	Aggregated by minute	Official government
	Greenhouse Gas Emissions Inventory	Emissions from transport sources	Publicly available	Traffic counters, sensors	WCS	other	Automated sensors	Reference points (data available through WMS)	Open access	None	Medium	Real-time	Highway	National level	Real-time	Aggregated by minute	Official government
Social Impact	Public Perception Surveys	Public attitudes and perceptions towards transport	Publicly available	Traffic surveys, government records	Tabular	XML	Survey questionnaires	KiM	Open access	None	High	2019	National	National level	Project-based	Aggregated by year	Official census data

Transport Network	Road Network Characteristics	Lane widths, speed limits, classifications	Publicly available	Traffic management agencies	Spatial	XML	Shapefile	NDW	Open access	None	High	2023	Highway	National level	Annual	Aggregated by year	Official government
	Bicycle and Pedestrian Infrastructure	Availability of bike lanes, sidewalks, crosswalks	Publicly available	Traffic management agencies	Spatial	XML	Shapefile	NDW	Open access	None	High	2024	Urban	National level	Annual	Aggregated by year	Official government
	Freight Routes and Distribution Centres	Routes and hubs for freight transportation	Limited availability	GPS	Spatial	other	GPS tracking	Bridgestone	Subscription required	License agreement	High	Real-time	Regional	Street-level	Real-time	Aggregated by minute	Verified by third party
Modal Split	Distribution of trips across different modes of transport	Percentage of trips by car, bus, bicycle, etc.	Publicly available	Traffic surveys, government records	Tabular	XML	Survey questionnaires	KiM	Open access	Privacy restrictions	High	2019	National	National level	Project-based	Aggregated by year	Official census data

Munich

Table 4. Data Categories, Variables, Sources, and Quality for Munich

Data Categories	Data Variables	Description	Availability	Data Type	Data Source	Last Updated (Date)	Spatial Coverage	Data Quality	Data Collection Method	Data Coverage	Temporal Resolution	Spatial Resolution	Data Format	Data Access Restrictions	Data Aggregation Level	Data Source Reliability	Data Usage Restrictions
Traffic Data	Average Daily Traffic (ADT)	Number of vehicles passing through a specific location on a road or highway within a day	Yes	spatial, numeric	Mobility department	Real time, every 15min	Urban	High	Sensors&Countings	-	15min	will be delivered at a later time	CSV	Open access (Mobilithek)	15min, 150 sensors	Official government	Open access (Mobilithek)
	Traffic Flow Patterns	Peak hours, congestion hotspots, directional flow	Partially	spatial, numeric	Mobility department	Real time, every 15min	Urban	Medium	Sensors&Countings& FCD	-	15min	-	CSV	Open access (Mobilithek)	15min, 150 sensors	Official government	Open access (Mobilithek)
	Vehicle Types and Classifications	Distribution of vehicle types (e.g., cars, trucks, buses, bicycles)	Yes	spatial, numeric	Statistic Office	01.01.2024	Urban	High	Statistics	-	monthly	-	CSV	Open statistics	yearly	Official government	Open statistics
	Origin-Destination Data	Origin and destination of trips, commuter and freight traffic	Partially	spatial, numeric	Mobility department -- model	yearly	Urban	Medium	Traffic model	-	yearly	-	CSV	Internal data on request	yearly	Official government	Internal data on request
	Traffic Volume	Number of vehicles passing through a specific point or section of road within a given time frame	Yes	spatial, numeric	mobility department	Real time, every 15min	Urban	High	Sensors&Countings	-	15min	-	CSV	Open access (Mobilithek)	15min, 150 sensors	Official government	Open access (Mobilithek)
	Traffic Density	Measure of vehicle concentration per unit length of road	Partially	spatial, numeric	mobility department -INRIX (external data provider)	15min	Urban	Medium	FCD	-	15min	-	CSV	Internal data on request	15min	Official government	Internal data on request
	Average Speed	Mean speed of vehicles along a road segment or corridor	Yes	spatial, numeric	mobility department -INRIX (external data provider)	15min	Urban	High	FCD	-	15min	-	CSV	Internal data on request	15min	Official government	Internal data on request
	Free Flow Speed	Speed vehicles would travel at under ideal conditions, unaffected by congestion	Yes	spatial, numeric	mobility department	daily	Urban	High	FCD	-	daily	-	CSV	Internal data on request	daily	Official government	Internal data on request
	Congestion Index	Measure of traffic congestion level, often based on travel time	Yes	spatial, numeric	mobility department -INRIX	15min	Urban	High	FCD	-	15min	-	CSV	Internal data on request	15min	Official government	Internal data on request

