D1.4 MetaDesigned ZESM use cases for the trailblazer LLs and the SIEF

WP1

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Abbreviations and Acronyms

ACRONYM	Description
API	Application Programming Interface
AV	Automated Vehicle
BAU	Business-as-Usual
BIGM	Business Innovation & Governance Model
CBA	Cost Benefit Analysis
CCAM	Cooperative, Connected and Automated Mobility
CEA	Cost Effectiveness Analysis
CINEA	European Climate, Infrastructure and Environment Executive Agency
CIVITAS	City-Vitality-sustainability
DCM	Dynamic Curbside Management
F-LL	Follower Living Lab
GHG	Greenhouse Gas
ITS	Intelligent Transport Systems
IoT	Internet of Things
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LL	Living Lab
OBU	Onboard Unit
SIEF	Standardized Impact Evaluation Framework
SUMP	Sustainable Urban Mobility Plan
T-LL	Trailblazer Living Lab
TMC	Tradable Mobility Credits
TUMS	Total Urban Mobility System
UC	Use Case
UKB	Urban Knowledge Base
VoT	Value of Time
WP	Work Package

ZESM	Zero Emission Sustainable 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 in the EU. 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 to 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 6 follower cities for up to 8 months, to ensure their transferability and resilience potentials.

Executive Summary

To enable **scalable, adaptable and future-proof urban mobility solutions**, cities must rely on well-structured methodologies that **support knowledge transfer, reduce implementation timelines, and allow innovations to evolve with urban complexity**. Deliverable D1.4 of the metaCCAZE project introduces such a methodology - a practical and standardised framework for designing transferable Zero Emission Sustainable Mobility Use Cases.

The core **objective of the deliverable** is to highlight the main outcomes from the definition of the T-LLs Use Cases, as well as to capacitate cities beyond the project to catalogue and define further scalable use cases and contribute to accelerating the implementation of low/zero-carbon solutions in mobility and other fields of the Smart City, in alignment with the 100 Mission Cities commitment to become smart and carbon neutral by 2030. By following this methodology, cities can proactively identify and mitigate potential barriers before implementation, define key stakeholders, infrastructure requirements, operational workflows, and risks – ensuring that mobility innovations are both locally relevant and implementation ready.

To achieve this objective, metaCCAZE follows a methodology that lies on **a co-design approach**, engaging city officials, mobility stakeholders, and citizens in a multi-phase process. By the nature and logic of the tasks within Work Package 1 (WP1), they have been categorised into two complementary groups: **tasks carried out for analysis** and **tasks carried out for monitoring and evaluation**. The approach combines a multi-perspective alignment based on these task groupings:

Analysis of the Use Cases:

- Foundation analysis *(Status Quo Mapping includes sub-tasks Capacity and Empathy Maps and Data Maps in T1.1)*
- Fine-tuning the proposed solutions to systematically identify challenges, objectives, key stakeholders, infrastructure needs, operational processes, risks *(Use Case definition in T1.2)*
- Defining the roles and responsibilities of different stakeholders, ensuring structured collaboration between various stakeholders to barriers and features in business and governance *(Business Innovation and Governance Models (BIGMs) in T1.3)*

Monitoring and Evaluation of the Use Cases:

- Development of Key Performance Indicators (KPIs) and a well-structured evaluation methodology to assess the impact and effectiveness of the implemented Use Cases—both before and after deployment—thereby supporting future evaluations of what worked, what didn't, and why *(Standardised Impact Evaluation Framework (SIEF) in T1.4)*
- Evaluating user readiness, behavioural incentives, and social acceptance of new solutions and services to drive long-term adoption *(Social Embracement in T1.5)*
- Contributing to cross-fertilisation and transferability knowledge-sharing activities with other cities to refine their approach and prototype Use Cases *(in T1.6)*

The co-design approach was also embedded within the analysis phase through the **metadesign activities** (referred to as LL activities and detailed in *the interaction with city actors*). Specifically, LL2 and LL3 metadesign phases, held between July and September 2024, ensured that the Use Cases and Business Innovation & Governance Models (BIGMs) were grounded in the actual needs of each city. These phases also aimed to maximise solution uptake by incorporating user feedback and addressing behavioural incentives to enhance adoption and long-term viability. These activities laid the foundation for the Use Case prototyping and BIGMs—later validated in LL4—which are presented in this deliverable, along with the outputs of LL5 and forthcoming Social Embracement Surveys (referred to as SS activities and detailed in *10.1.3. The interaction with city actors*), focusing on KPI definition and travel behaviour.

Deliverable D1.4 begins with presenting **a fine-tuning tuning process based on a WHY – WHAT – HOW logic** aim to systematically identify challenges, objectives, key stakeholders, infrastructure needs, operational processes, risks, and impact assessment aiming at defining the Use Cases and the Business Innovation & Governance Model (BIGM). This ensures the definition of the Use Case and the roles and responsibilities of different stakeholders, ensuring structured collaboration between public authorities, private sector actors, and citizens.

The reader will find structured **use case definitions** tailored to each city's mobility challenges, along with their governance and innovation strategies at the level of the **four Living Lab cities (Munich, Amsterdam, Tampere, and Limassol)**. For instance, Munich's Dynamic Curbside Management (MU-UC01) focuses on optimizing curbside space allocation for logistics and shared mobility, integrating real-time monitoring and booking systems to reduce congestion and emissions. Similarly, Tampere's Autonomous e-Shuttle Use Case (TA-UC01) explores the feasibility of driverless public transport, addressing both technical and regulatory challenges while integrating the service into the city's existing transit network. Each city's **use cases follow the same proposed methodologies above**, ensuring comparability and scalability.

Beyond the Use Case definitions and Business Innovation & Governance Models (BIGMs), the deliverable also introduces the **Social Embracement Approach**, which highlights the critical role of public acceptance and stakeholder alignment. This approach acknowledges that the success of mobility innovations depends not only on technical performance, but also on effectively engaging users and sustaining their participation over time. Additionally, the **Standardised Impact Evaluation Framework (SIEF)** offers a robust, consistent, and transferable approach to assess the technical, environmental, economic, and social impacts of the implemented Use Cases across all 12 Living Labs, thereby ensuring that the project outcomes can inform wider deployment beyond metaCCAZE.

The Use Case and BIGMs Template presented in this deliverable is a **living framework** that will be continuously updated based on **real-world implementation insights**. As cities implement these solutions, the framework will be enriched with lessons learned, identified success factors, and actionable next steps, ensuring that future adopters benefit from accumulated experience and practical insights. Crucially, the **Standardised Impact Evaluation Framework (SIEF)** and acceptance (**Social Embracement)** tools will be re-appliedyes after the implementation to monitor outcomes, assess user acceptance, and evaluate the overall performance of the Use Cases, thereby closing the feedback loop and supporting continuous improvement.

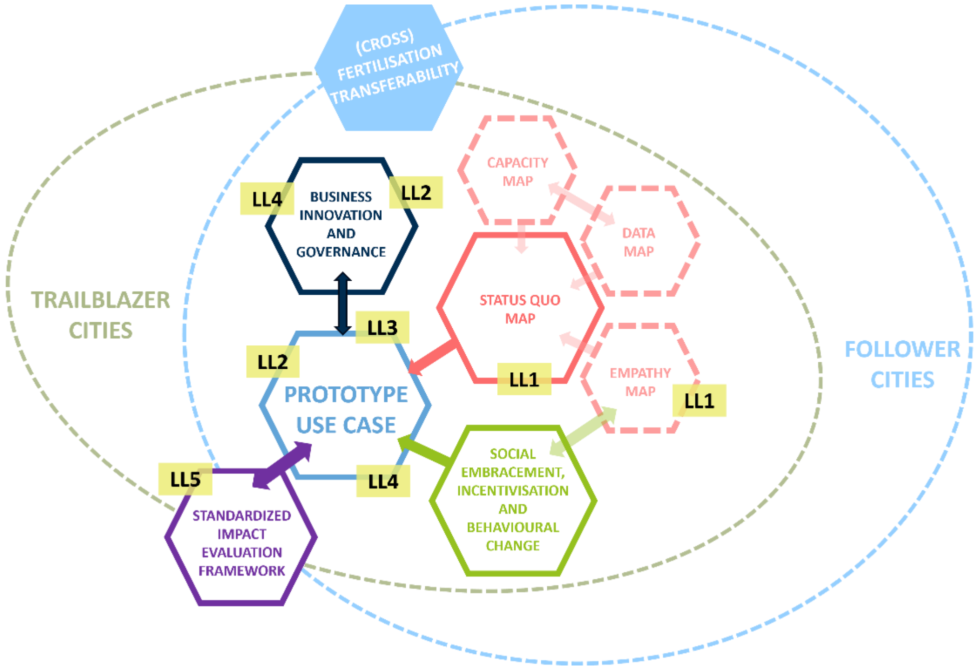


Figure 1: Interrelation within WP1 Tasks leading to Use Case Prototype & BIGMs Approach

Finally, Deliverable D1.4 also offers a set of **reusable materials** to support stakeholders in defining, structuring, and scaling urban innovation projects in the 6 follower cities of the project, as well as in other cities across Europe. The combination of impact-driven assessment, stakeholder collaboration models, and social readiness analysis ensures that mobility innovations are not only technically and operationally sound but also socially accepted and widely replicable. Ultimately, this integrated methodology supports the transition to a low-carbon, efficient, and resilient urban transport ecosystem, fostering knowledge transfer, replication, and long-term sustainability across diverse urban contexts.

1. Introduction

Effective **pre-deployment planning** is crucial for ensuring the success of **zero-emission mobility (ZESM) use cases** before implementation. Cities often face challenges in defining, structuring, and parameterizing their mobility solutions due to **a lack of standardized frameworks and methodologies**. Without a structured approach, urban mobility projects risk inefficiencies in resource allocation, stakeholder coordination, and operational feasibility. By creating a standardized and well-defined structure, cities can seamlessly implement solutions tailored to their unique needs while maintaining consistency with proven methodologies.

D1.4 – MetaDesigned ZESM Use Cases for the Trailblazer LLs and the SIEF provides a guideline for pre-deployment planning, equipping cities with the necessary tools to define, structure, and refine their use cases before implementation. **This deliverable enables cities to establish well-defined, parameterised Use Cases** that are aligned with **local conditions, regulatory frameworks, and user acceptance requirements**.

By leveraging insights from the four Trailblazer Living Labs (Munich, Amsterdam, Limassol, and Tampere), this deliverable compiles practical methodologies and structured guidelines that ensure cities can effectively prepare their mobility solutions. Key elements include prototype use case development, business innovation and governance models (BIGMs), standardized impact evaluation (SIEF), and social embracement strategies—all of which contribute to robust pre-deployment planning.

Through this structured approach, metaCCAZE enables cities to prepare their mobility innovations for real-world deployment, ensuring they are technically feasible, economically viable, and socially embraced from the outset – laying the groundwork for successful implementation and long-term sustainability.

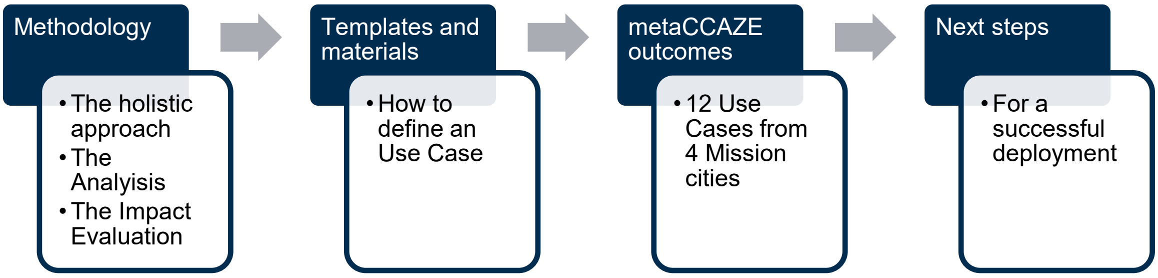
1.1. Objectives of the Deliverable

The ultimate goal of the present deliverable is to **enable the development of additional Use Cases and support new cities beyond the metaCCAZE framework**, allowing the catalogue and definition of scalable, ready for deployment mobility use cases solutions. This is achieved through a **holistic methodology developed specifically for metaCCAZE**, integrating the consortium's collective insights to define Use Cases that combine **technical, regulatory, social, and economic dimensions**. This cross-disciplinary approach ensures that solutions are not only well-conceived but also **deployment-ready and adaptable across different urban contexts**.

By integrating these components, **D1.4 serves as a foundational practical guideline for cities** and stakeholders, enabling them to **systematically plan, structure, and refine mobility solutions before deployment**. This deliverable also acts as an interim report ahead of D1.5 (MetaDesigned Transferable SEZM Use Cases for the Follower LLs), supporting the further implementation and adaptation of use cases beyond the Trailblazer Living Labs.

1.2. Structure of the Document

This deliverable is intended to serve as both a summary of the latest development metadesigned (codesigned) Zero Emission Sustainable Use Cases In Mobility during metaCCAZE implementation and a set of guidelines to identify and promote further applications beyond the project scope. Therefore, the document is divided into a set of modules that intends to explain the metadesign process from the different perspectives and disciplines with practical examples.



The reader will find:

- A comprehensive description of the **methodological approach** adopted in the study.
- A detailed overview of the **key activities conducted to define and evaluate** the impact of the Use Cases.
- **Twelve fully documented Use Cases**, representing diverse urban mobility challenges addressed across the four Trailblazer Cities.
- A summary of the **next steps** required to ensure the successful deployment and transferability of these solutions to other urban contexts.

To illustrate the previous, the reader may get access to the detailed description of the 12 project Use Cases as well as the next steps to ensure its deployment

1.3. Relation to Project Documents

D1.4 builds upon and integrates insights from previous metaCCAZE deliverables, particularly those developed within Work Package 1 (WP1). It consolidates key findings from Trailblazer Living Labs activities, metadesign processes, and previous analyses to establish a structured pre-deployment planning framework for defining and refining MetaDesigned Zero-Emission Smart Mobility (ZESM) Use Cases (UCs).

A key reference for D1.4 is Deliverable D1.1, which provided a comprehensive assessment of Use Cases across the four Trailblazer Living Labs (Munich, Amsterdam, Limassol, Tampere). This foundational work included:

- **Capability maps, empathy maps, and mini-dialogues** that captured stakeholder insights and ecosystem challenges.
- **Identification of initial barriers, existing services, and relevant projects** that could influence the implementation of UCs.

By integrating these insights, D1.4 advances the definition and structuring of Use Cases through the development of the Prototype Use Case Template and Business Innovation & Governance Models (BIGMs). It ensures that all WP1 tasks interact seamlessly, forming a cohesive methodology for pre-deployment planning. Additionally, this deliverable serves as a preparatory document for D1.5 (MetaDesigned Transferable SEZM Use Cases for the Follower LLs), laying the groundwork for the transfer and adaptation of UCs beyond the Trailblazer Living Labs, while maintaining a structured and replicable approach.

1.4. Overall Approach

The holistic methodology described in the next chapters, integrated technical, regulatory, social, and economic dimensions to ensure the readiness for deployment of use cases and their scalability. It consolidates the outcomes of Work Package 1 (WP1), and the interconnections with WP2 MetaInnovations, and WP3 Deployment in the Trailblazer cities. WP1 is defined as the groundwork for defining, structuring, and preparing urban mobility solutions for their deployment.

This approach consolidates the outcomes of **Work Package 1 (WP1)**—which serves as the foundation for defining, structuring, and preparing urban mobility solutions—while also aligning with:

- **WP2 (MetaInnovations)**, which focuses on technological development and innovation;
- and **WP3 (Deployment)**, which oversees implementation in the Trailblazer Cities.

Together, these interconnected work packages establish a comprehensive and systematic pathway for cities to move from **problem identification to real-world deployment**, ensuring that proposed solutions are not only feasible but also **sustainable, inclusive, and transferable**.

2. Methodology

The following subchapters will follow an integrated, step-by-step approach built around the co-development and validation of MetaDesigned Zero Emission Sustainable Mobility (ZESM) Use Cases. The holistic methodology combines technical, regulatory, social, and economic disciplines to ensure the readiness for deployment of use cases/solutions and their scalability. It consolidates the outcomes of Work Package 1 (WP1), where the groundwork for defining, structuring, and preparing urban mobility solutions for deployment is laid. The overall methodology combines standardized structuring tools, stakeholder co-creation processes, and validation mechanisms that ensure each Use Case is both locally relevant and scalable across other urban contexts. The approach to D1.4 has been developed as a multi-phase process, integrating **standardised structuring tools, stakeholder co-creation, and validation mechanisms** to ensure that each Use Case is **locally relevant and transferable**. It is structured across six key tasks of WP1:

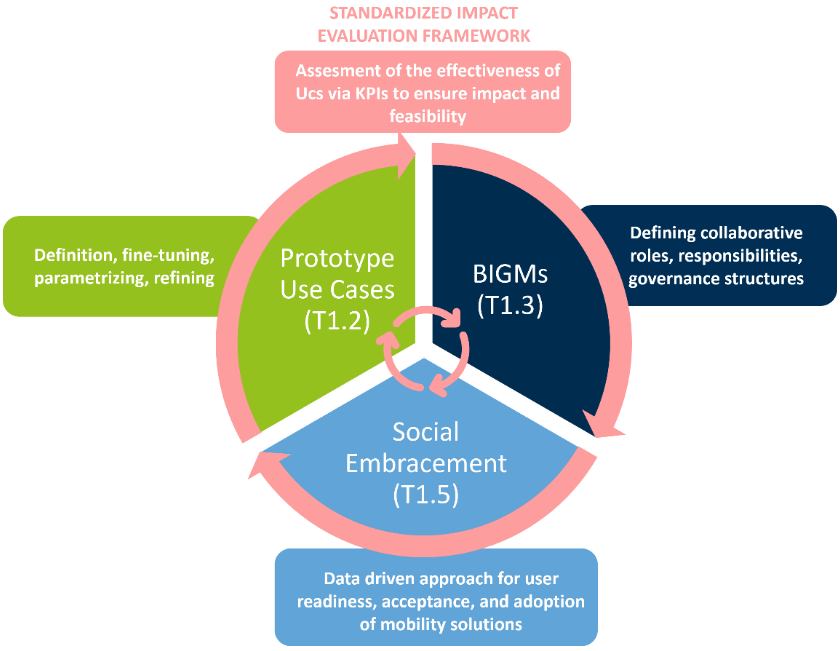


Figure 2: Methodology for Ready for Deployment metadesigned Zero Emission Sustainable Mobility Use Cases

Status Quo Mapping (T1.1): Conducted through Capacity Maps, Empathy Maps, and Data Maps to assess baseline conditions and stakeholder ecosystems in each city.	**Definition of the Standardized Impact Evaluation Framework (T1.4):** Introduction of project-wide and context-specific KPIs to assess the impact of the Use Cases post-deployment, aligned with CIVITAS, 2ZERO, and CCAM methodologies.
Definition of Prototype Use Cases (T1.2): Development of Use Cases based on the WHY–WHAT–HOW logic. Each case was tailored to local urban challenges and aligned with the CEN-CENELEC CWA 17381:2019 standard and DIN SPEC 91387.	**Social Embracement and Behavioural Change (T1.5)**: Execution of stakeholder and user surveys to capture readiness, behavioural incentives, and acceptance of the proposed innovations (LL3 and LL5).
Development of Business Innovation & Governance Models (T1.3): Creation of structured, modular governance and business models validated in LL4, clarifying stakeholder	**Fertilization and Transferability Activities (T1.6)**: Preparation for cross-city learning and adaptation of solutions by capturing key insights to be used in future follower cities

roles, operational structures, and funding mechanisms.	(D1.5), including refinement of indicators and methodologies through LL5.