		compared to free-flow conditions			(external data provider)												
	Queue Length (Intersections / Bottlenecks)	Length of vehicle queues at intersections or bottlenecks during peak hours	No	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Peak Hour Traffic	Traffic volume and flow patterns during peak hours of the day	Yes	spatial, numeric	mobility department	15min	Urban	High	Sensors&Countings	-	15min	-		Open access (Mobilithek)	15min	Official government	Open access (Mobilithek)
Transport Network	Road Network Characteristics	Lane widths, speed limits, classifications	Yes	categorical	mobility department, local authority department	Current status	Urban	High	Geodata	-	Static	-	GIS	Internal data on request	Static	Official government	Internal data on request
	Bicycle and Pedestrian Infrastructure	Availability of bike lanes, sidewalks, crosswalks	Yes	categorical	mobility department, construction department, local authority department	Current status	Urban	High	Geodata	-	Static	-	GIS	Internal data on request	Static	Official government	Internal data on request
Electric Vehicle Fleet Charger Types and Specification	Number and Locations of Chargers	Count and geographical distribution of EV charging stations	Yes	numerical	mobility department	2024	Urban	High	Geodata	-	Static	-	GIS	Open Data Portal	daily	Verified third party	Open Data Portal
	Charging Schedule and Charging Stations Occupation Rates	Schedules and occupancy rates for charging stations	Potentially available, from one operator	numerical	mobility department, public transport authority	Unknown	Urban	High	Statistics	-	Static	-	-	-	-	Unknown	Unknown
	Weather Data	Meteorological data including temperature, precipitation, etc.	Yes (Hourly/Daily data)	spatial, numeric	Meteorological agencies	Updated daily	Urban	High	-	-	Static	-	CSV	Open data	hourly, daily	Official government	Open data
	Parking Data / Parking e-Smart Data	Information on parking availability, occupancy, and payment	Yes (every parking ticket)	spatial, numeric	mobility department, construction department	Monthly update	Urban	High	Statistics	-	Static	-	CSV	Internal data on request	1min	Official government	Internal data on request
Traffic more	Intersection Management	Management strategies and data for traffic intersections	Partially	-	mobility department	Yearly update	Urban	High	-	-	Static	-	-	-	yearly	Official government	Internal data on request

Limassol

Table 5. Data Categories, Variables, Sources, and Quality for Limassol

Data Categories	Data Variables	Description	Availability (need to check	Data Type	Data Source	Last Updated (Date)	Spatial Coverage	Data Quality	Data Collection Method	Data Coverage	Temporal Resolution	Spatial Resolution	Data Format	Data Access Restrictions	Data Aggregation Level	Data Source Reliability	Data Usage Restrictions
Public Transport Data	Ridership Statistics	Number of passengers using public transit services	Available	Calculation	PT office	-	Limassol region	High	Ticketing	Public Bus route	Real Time+ History	per route	-	Available	Per Route	High	None
	Frequency and Reliability	Frequency of public transit	Available	Calculation	PT office	-	Limassol region	High	Ticketing	Public Bus route	Real Time+ History	per route	-	Available	Per Route	High	None