Each phase was iteratively co-developed through Living Lab (LL) activities—specifically metadesign activities LL2, LL3, LL4, and LL5—allowing for continuous refinement of the Use Cases and BIGMs based on **stakeholder engagement and local context**, ensuring practical alignment and long-term viability.

2.1. The metaCCAZE holistic methodology for a metadesigned ZESM Use Case. A suggested multi-dimensional approach

This diagram illustrates **the timeline of a use case** within the metaCCAZE project, showcasing a structured, multi-dimensional approach from initial analysis to deployment.

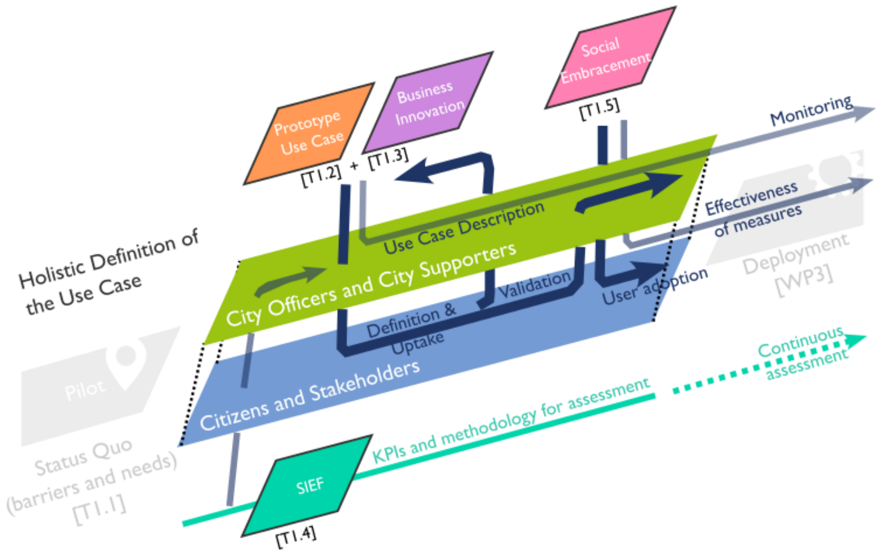


Figure 3: multi-dimensional approach for defining ZESM Use Cases

The process begins with the Status Quo Analysis, which serves as the catapult for shaping the trajectory of the use case. This foundational phase involves mapping existing conditions, identifying challenges, and understanding the urban mobility landscape through data-driven insights. The findings of this phase provide the basis for the Mission-Driven City Pilot & Use Case, ensuring that the identified solutions align with real-world needs and urban dynamics.

Building upon this groundwork, a Prototype Use Case is formulated, integrating Business Innovation and Governance models. This phase ensures that the use case is not only technically feasible but also has a viable operational and governance structure, making it scalable and adaptable to various urban settings. To enable a future evaluation of its effectiveness, the use case has been aligned with the Standardized Impact Evaluation Framework (SIEF), which defines key performance indicators (KPIs) and outlines the methodology for assessing what worked, what didn't, and why—once implementation is complete. Simultaneously, social empowerment, incentive, and behavioural change strategies are introduced to facilitate user adoption and stakeholder buy-in, addressing the social and cultural dimensions of urban mobility solutions.

Throughout this process, there is an iterative engagement with City Officials, Supporters, Citizens, and Stakeholders, ensuring that the use case is co-designed, refined, and validated through real-world inputs. This multi-layered validation process ensures that both technical and behavioural aspects of the solution are addressed. The culmination of these steps leads to a Ready for

Deployment (WP3) Use Case, which is fully validated, socially accepted, and structured for large-scale implementation. By following this systematic approach, metaCCAZE ensures that urban mobility solutions are not only effective but also scalable and replicable, supporting cities in their transition towards sustainable and smart environments.

To support this structured approach from ideation to pre-deployment, the table below offers a role-driven mapping of the pre-deployment Use Case development process, based on the core methodology of WP1. It is organized around four main targets (roles): City Officers, Citizens, Stakeholders, and other relevant organization to provide technical support to cities (City Supporters). Each role is associated with key tasks—Use Case Definition, Business Innovation & Governance Models (BIGMs), Social Embracement, and Impact Evaluation (SIEF)—reflecting the comprehensive scope of WP1. The corresponding activities illustrate the practical contributions of each actor, from co-developing pilot concepts and defining governance logic to validating user acceptance and supporting technical or policy alignment. Finally, the "Target Output" column captures how each task links into the overarching methodology, showing the connection between individual contributions and the iterative co-creation process that underpins a robust, ready-for-deployment Use Case.

Table 1: Role-Based Mapping of Pre-Deployment Use Case Development in WP1

ROLE	TASK	ACTIVITY	TARGET OUTPUT
City Officer	Definition of Use Case	Identify city needs, co-developing Use Case definitions tailored to local contexts	Use Case Template (WHAT – WHY)
	BIGMs	Defining operational structures, stakeholder roles, and potential funding mechanisms	Business Innovation & Governance Model (BIGM)
	SIEF	Setting KPIs, define data sources and calculation methods according to the SIEF methodology. Getting ready for base-line data collection	Standardised Impact Evaluation Framework (SIEF)
	Social Embracement	Collecting perceptions, challenges and concerns about the innovations being proposed	Co-design tools, behavioural readiness surveys
Citizens	Definition of Use Case	Validation activities (see LL2 + LL4 description) Maximize the uptake (see LL3 description)	Use Case Template
	BIGMs	Identifying incentives, expectations, and citizen role	Business Innovation & Governance Model (BIGM)
	Social Embracement	Assessing willingness to adopt or pay, reactions to service characteristics, and understanding potential impacts and concerns about the proposed innovation	Co-design tools for behavioural change, awareness campaigns

Stakeholders	Definition of Use Case	Validation activities (see LL2 + LL4 description) Maximize the uptake (see LL3 description)	Use Case Template
	BIGMs	Define synergies with public/private sector goals	Business Innovation & Governance Model (BIGM)
City Supporter	Definition of Use Case	Technical & Operational or policy support	Use Case Template (HOW)
	BIGMs	Define roles, business logic	Business Innovation & Governance Model (BIGM)
	Social Embracement	Collect perceptions, challenges and concerns about the innovations being proposed	Co-design tools, behavioural readiness surveys

The methodology used is based on the analysis and impact monitoring of 12 use cases in 4 Mission cities (The trailblazer cities).

Overview of metaCCAZE Use Cases by Trailblazer City

City	Use Cases
Amsterdam	- AM-UC01: Autonomous electric waterborne vessels for logistics - AM-UC02: Adaptive Speed Governance for connected e-bikes - AM-UC03: Optimising intermodality in urban waste collection - AM-UC04: Tradable Mobility Credits (TMC) scheme
Munich	- MU-UC01: Dynamic Curbside Management (DCM) - MU-UC02: Establishment and operation of multimodal logistics hubs
Limassol	- LI-UC01: On-demand mini-bus service - LI-UC02: Shared e-bikes - LI-UC03: Multimodal passenger hub - LI-UC04: Transport and Energy Integration Platform
Tampere	- TA-UC01: Autonomous e-shuttles with advanced remote control and inductive charging - TA-UC02: Tram feeder service with advanced remote control and inductive charging

2.2. Analysis: The Prototype Use Cases [T1.2] and the Business Innovation & Governance Models [T1.3]

2.2.1. What are they about and the importance of their role

Cities often struggle to define, structure, and parameterize their mobility solutions due to a lack of standardized frameworks and methodologies. This challenge underscores the necessity for a structured and standardized methodology that enables cities to develop scalable and transferable solutions effectively. To address this, the metaCCAZE project developed a Prototype Use Case Template as one of the key outcomes of Task T1.2. This task focused on co-developing use case definitions tailored to local contexts in collaboration with cities, particularly through the cocreation workshops (metadesign activities) conducted in LL2 and LL3. These sessions were instrumental in ensuring that the identified mobility challenges, stakeholder needs, and operational conditions were properly reflected in the proposed solutions. Complementing this, Task T1.3 focused on the development of Business Innovation and Governance Models (BIGMs), which define operational structures, stakeholder roles, and potential funding mechanisms. These models were validated during the LL4 phase, where cities assessed the governance feasibility and operational scalability of the proposed use cases.

The Use Case Template is built upon the **CEN-CENELEC CWA 17381:2019** standard for Urban Innovation Use Cases, with tailored adaptations for the **metaCCAZE** project. The structured use case format is defined in **DIN SPEC 91387**, ensuring consistency in how cities **conceptualize, evaluate, and scale** smart city and urban solutions. By creating the **"DNA" of transferable use cases**, this template allows cities to seamlessly implement solutions tailored to their specific conditions while maintaining alignment with proven methodologies. This standard provides a **proven methodology**, having been applied successfully in **over 650 Use Cases**, ensuring scalability, replicability, and adaptability across diverse urban environments. Several **tailoring sessions** conducted within the **metaCCAZE consortium** contributed to the refinement of the **Prototype Use Case Template**, ensuring its alignment with **urban innovation standards** and enhancing its applicability across diverse city contexts.

BIGMs (Business Innovation and Governance Models) are frameworks designed to define and structure the collaborative roles, responsibilities, and interactions of stakeholders involved in implementing innovative use cases. They also outline the economic and value-creation mechanisms for ensuring the sustainability and scalability of these use cases. BIGMs are critical for aligning stakeholder efforts, optimising resource allocation, and ensuring compliance with regulatory frameworks.

Why BIGMs are Important Before deployment

1. **Clarity on Stakeholder Roles**: BIGMs establish clear roles and responsibilities for each stakeholder (e.g., operational, infrastructure, regulatory, and beneficiary), reducing ambiguity during implementation.
2. **Collaboration Framework**: They define how stakeholders interact, collaborate, and share resources to achieve the use case goals.
3. **Risk Mitigation**: By identifying dependencies and potential conflicts early, BIGMs help mitigate risks associated with governance or business model misalignment.
4. **Scalability**: A well-defined BIGM ensures that the use case can be scaled or replicated in other contexts with minimal adjustments.
5. **Financial Sustainability**: The business innovation component ensures that the use case has a viable revenue model, cost structure, and value proposition.

6. **Regulatory Compliance**: The governance model ensures alignment with local policies and regulations, avoiding legal or operational roadblocks during deployment.

By working on BIGMs before deployment, stakeholders can ensure that the use case is not only technically feasible but also economically viable and operationally sustainable in real-world conditions.

2.2.2. How are they being addressed

Following the tailored workshop sessions and the following discussions with city officers explained below (chapter Interaction with city actors), the following schema represents a logical sequence (Why, What, How) of crucial fields to be included in the Use Case structure. These fields ensure a comprehensive, standardized, and adaptable methodology for defining, implementing, and scaling urban mobility solutions. Below is a breakdown of these fields, their interconnections, and the justification for their inclusion:

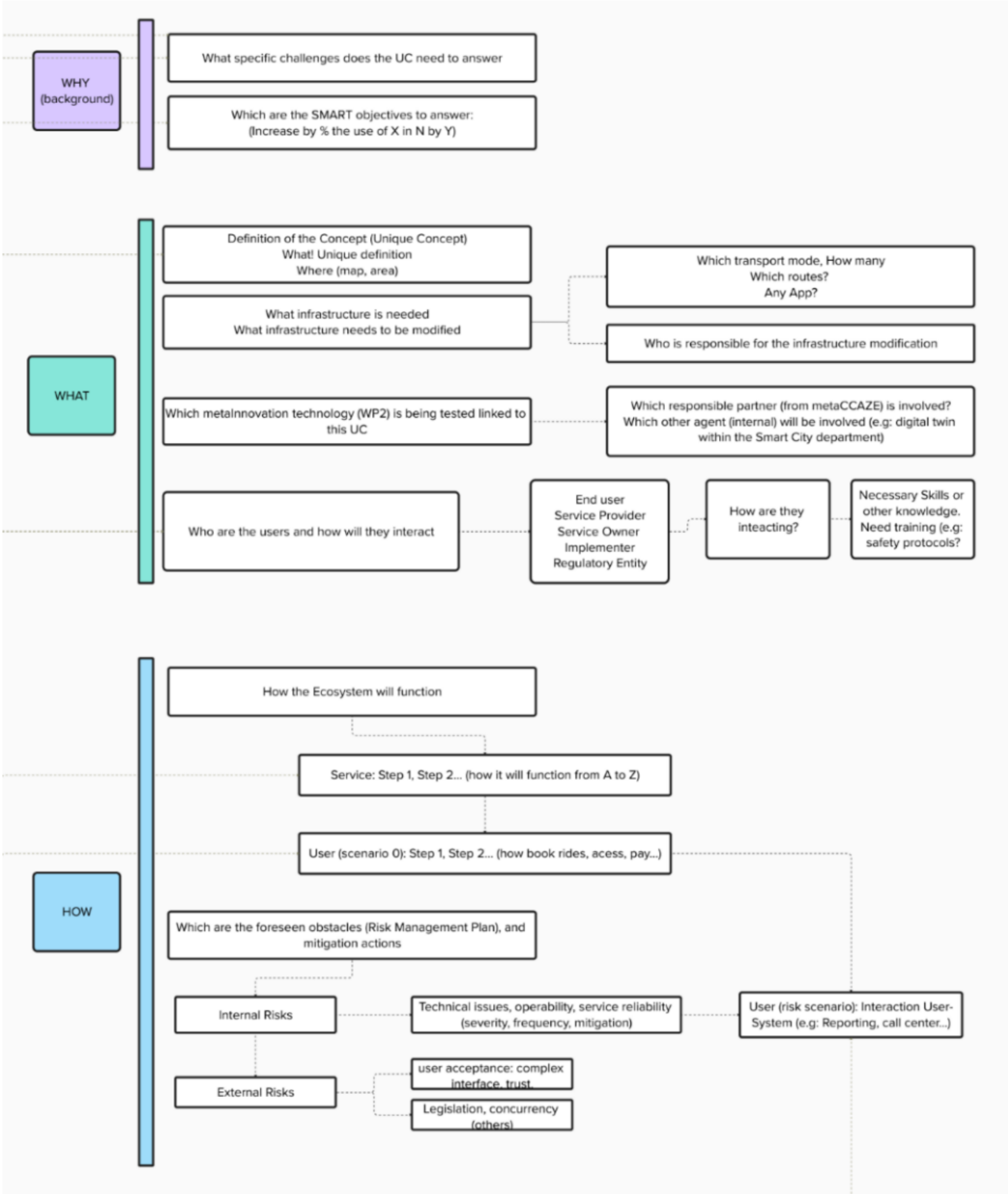


Figure 4: Structure of the Use Case Template and BIGMs (Why, What, How)

Why: Context and Justification

This section provides the background information necessary to understand the need for the Use Case and its relevance to the city's broader goals.

The **Challenges Addressed** field defines the core urban mobility problems the Use Case aims to resolve, such as congestion, air pollution, and safety concerns. This ensures that the solution is demand-driven and directly responds to the specific needs of the city. Including **Climate and**

Environmental Objectives aligns the Use Case with climate neutrality and sustainability targets, linking mobility initiatives to overarching policies like reducing CO2 emissions.

Cities must set **SMART Objectives** (Specific, Measurable, Achievable, Relevant, and Time-Bound) to provide measurable goals, such as increasing shared mobility usage by 20% within two years. This approach ensures clear benchmarks for assessing progress. To support these objectives, it is crucial to incorporate **Supporting Data and Evidence**, such as statistics, survey results, or previous case studies. An evidence-based approach strengthens the justification for the Use Case and enhances credibility when seeking stakeholder support.

What: Definition and Implementation Requirements

This section defines the Use Case in detail, including its scope, necessary infrastructure, operational dependencies, and potential risks.

The **Use Case Concept Definition** outlines a clear and unique definition of the proposed solution and explains how it differentiates from existing mobility solutions. This ensures clarity in purpose and highlights the novelty of the approach. The **Location and Area of Influence** field describes where the solution will be implemented, supported by maps and connectivity details to existing mobility networks. This field ensures that the Use Case is strategically integrated into the urban landscape.

A detailed overview of **Infrastructure Requirements** is necessary to identify both physical and digital infrastructure needs, such as bike lanes, transit hubs, or digital payment platforms. This ensures all required components for successful deployment are planned in advance. Identifying **Stakeholder Responsibilities** clarifies the roles of city authorities, private partners, or public-private partnerships (PPPs), ensuring accountability and efficient coordination. Additionally, the **Infrastructure Modifications** field highlights necessary adjustments to existing systems, such as accessibility improvements or new parking solutions. Addressing these aspects helps prevent integration issues.

The **Risk Assessment and Mitigation Strategies** section considers both internal risks (technical failures, financial sustainability) and external risks (user acceptance, regulatory barriers). Recognizing potential obstacles ensures proactive risk management, making the solution more resilient to unforeseen challenges.

How: Operational and Financial Aspects

This section details how the service will function, how users will interact with it, and the financial considerations for implementation.

The **Service Operation Under Normal Conditions** field describes how the system will function daily, including adjustments for peak and off-peak hours and integration with other transportation modes. This ensures that the Use Case is operationally feasible and scalable. Understanding **User Interaction and Accessibility** is equally important, as it defines how users will engage with the solution, including booking processes, pricing models, and accessibility for vulnerable groups. This ensures inclusivity and ease of adoption.

To ensure service reliability, the **Anomalous Scenarios and Contingency Plans** field outlines strategies for handling technical failures, cybersecurity risks, or unexpected disruptions. This enhances resilience and operational continuity. The **Financial Planning and Investment Needs** field breaks down initial investments required for hardware, software, staffing, and maintenance, ensuring financial feasibility and long-term sustainability. The inclusion of **Incentive Structures** ensures user engagement and promotes widespread adoption. Rewards, discounts, and priority access programs can enhance public interest and encourage behavioural shifts towards more sustainable mobility choices.

The methodology for developing the **metaDesigned** – ready for deployment - **Business Innovation and Governance Models (BIGMs)** in the metaCCAZE project was executed through an iterative, stakeholder-driven process, ensuring cross-city scalability and alignment with urban mobility objectives, as shown in the table below.