		services and reliability															
	Accessibility of Stops and Stations	Availability and accessibility of public transit stops and stations	Available	Spatial	PT office	-	Limassol region	High	-	-	-	-	-	Available	-	High	None
Charging Infrastructure	Number and Locations of Charging Stations	Count and geographical distribution of electric vehicle (EV) charging stations	Available: EMEL: 2 stations at Ypsonas and Aiolou station. Discussion to be continued with municipality.	Spatial	PT Office	-	Limassol region	High	-	-	History/updated when necessary	Location-based	-	Available	-	High	None
	Charging Capacity and Compatibility	Charging rates and compatibility with different EV models	Available: Charger type and relevant details available from the municipality. Also, data about 8 mobile fast chargers will be made available from EMEL.	-	PT Office+ Municipality	-	Limassol region	-	-	-	-	-	-	-	-	-	-
	Utilisation Rates	Usage patterns and utilization rates of charging stations	Available: Will be provided by EMEL	-	PT office	-	Limassol region	High	Per charging station	Limassol's region	History	Per charging station	-	Available	-		None
	Availability of Fast Charging	Presence and distribution of fast charging stations	Available: EMEL: 2 stations at Ypsonas and Aiolou station. Discussion to be continued with municipality.	-	PT office	-	Limassol region	High	-	-	History updated when needed	measure points	-	Available	-	High	None
Environmental Impact	Air Quality Monitoring Data	Pollutant concentrations, emissions	Available: Communication with Electricity Authority of Cyprus to collect data	-	Labor Inspection	Real-time	National	High	Counters	National	Real-Time + History	measure points	-	Available	Per hour	High	None
	Noise Pollution Levels	Levels of noise pollution along transport corridors	Discussion to be continued with the Limassol Municipality	-	Ministry	-	National	-	-	Limassol's region	History		-	Ask for permission	-	-	Based on Ministry
	Greenhouse Gas Emissions Inventory	Emissions from transport sources	Available: Communication with Electricity Authority of Cyprus to collect data	-	Electricity Authority of Cyprus	-	National	-	Counters	National		measure points	-	Ask for permission	-	-	Based on Electricity Authority of Cyprus
Travel Behaviour	Commuting Patterns	Commuting modes and travel times	Available: from both EMEL and Nextbike	Calculation	PT Office + Bike Sharing Office	-	Limassol region	High	Ticketing	Limassol's region	History	Per route/Per docking station	-	Available	-	High	None
	Ride-Sharing and Micromobility	Usage rates and preferences for	Available: from both EMEL and Nextbike	Calculation	PT Office + Bike Sharing Office	-	Limassol region	High	Tracking	Limassol's region	Real-Time + History	Tracking	-	Available	Per vehicle	High	None