Data Collection & Stakeholder Mapping	**Stakeholder Identification**: Leveraged Why-What-How documents to update the map of stakeholders for each UC, distinguishing between generic categories (e.g., "Municipality") and adding specific entities (e.g., *Amsterdam Municipality* for AM-UC01). This dual classification ensures replicability while retaining local context. **Role Clarification**: Updated stakeholder roles using input from Living Lab (LL) workshops to detail the specifics of pilot operations. For example, in **LI-UC01** (on-demand mini-buses), EMEL (public transport operator) was designated as the focal organisation for fleet management, while MaaSLab provided routing algorithms. **Stakeholder Engagement Status Classification**: To clarify the current level of involvement of identified stakeholders, each has been assigned an engagement status. These labels help communicate the project's strategic approach to stakeholder coordination across its different phases: • **Confirmed**: Stakeholders actively involved and committed to current project activities. • **In Discussion**: Stakeholders engaged in ongoing dialogue; roles and participation are under consideration. • **To Be Contacted**: Stakeholders identified as relevant, with planned outreach before pilot commences. • **Future Engagement**: Stakeholders not required during the initial phases, but expected to contribute once operations are underway. This classification supports a phased and flexible stakeholder engagement strategy aligned with the project's evolving needs.
Business Model Validation	**Model Type Selection**: Confirmed the use of the **Classic Business Model Canvas** for single-provider UCs (e.g., *NextBike* in LI-UC02) and the **Service-Dominant Business Model Radar (SDBM/R)** for multi-actor ecosystems (e.g., *MU-UC02's logistics hubs*). • **Note on SDBM/R Representation**: Due to the large number and diversity of stakeholders involved in the project, it was not feasible to

	represent the Service-Dominant Business Model Radar (SDBM/R) using a traditional radial diagram. To maintain clarity and accurately reflect stakeholder roles and relationships, the SDBM/R-related data is instead presented in a structured table format. This approach allows for more detailed descriptions and status indicators while preserving the model's logic and intent. **Cost-Revenue Analysis**: Refined revenue streams (e.g., subscription fees for shared e-bikes) and cost structures (e.g., inductive charging infrastructure in TA-UC01) through financial simulations and LL feedback.
Governance Structuring	**Four-Category Framework**: Stakeholders were classified into: ▪ **Four-Category Framework**: Stakeholders were classified by their type of role / interest: o **Regulatory & Support**: Municipalities (permits, policy alignment). o **Infrastructure**: Entities managing physical/digital assets (e.g., charging stations). o **Operational**: Service providers (e.g., *Roboat* for vessel software in AM-UC01). o **Beneficiary**: End-users (e.g., commuters using tram-feeder services in TA-UC02). ▪ **Interaction Mapping**: Defined dependencies (e.g., Amsterdam Police enforcing e-bike speed limits in AM-UC02
Co-Development with Living Labs	**Stakeholder Workshops**: Conducted iterative sessions with LL partners to: • Co-design governance structures. • Align value propositions with city-specific goals (e.g., Limassol's integration of LI-UC04 with climate neutrality targets). **Prototype Refinement**: Adjusted UC parameters based on LL feedback, such as optimising waste collection routes in AM-UC03 using TU Delft's algorithms. **Cross-City Scalability Checks**: Validated that generic stakeholder categories (e.g., "Technology Provider") could adapt to diverse contexts.
Finalization & Approval	**LL Leader Feedback**: Incorporated revisions from LL leaders, ensuring BIGMs balanced innovation with local regulatory compliance. **Deployment-Ready Models**: Delivered BIGMs with modular governance templates, enabling cities to adjust roles.
Identification of changes from prototypical to	**BIGM Changes:** Any changes to the BIGMs were highlighted in each use case. **Structured Governance for Cross-City Scalability:** The BIGMs' framework ensures replicability through:

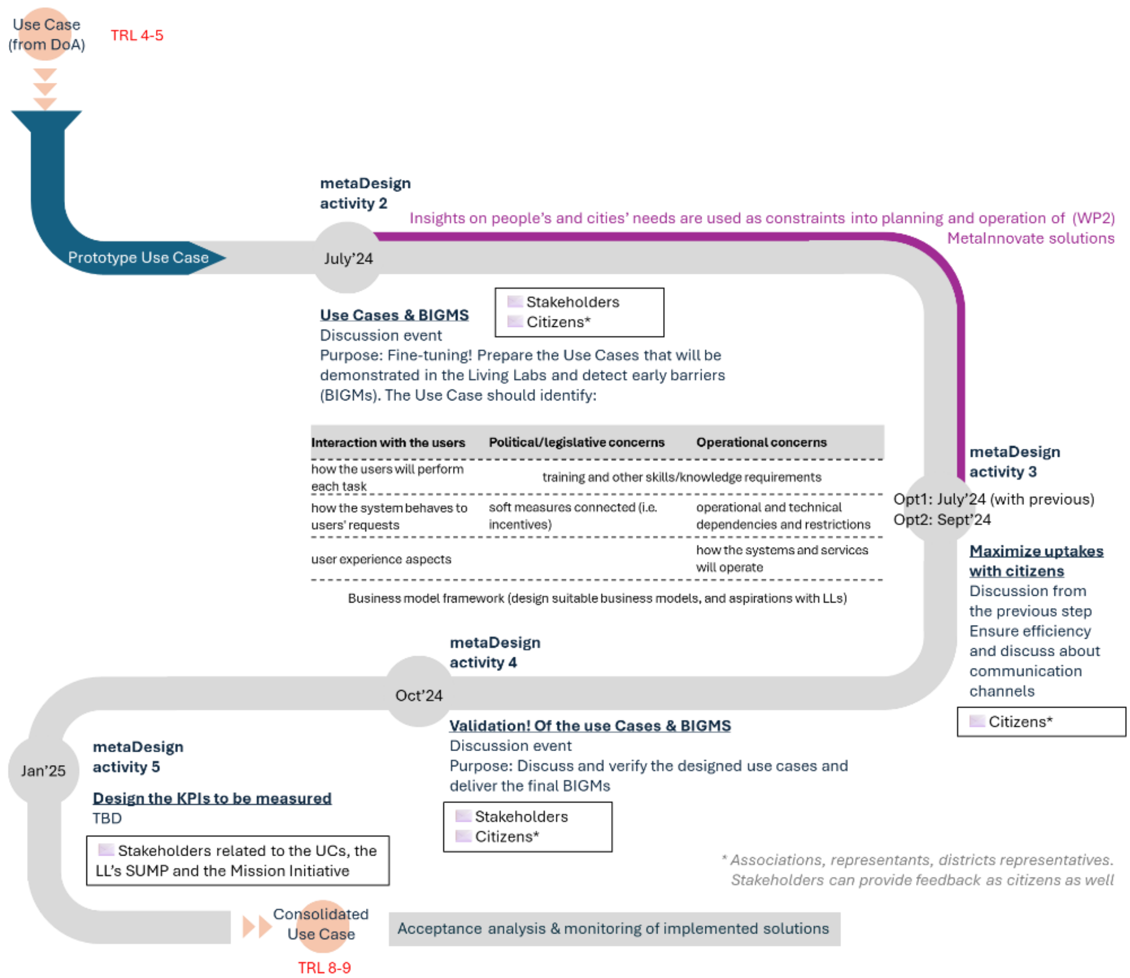
ready for deployment BIGM	**Modular Design**: Generic stakeholder roles (e.g., "Infrastructure Provider") allow cities to plug in local entities without redesigning the entire model. **Policy Harmonization**: Regulatory templates (e.g., safety protocols for e-bikes) align with EU mobility directives, reducing implementation barriers. **Funding Flexibility**: Multi-source revenue streams (e.g., public-private partnerships for MU-UC02 hubs) cater to varying fiscal environments.

This methodology underscores how iterative co-creation and validation in Living Labs ensure that BIGMs are both context-aware and scalable, addressing the metaCCAZE project's goal of fostering interoperable, sustainable urban mobility ecosystems.

These refined templates and governance models serve as the foundation for the Trailblazer Use Cases presented in the following chapters, where their practical application is demonstrated across varied urban contexts.

2.2.3. The metaDesign process

The Living Lab (LL) activities within the metaCCAZE city ecosystem framework are essential for the successful deployment, validation, and scaling of Zero-Emission Shared Mobility (ZESM) solutions. These activities provide a structured, iterative, and co-creative approach that ensures mobility innovations are not only technologically viable but also aligned with real-world user needs and urban challenges. Without such a framework, cities risk inefficient resource allocation, low adoption rates, and fragmented implementation efforts.



A user-centric approach is at the core of LL activities. By engaging citizens, local stakeholders, and transport users, these activities help shape solutions that reflect real mobility behaviors, needs, and expectations. Through tools such as empathy mapping, stakeholder dialogues, and data-driven research, the solutions developed are designed to enhance accessibility, efficiency, and overall user experience.

In addition to user engagement, stakeholder collaboration is a key driver of LL activities. These initiatives create a multi-stakeholder environment, bringing together municipal authorities, industry partners, mobility operators, and researchers. By fostering dialogue and co-creation, LL activities facilitate collective ownership of mobility solutions, leading to higher acceptance and smoother policy integration.

Another significant benefit of LL activities is the cross-fertilization of ideas. By exchanging insights across multiple cities, LLs ensure that best practices are transferred, adapted, and improved based on diverse urban contexts. This approach enhances the replicability and scalability of ZESM solutions, making them more adaptable to different regulatory, economic, and social conditions.

Furthermore, LL activities play a crucial role in defining economic and governance models. The development of Business Innovation and Governance Models (BIGMs) allows cities and mobility providers to establish financially viable and regulatory-aligned frameworks for long-term success. By considering funding strategies, operational responsibilities, and policy requirements, these models ensure that mobility solutions are sustainable beyond the pilot phase.

Lastly, LL activities emphasize impact monitoring and scalability. Through the definition of Key Performance Indicators (KPIs) and the Standardized Impact Evaluation Framework (SIEF), they provide a data-driven methodology to measure, refine, and scale successful mobility solutions. This structured evaluation process ensures that cities can track progress, make informed decisions, and continuously optimize mobility services for greater efficiency and broader adoption.

By integrating these elements—user engagement, stakeholder collaboration, cross-city learning, governance structuring, and impact assessment—LL activities serve as a foundation for scalable, sustainable, and user-friendly mobility innovations that support the transition towards zero-emission shared mobility.

The activities designed in the metaCCAZE city ecosystem framework play a crucial role in ensuring the effective deployment and scalability of Zero-Emission Shared Mobility (ZESM) solutions. These activities, particularly the Living Lab (LL) metadesign activities, provide a structured approach to co-designing and validating mobility innovations while engaging stakeholders from various sectors:

As part of the metaCCAZE project's co-design and innovation development approach, a sequence of metadesign activities was designed and implemented within the four Trailblazer Living Labs (LLs). These activities—carried out through LL2, LL3, and LL4—constitute a structured and iterative process to collaboratively define, refine, and validate innovative zero-emission shared mobility solutions. They are grounded in user-centred and multi-stakeholder engagement methodologies to ensure that each solution reflects the unique characteristics and needs of the respective urban context. The following sections outline the scope, methodology, and objectives of each metadesign phase.