		ridesharing, micromobility															
Energy Grid Data	Transition, distribution, renewable/conventional energy mix, energy price changes	Data on energy grid infrastructure and characteristics	Available: Communication with Electricity Authority of Cyprus to collect data	-	Electricity Authority of Cyprus	-	-	-	-	-	-	-	-	-	-	-	Based on Electricity Authority of Cyprus
Public Transport Services Timetables	General Transit Feed Specification (GTFS) data, telematics, or other static data	Timetables and schedules for public transport services	Available: Telematics – EMEL, and/or real-time tracking, and/or GPS, and/or NextBike's application	-	PT Office + Bike Sharing Office	-	Limassol region	High	Tracking	National	Real-Time + History	Tracking	Shapefile	-	per Route/ Per Service	High	None
Public Transport Fleet Specification	Vehicle range, power capacity, energy consumption	Specifications of public transport fleet vehicles	Available: Data about 370 conventional bikes in 83 stations around Limassol region	Text	PT Office + Bike Sharing Office	-	Limassol region	High	Based on infrastructure	Limassol's region	-	-	PDF	Available	per vehicle	High	None
	Public Transport Ticketing Data	Data related to ticketing and fare collection on public transport	Available: from both EMEL and Nextbike	-	PT Office + Bike Sharing Office	-	Limassol region	High			Real Time+ History	per route			-	High	None
	Existing Origin-Destination Analyses	Analyses of existing trip origins and destinations	Available: from both EMEL and Nextbike	Calculation	Ministry +PT Office + Bike Sharing Office	-	National	High	Tracking	Limassol's region	History		PDF	Available	-	High	None
	Weather Data	Meteorological data including temperature, precipitation, etc.	Discussion to be continued with the municipality	-	Measure point	Realtime	National	High	Sensors		Realtime + history	based on measure points			-	High	None
	Average Speed for Vehicles in Urban Environment	Average speed of vehicles in the urban environment	Available: To be provided by EMEL, for public transport vehicles	-	PT office	-	Limassol region	High	-	Limassol's region	-	-	-	Available	-	High	None
	Road Service Status	Data on traffic flow and signal states, historical or real-time	Discussion to be continued with the Limassol Municipality	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Speed Regulations for the Road Network	Legal speed limits and regulations for road traffic	Available	-	Traffic police	Updated when needed	National	High	Current legislation	National	History	National legislation	PDF	Available	-	High	None
	Parking Data / Parking e-Smart Data	Information on parking availability, occupancy, and payment	Available by Nextbike and EMEL. Discussion to be continued with the Limassol Municipality	Calculation	Ministry		Limassol region	Medium	Survey	Per parking segment	History	measure points	-	Available	-	High	
Traffic more	Traffic Flows Data and Traffic Lights/Signaling States	Data on traffic flow and signal states,	Discussion to be continued with the Limassol Municipality	-	Ministry	History	Limassol region	High	Survey	Limassol's region	History- unknown for real time	Measure points	-	-	-	High	Based on Ministry

		historical or real-time															
	Intersection Management	Management strategies and data for traffic intersections	Discussion to be continued with the Limassol Municipality/ Not sure if it still working	-	Ministry	-	Limassol region	-	-	-	-	measure points	-	-	-		
Mobility Hub Infrastructure	Mobility Hub Infrastructure Specification	Specifications of mobility hub infrastructure	Available	Text	Municipality	apr-24	Limassol region	High	Current legislation	Place where Mobility Hub is going to be located	-	-	PDF	Available	-	High	None
Curbside Information	Curbside Information for the Urban Environment	GIS data related to curbside management in urban areas	Available by Nextbike and EMEL. Discussion to be continued with the Limassol Municipality	-	Bike Sharing Office	-	Limassol region	High	-	Limassol's region	History	-	Shapefile	Available	-	High	None
Demand for On-demand Mobility Services	Demand for On-demand Mobility Services	Data on demand for on-demand mobility services	Available: from both EMEL and Nextbike	-	PT Office + Bike Sharing Office	-	Limassol region	Hogh	Tracking	Demand, time used, tracking	Real Time+ History	Measure points	-	Available	Per dock station	High	None

Tampere

Table 6. Data Categories, Variables, Sources, and Quality for Tampere

Data Categories	Data Variables	Description	Availability	Data Type	Data Source	Last Updated (Date)	Spatial Coverage	Data Quality	Data Collection Method	Data Coverage	Temporal Resolution	Spatial Resolution	Data Format	Data Access Restrictions	Data Aggregation Level	Data Source Reliability	Data Usage Restrictions
Traffic Data	Origin-Destination Data	Origin and destination of trips, commuter and freight traffic	Limited	Spatial	Traffic Models	-	Tampere region	-	Models based on NTS-data and location specifications	-	-	zone-based	Model	Limited	-	Medium	Some apply
	Peak Hour Traffic	Traffic volume and flow patterns during peak hours of the day	Available	Spatial	Measure points	Realtime	Highways and traffic light junctions	-	Sensors	-	Realtime + history	traffic light junctions + highway sensors	XML-based API	Available, through some time limits or limits for queries outside Finland might exist	None	High	-
Transport Technology	Vehicle-to-Vehicle (V2V) Communication	Communication technologies between vehicles	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Advanced Driver Assistance Systems (ADAS)	Adoption and prevalence of ADAS technologies	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental Impact	Air Quality Monitoring Data	Pollutant concentrations, emissions	Available	-	Measure points	Realtime	4 measure points	High	Sensors		Realtime + history	measure points	WFS	None?	Per hour	High	None, though FMI open data
Economic Impact	Transportation Expenditures	Costs related to transportation, fuel, maintenance	Partly available	-	Models	2012	National	-	-	-	-	-	Model	-	Annual, national	Medium (model data)	

	Economic Benefits of Transport Investments	Job creation, business growth resulting from investments	Available, if done	Calculation report	Calculation by city/third-party	-	-	High	-	-	-	-	PDF	None	-	-	None
	Cost-Benefit Analysis	Costs and benefits associated with transport projects	Available, if done	Calculation report	Calculation by city/third-party	-	-	High	-	-	-	-	PDF	None	-	-	None
Energy Grid Data	Transition, distribution, renewable/conventional energy mix, energy price changes	Data on energy grid infrastructure and characteristics	Limited?	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Public Transport Services	Timetables	Timetables and schedules for public transport services	Available	GTFS	PT Office	Current data	Tampere region (datasets for other regions exists)	High	Based on PT office data		Updated when needed (i.e., when timetable or route changes), some history available		GTFS-format	None	None	High	None
	Electric Vehicle Fleet Chargers' Types and Specification	Charger types and specifications for electric vehicle fleets	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Number and Locations of Chargers	Count and geographical distribution of EV charging stations	Available	Spatial	Charging operators	Current data	National	High	Based on operator data	-	-	location-based	-	Per operator access by request, also crowdsourced data is more openly available	-	-	Based on operator source
	Charging Schedule and Charging Stations Occupation Rates	Schedules and occupancy rates for charging stations	Limited?	-	Charging operators	-	-	-	-	-	-	-	-	Might be available per operator access by request	-	-	-
	Public Transport Fleet Specification	Specifications of public transport fleet vehicles	Limited, through request?	-	PT Office	Realtime	Tampere region	High	-	-	-	-	-	-	-	-	-
	Public Transport Ticketing Data	Data related to ticketing and fare collection on public transport	Limited, through request?	-	PT Office	Realtime	Tampere region	High	-	-	-	-	-	-	-	-	-
	Existing Origin-Destination Analyses	Analyses of existing trip origins and destinations	Might exist, through request?	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Weather Data	Meteorological data including temperature, precipitation, etc.	Available	-	Measure points	Realtime	National	High	Sensors	-	Realtime + history	based on measure points	WFS	-	Per hour	High	None, through FMI open data
	Average Speed for Vehicles in	Average speed of vehicles in	Available on highways,	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Urban Environment	the urban environment	limited on urban areas														
	Road Service Status	Information on road conditions, maintenance, and construction	Available	DATEX + spatial	-	Realtime	National	High	Based on reports	-	Realtime + history	location-based	-	None?	-	High	None?
	Speed Regulations for the Road Network	Legal speed limits and regulations for road traffic	Available	Spatial	National road administr ation	Realtime	National	High	-	-	Realtime	per network	Shapefil e	None	-	High	None
	Parking Data / Parking e-Smart Data	Information on parking availability, occupancy, and payment	Limited, through request per parking operators	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Traffic Flows Data and Traffic Lights/Signalin g States	Data on traffic flow and signal states, historical or real-time	Available	Spatial	Sensors	Realtime	Traffic lights + highway sensors	High	Sensor data		Realtime + history	traffic light junctions + highway sensors	XML-based API	Available, through some time limits or limits for queries outside Finland might exist	None?	High	-
	Intersection Management	Management strategies and data for traffic intersections	Limited through city?	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mobility Hub Infrastructure Specification	Specifications of mobility hub infrastructure		-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Curbside Information for the Urban Environment	GIS data related to curbside management in urban areas	Not known	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Demand for On-demand Mobility Services	Data on demand for on-demand mobility services	Not generally available	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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