LL2: Metadesign of Use Cases and Business Innovation & Governance Models (BIGMs)

This activity represents a critical step in the metadesign process, focusing on the co-design and fine-tuning of the prototype Use Cases (UCs) and their associated Business Innovation and Governance Models (BIGMs). These activities aim to ensure that the proposed mobility solutions respond directly to the contextual needs, barriers, and opportunities identified by each city, as well as to the inputs provided by local stakeholders and citizens.

Conducted through physical workshops, LL2 activities facilitate a participatory process in which citizens, mobility operators, and other relevant actors are invited to review the initial UC prototypes.

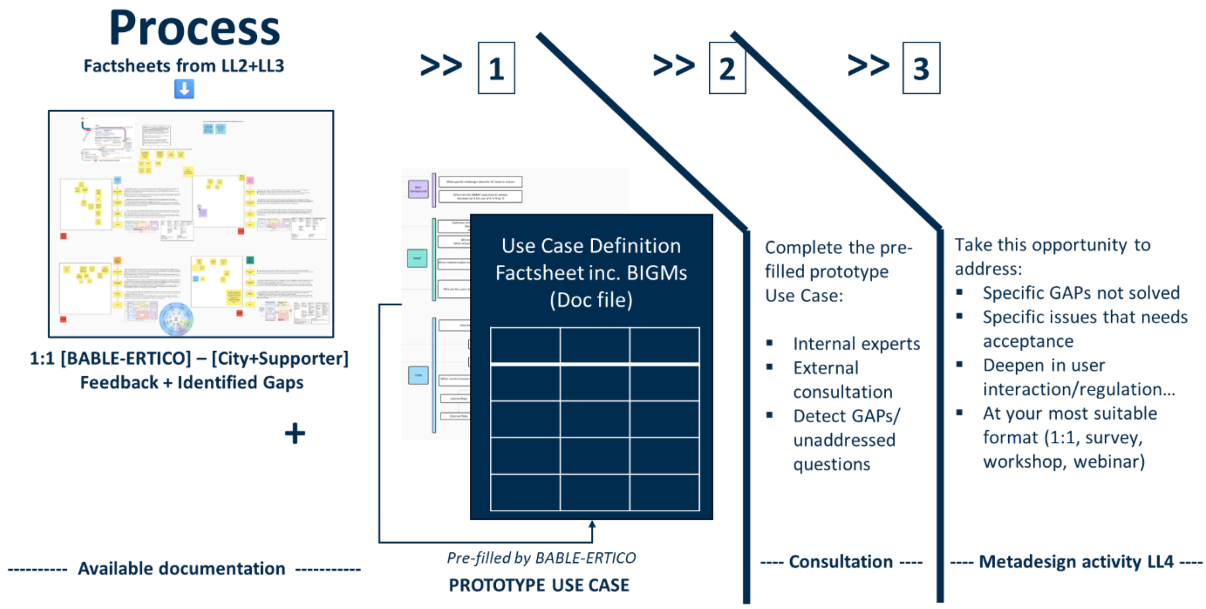
All workshop materials, including tailored pitch presentations, annotated agendas, and factsheet templates, are developed centrally (e.g., by BABLE) and localized by each city's supporting partner to ensure alignment with local context and policy goals. The LL2 activity outcomes form the foundation for finalizing the demonstration-ready Use Cases and their BIGMs, feeding directly into the subsequent validation and deployment phases.

LL3: Maximizing the Uptake of MetaServices

LL3 activities are designed to build upon the work of LL2, with a specific focus on increasing the societal acceptance and potential uptake of the metadesigned mobility solutions. These workshops aim to gather focused feedback from citizens concerning the attractiveness, usability, and relevance of the proposed solutions, particularly from the perspective of behavioural adoption and day-to-day integration.

The LL3 sessions are organized as citizen-centric forums where participants are encouraged to reflect on the outcomes of LL2 and contribute ideas on how to maximize the impact and acceptance of the proposed UCs and services. Discussions focus on identifying perceived barriers, communication preferences, incentives, and support mechanisms that would influence user engagement. Stakeholders may also take on the role of "citizens" during these sessions, offering insights from a personal—not institutional—perspective.

These sessions typically follow LL2 activities on the same day to capitalize on participant engagement and workshop momentum. The interactive format may include role-playing, mapping exercises, and moderated group discussions. The feedback collected during LL3 supports the design of marketing strategies, user experience elements, and engagement campaigns, contributing directly to the social embracement and communication components of the project.



LL4: Validation of Use Cases and BIGMs

LL4 serves as a pivotal moment in the metadesign process, where the refined Use Cases and BIGMs are formally validated with stakeholders. The objective of LL4 is to confirm the feasibility, clarity of roles, and alignment of responsibilities among actors involved in the upcoming demonstration phases. This stage ensures that all components—technical, operational, financial, and governance-related—are adequately defined and agreed upon. First, a pre-filled Prototype Use Case fact sheet (including BIGMs) was provided to each city based on LL2 and LL3 outcomes. This was followed by a one-on-one consultation between BABLE/ERTICO and each city with its supporter, to clarify feedback and identify remaining gaps. Lastly, cities conducted local validation activities—such as workshops, surveys, or interviews—to address unresolved issues, ensure stakeholder alignment, and confirm implementation feasibility. This process enabled cities to finalize their Use Cases and BIGMs through both technical and participatory input, forming a robust foundation for the upcoming demonstration phase

Table 2: LL4 Activity Summary Table in Trailblazer Cities

CITY	UC	STAKEHOLDER	FORMAT	# ATTS	KEY FINDINGS
Mun.	MU-UC01	Municipal Traffic Enforcement Agency	In-person meeting	3	Clarified how to integrate DCM violations into enforcement mechanisms; stressed need for digital curb monitoring

CITY	UC	STAKEHOLDER	FORMAT	# ATTS	KEY FINDINGS
	MU-UC01	Fraunhofer Fokus	Online exchange	5	Introduced GDPR-compliant traffic monitoring; relevant for long-term data collection
	MU-UC01	Stadtwerke München	In-person exchange	5	Discussed integrating DCM functionalities into existing city mobility apps
	MU-UC01	EIT Urban Mobility	Online exchange	3	Shared lessons from EU smart curb projects on policy and business models
	MU-UC01	Online Retailers & Taxi Reps	Individual interviews	Not specified	Input on curbside delivery and ride-hailing needs
	MU-UC02	Amsterdam Micro-Hub Operators (PostNL, AMS)	Site visit	5	Emphasized importance of multi-operator logistics hub models for financial viability
Ams.	AM-UC01	Authorities (Autonomous Navigation)	Online interviews	2	Complex approvals required from multiple regulatory bodies
	AM-UC02	Policymakers & Cycling Advocacy Groups	Public stakeholder consultation	20+	Trade-offs between enforcement and public acceptance noted
	AM-UC03	Waste Managers & Logistics Planners	Expert interviews	4	Quay wall constraints require hybrid road-water waste collection
	AM-UC04	Corporate Stakeholders	Online discussion	30+	Corporates concerned mobility credits might discourage office commutes
Lim.	LI-UC01	Parents & Drivers	Focus groups	12 (7+5)	Safety and convenience prioritized by parents; drivers open to seasonal operations
	LI-UC02	Municipality & NextBike	Online session	10	Decided to use existing infrastructure for shared e-bikes
	LI-UC03	Municipality & Ministry of Transport	Workshop	8	Land ownership issues identified as timeline risk
	LI-UC04	Electricity Authority, EMEL, MaaSLab	Online workshop	Not specified	Real-time energy management highlighted as a barrier
Tam.	TA-UC01	Lintuhytti Residents	Survey	15	Residents want real-time updates and better accessibility in autonomous shuttle services
	TA-UC02	Public Transport Authority	Interviews	5	Service must adapt to weather variability for long-term success

2.2.4. The expected outcomes

The outcomes of Task T1.2 and T1.3 significantly enhance the robustness and deployment-readiness of the metadesigned Use Cases, ensuring each Use Case has a clearly defined deployment DNA—combining structure, governance, and stakeholder consensus. The expected outcomes from the development of the Use Cases definition and the Business Innovation & Governance Models are:

1. Ready-for-Deployment MetaDesigned Use Cases: These Use Cases are now fully defined using the WHY–WHAT–HOW logic, providing a structured, standardized format based on the CEN-CENELEC CWA 17381:2019 and DIN SPEC 91387 standards. The result is a coherent and replicable set of solutions that cities can implement with clear operational logic, risk mitigation plans, and user interaction pathways.
2. Modular and Transferable BIGMs: The results include clearly mapped stakeholder roles, funding mechanisms, operational dependencies, and regulatory needs. Thanks to their modular structure, BIGMs can be easily adapted by other cities, supporting scalability and cross-city transferability while maintaining contextual relevance.
3. Stakeholder-Validated Structures: Both the Use Cases and BIGMs have been iteratively validated through stakeholder engagement in the metadesign sessions. These included input from municipal authorities, mobility providers, citizens, and private sector actors, ensuring that the proposed solutions are realistic, implementable, and responsive to local needs.
4. Foundation for Implementation in WP3: The outcomes from T1.2 and T1.3 represent the “deployment DNA” for WP3. They offer a common language, tools, and frameworks that will directly support the transition of these Use Cases from planning to real-life demonstration, minimizing ambiguity and streamlining coordination between partners.
5. Increased Alignment between Innovation, Governance, and Behavioural Realities: By developing Use Cases and BIGMs in parallel and under a unified logic, cities now possess fully aligned blueprints that combine technological feasibility, operational viability, and governance clarity—while also being socially embraced and validated during LL4.

These outcomes ensure that the Use Cases are not only innovative on paper but also institutionally grounded and practically implementable, helping metaCCAZE cities lead the way in scalable zero-emission shared mobility.

2.3. Analysis: Social Embracement, incentivisation, and behavioural change exploration tools [T1.5]

2.3.1. What is it about and its importance

A successful implementation of a new mobility innovation depends not only on its technological advancements and potential benefits but also, and more importantly, on attracting and retaining users while maintaining stakeholder support. Therefore, gathering insights from both stakeholders and potential users, and tailoring the final innovation product/solution to meet the needs of both parties, becomes crucial in increasing the likelihood of success. **Social embracement activities** play a key role in promoting opportunities to collect both qualitative and quantitative data, which can be used in the design and assessment of innovations. To ensure efficient and strategic social embracement activities, it is essential to clearly define four key pillars: **who** the interested parties are, **what** key information should be collected, and **how** and **when** this data should be collected.

The **metaCCAZE Social Embracement Activities** focus on assessing and enhancing user acceptance and the overall effectiveness of the metaCCAZE innovations. These activities are included in T1.5, which focuses, more specifically, on:

- **Developing data collection tools** to evaluate social embracement, readiness, behavioural change, and the efficiency of the metadesigned UCs, as well as their impact on users' travel patterns and operations.
- **Analysing the collected data** to inform and support developments across WP1 to WP5, ensuring that findings contribute to both the development and assessment of the metaCCAZE concepts.
- **Recommending nudging and incentivisation strategies** to enhance the attractiveness and adoption of the services.

The task process begins in **month 4** and continues until **month 41**. Initially, the task includes activites in all T-LL. Then, after month 18, the transferability activities between the T-LL and F-LL start, ensuring that insights and findings are effectively applied across different contexts.

2.3.2. How is this addressed

The metaCCAZE approach for T1.5 integrates social embracement and behavioural surveys across LLs, covering both passenger and freight demonstration services. These surveys are designed for citizens, stakeholders, and service providers, ensuring that they include questions that measure specific KPIs outlined in the SIEF. These surveys will be conducted at two rounds within the Living Labs: (1) **Post-co-design phase:** after the LLs have co-designed the UCs, to collect data prior to the implementation phase, (2) **During and after implementation**: during/after the demonstration phase, to gather feedback for refining the services and innovations in real time and to evaluate the overall impact and effectiveness of the UCs. The figure below shows an overview of the metaCCAZE approach.

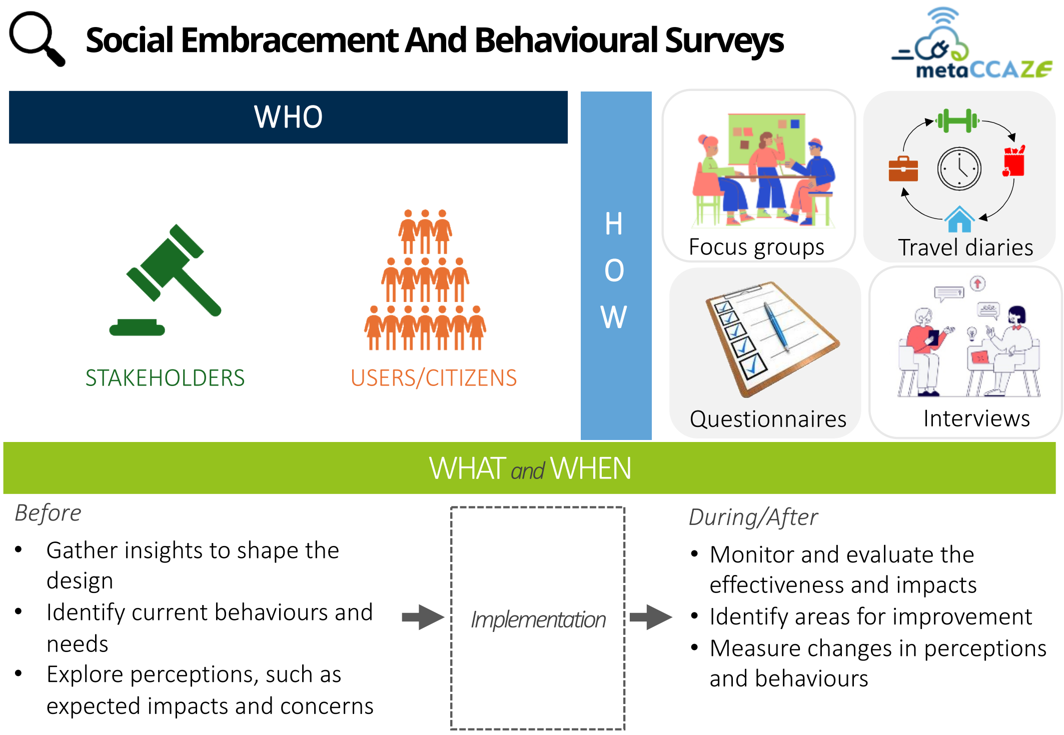


Figure 5: Social embracement and behavioural surveys framework (Who, How, What, and When)

Stakeholder surveys target local authorities and companies that are either involved in the service provision or affected by it, such as the municipalities and public transport operators. These surveys aim to collect perceptions, challenges and concerns about the innovations being proposed. Before the implementation, these surveys help understanding expectations and needs that can feed the development of the innovation. During the implementation, these surveys are tools to monitor and evaluate the implementation, being able to identify areas of improvement. After the implementation, these surveys are used to understand the effectiveness of the measures and identify changes in the perceptions and opinions of the stakeholders. These data are collected using focus groups and semi-structured interviews.

Citizen surveys focus on specific groups directly impacted by the UCs, such as current and potential users, as well as the general population within the LL. The primary goal of these surveys is to support a user-centred approach to service design by gathering opinions and perceptions about the proposed innovation. This includes assessing willingness to adopt or pay, reactions to service characteristics, and understanding potential impacts and concerns. The surveys also capture travel behaviours, providing data that allows for modelling and studying the introduction of the innovations, ensuring a more effective implementation. Additionally, these surveys play a crucial role in evaluating and monitoring the service during and after implementation. Various methods are used to collect this data, including focus groups, semi-structured interviews, and travel diaries.

A clear and structured process has been established to design, gather, and monitor surveys and questionnaires for each LL, led by the Scientific Responsible partners. The aim of this process is to ensure, from the very beginning, that the surveys are effective in achieving the expected outcomes and that the collected data adheres to FAIR principles and ethical standards (in collaboration with T6.6). The process begins with the definition of survey plans for each LL and UC. These plans outline the objectives, expected timelines, target population, methodologies, tools, available budget for data collection (which may include hiring panel companies), and KPIs to be measured. The survey plans are gathered, reviewed, and discussed to ensure their effectiveness and alignment with the SIEF. Then, questionnaires are designed according to the timelines of each UC, using a standardized template provided to all LLs. The questionnaires are carefully reviewed before the surveys take place to ensure that the expected KPIs are captured and that the data collected adheres to FAIR principles, ensuring it is reusable beyond the metaCCAZE extension.

2.3.3. The interaction with city actors.

The **metaCCAZE Social Embracement Plan** includes 23 surveys to support the 12 UCs in the 4 T-LL. From these surveys, 12 focus stakeholders and 11 are directed to citizens. The overall plan for each survey is tailored to its respective UC to ensure that transportation strategies align with the specific needs and characteristics of each use case.

MUNICH: Dynamic Curbside Management & Multimodal Logistics Hubs

The Munich UCs aim to reduce car traffic while enhancing road safety and environmental protection. **MU-UC01** focuses on implementing a dynamic curbside management (DCM) system in selected districts of Munich, where curbside spaces will be digitally mapped, managed, and monitored to optimize their use by logistics companies, local vendors, public utilities, taxis, and on-demand mobility services. Additionally, this UC includes the development of a connected, semi-automated, zero-emission Rickshaw for last-mile passenger and freight transport. **MU-UC02** evaluates the use of logistics hubs to facilitate last-mile delivery of parcels and freight using cargo bikes and other energy-efficient vehicles. To support these UCs, four surveys are planned to collect data for monitoring, assessing, and refining their implementation (see an overview in table below).

Table 3: Overview of Munich Survey Plans

(MU-UC01) Dynamic Curbside Management (DCM) S1 (Stakeholders)	
Objective	• Explore stakeholders' expectations, anticipating challenges and concerns [Before] • Evaluate stakeholders’ perceptions of the service, including user acceptance and potential areas for improvement [During/After]
Target	Municipality of Munich (Mobility Department), logistics company using the service, and craftspeople using the service
Data collection tools	Semi-structured interviews and online questionnaires
Estimated dates	Before: Apr-June/25 | During/After: Apr-May/26
(MU-UC01) Dynamic Curbside Management (DCM) S2 (Citizens/Users)	
Objective	• Assess the negative perception of double-parking, the awareness and acceptance of the DCP, the expected benefits [Before] • Monitor satisfaction, track awareness of project activities, and identify challenges and areas for improvement while monitoring perceived benefits [During/After]
Target	Residents of the neighbourhood where the DCM zones are implemented and local business owners in the affected streets

Data collection tools	Online questionnaires
Estimated dates	Before: Apr-June/25 | During/After: Apr-May/26
(MU-UC02) Establishment and operation of multimodal logistics hubs S3 (Stakeholders)	
Objective	• Examine stakeholders' expectations, evaluates acceptance, anticipates challenges and concerns, and detects special needs [Before] • During implementation, it monitors the service rollout, assesses alignment with expectations, tracks acceptance and satisfaction, identifies areas for improvement, and evaluates perceived impacts [During/After]
Target	Municipality of Munich (Mobility Department) and the logistics company using the hub
Data collection tools	Semi-structured interviews and online questionnaires
Estimated dates	Before: Apr-June/25 | During/After: Apr-May/26
(MU-UC02) Establishment and operation of multimodal logistics hubs S4 (Citizens/Users)	
Objective	• Assess perceptions of delivery vehicle, evaluate acceptance of the concept; and identify expected benefits [Before] • Monitor satisfaction, track awareness of project activities, identify challenges and areas for improvement, and evaluate perceived benefits. [During/After]
Target	Residents of the neighbourhood where the DCM zones are implemented and business owners served by the cargo bikes
Data collection tools	Online questionnaires
Estimated dates	Before: Apr-June/25 | During/After: Apr-May/26

AMSTERDAM: Autonomous Sailing, Adaptive Speed Governance, Waste Logistics & Mobility Credits

The Amsterdam UCs explore innovative mobility and logistics solutions to enhance sustainability and efficiency in the city. **AM-UC01** focuses on deploying autonomous electric vessels for logistics, starting with pilot tests in the Port of Amsterdam, with the long-term goal of integrating automated vessels into the city's complex waterways. **AM-UC02** aims to develop a dynamic speed regulation system that allows city officials to adjust speed limits in response to events, weather conditions, and construction. **AM-UC03** introduces a multi-modal waste collection system using light electric vehicles, electric cargo bikes, and electric barges to improve waste management in the city centre. This pilot seeks to optimize operations while addressing urban logistics challenges. Finally, **AM-UC04** explores the implementation of a Tradeable Mobility Credits (TMC) system, using a cap-and-trade approach to manage traffic-related environmental impacts. A digital twin platform will serve as a real-time dashboard, allowing for better mobility monitoring, planning, and citizen engagement. Together, these UCs aim to create a smarter, more sustainable, and adaptive urban transport ecosystem in Amsterdam. These UCs are supported by **eight surveys**, of which an overview is shown in overview in table below).

Table 4: : Overview of Amsterdam Survey Plans

(AM-UC01) Autonomous electric waterborne vessels for logistics S1 (Stakeholders)	
Objective	• Identify key logistics needs and pain points of potential users (e.g., distribution centres, beverage companies, municipality), understand stakeholders' perceptions of autonomous barges, including expected benefits and potential barriers, gather insights on safety concerns and regulatory compliance expectations from stakeholders; assess how much value stakeholders place on reducing emissions and congestion through waterborne transport; evaluate stakeholders' willingness to adopt [Before] • Monitor operational performance, user satisfaction, perceived environmental and community impact; and identify areas for improvement based on real-time feedback [During/After]
Target	Local Government Authorities, Logistics Companies, and Businesses and Retailers, Technology Providers, Environmental Groups, Public Transportation Operators
Data collection tools	Online surveys, focus groups, and interviews
Estimated dates	Before: Jan/26 | During/After: Jul-Sep/26
(AM-UC01) Autonomous electric waterborne vessels for logistics S2 (Citizens/Users)	
Objective	• Assess public awareness and perception towards safety, environmental impact, and potential risks of autonomous electric vessels, as well as user expectations, willingness to adopt the service, and satisfaction with its accessibility and ease of use [Before] • Monitor perceived benefits, such as congestion reduction and improved deliveries, while identifying operational challenges and areas for service enhancement. It also monitors public support and any emerging concerns [During/After]
Target	Residents of the inner city, commuters, local business owners, environmental and sustainability enthusiasts, community leaders and organization
Data collection tools	Online surveys, focus groups, and interviews
Estimated dates	Before: Jan/26 | During/After: Jul-Sep/26
(AM -UC02) Adaptive Speed Governance of connected e-bikes S3 (Stakeholders)	
Objective	• Explore the experiences of the respondents within the park, evaluate the effectiveness of nudges and safety interventions for cyclists, and examine whether park officials observe significant changes in cyclist behaviour [Before] • Monitor the impact of these measures and identify necessary adjustments [During/After]

Target	Park staff, the head of Amsterdam's National Cycling Association, and park users
Data collection tools	Semi-structured interviews
Estimated dates	Before: Feb25-April25 | During/After: Apr26-May26

(AM-UC02) Adaptive Speed Governance of connected e-bikes S4 (Citizens/Users)

Objective	• Investigate current cycling safety issues in the park, pinpointing high-risk areas and determining where safety measures are needed; evaluate the effectiveness of user interactions and interventions [Before] • Assess system performance, particularly the low-latency capabilities of the Mobile Network Operator, and identify areas for improvement [During/After]
Target	Citizen groups, Park staff, Entrepreneurs in the Park, Municipal Staff
Data collection tools	Semi-structured interviews
Estimated dates	Before: Feb-Jun/25 | During/After: Oct-Dec/25

(AM-UC03) Optimizing intermodality of waste collection in the urban systems S5 (Stakeholders)

Objective	• Analyse the municipality's needs regarding waste collection and assesses the current state of operations [Before] • Monitor and evaluate the efficiency and effectiveness of waste collection services [During/After]
Target	Municipality of Amsterdam
Data collection tools	Semi-structured interviews
Estimated dates	Before: Feb-Apr/25 | During/After: Apr-May/26

(AM-UC03) Optimizing intermodality of waste collection in the urban systems S6 (Citizens/Users)

Objective	• Examine citizens' initial perceptions of the waste collection service before its demonstration [Before] • Assess changes in their perceptions, resident's and identify potential improvements [During/After]
Target	Citizens of the city centre of Amsterdam
Data collection tools	Online questionnaires
Estimated dates	Before: Sep-Nov/25 | During/After: Oct-Dec/25

(AM-UC04) Tradable Mobility Credits (TMC) scheme S7 (Stakeholders)

Objective	• Investigate stakeholder acceptance of the TMC concept and their expectations for its impact [Before] • Monitor the system's performance, assessing whether it functions as expected, identifying unintended effects, and evaluating integration with existing company systems [During/After]
Target	Municipality of Amsterdam and companies implementing the credits system
Data collection tools	Semi-structured interviews
Estimated dates	Before: Feb-Apr/25 | During/After: Apr-May/26
(AM-UC04) Tradable Mobility Credits (TMC) scheme S8 (Citizens/Users)	
Objective	• Evaluate overall user acceptance of the system and gather feedback to refine operational strategies [Before] • Track system performance and collect insights on aspects that require improvement [During/After]
Target	Travelers who are employees of a company participating in the TMC scheme
Data collection tools	Online questionnaires
Estimated dates	Before: Feb-Jun/25 | During/After: Oct-Dec/25

LIMASSOL – On-Demand Mini-Buses, Shared E-Bikes, Multimodal Hub & Energy-Transport Integration

The Limassol UCs focus on enhancing urban mobility through technology-driven solutions. In **LI-UC01**, an on-demand mobility service with electric mini-buses and private vans is implemented, initially catering to school transport before expanding to tourists and city employees. In **LI-UC02**, a shared e-bike system with smart docking stations and AI-driven management to balance supply and demand is launched. In **LI-UC03,** a Mobility Hub is built to integrate multiple transport modes, including public transit, bike-sharing, and Park & Ride facilities, ensuring seamless connectivity. In **LI-UC04,** an IoT platform is developed to connect transport, EV charging, and the electricity grid, optimizing charging demand through data integration and smart guidance. To support these UCs, **seven surveys are planned** to gather valuable insights to refine and assess these innovations (see an overview of the surveys in overview in table below).

Table 5: Overview of Limassol Survey Plans

(LI-UC01 On-demand mini-buses service) S1 (Stakeholders)	
Objective	• Present the service for stakeholders (before) and explore their attitudes and perceptions about the service design, its potentials to be successful, and the expected impacts on traffic, safety, emissions, climate contract targets (before and during) [Before]

	• Explore if the participants have recommendations for further improving the service [During/After]
Target	Municipalities in the Limassol metropolitan area, Ministry of Transport, Traffic Police Department, Public Transport Operator, and Bus operators
Data collection tools	Semi-structured interviews and online questionnaires
Estimated dates	Before: Feb-Apr/25 | During/After: Apr-May/26

(LI-UC01 On-demand mini-buses service) S2 (Citizens/Users)

Objective	• Understanding how different population groups travel and understand what characteristics would attract potential users of the on-demand service and how they perceive this service [Before] • Assess changes in perception and travel behaviour, as well as user satisfaction [During/After]
Target	General population covering the Limassol metropolitan and users
Data collection tools	Focus groups, online questionnaires, and travel diaries
Estimated dates	Before: Dec/24-Jun/25 | During/After: Nov-Dec/26

(LI -UC02 Shared e-bikes) S3 (Stakeholders)

Objective	• Explore the expectations of stakeholders for the e-bike sharing service in terms of potential impacts on the city and challenges they expect to face in terms of charging, installation, locations, etc [Before] • Explore whether their previous expectations were met or not [During/After]
Target	NextBike and Municipality of Limassol
Data collection tools	Semi-structured interviews
Estimated dates	Before: Nov-Dec/24 |During/after: Nov-Dec/26

(LI-UC02 Shared e-bikes) S4 (Citizens/Users)

Objective	• Collect data on travel behaviours and opinions about the e-bike sharing service, including service attributes and potential impacts [Before] • Assess changes in opinions and travel behaviour, as well as user satisfaction [During/After]
Target	General population and users of e-bikes
Data collection tools	Online questionnaires and travel diaries

Estimated dates	Before: Jan-Jun/25 | During/After: Nov-Dec/26
(LI-UC03 Multimodal passenger hub) S5 (Stakeholders)	
Objective	• Present the mobility hub concept to stakeholders and explore their attitudes and perceptions about the design of the service, its potentials for success, its expected impact on traffic, safety, emissions, climate contract targets [Before] • Assess if there are any changes in their opinions after the launch of the hub and collect recommendations for further improvements [During/After]
Target	Municipalities in the Limassol metropolitan area, Ministry of Transport, and Public Transport Operator
Data collection tools	Semi-structured interviews and online questionnaires
Estimated dates	Before: Feb-Apr/25 | During/After: Apr-May/26
(LI-UC03 Multimodal passenger hub) S6 (Citizens/Users)	
Objective	• Explore citizens' opinions on mobility hubs, their expected impacts and hub attributes (e.g., services and facilities) [Before] • Evaluates the opinion of hub users about what services they use and their impressions on the impact of the hub [During/After]
Target	General population covering the Limassol metropolitan and users
Data collection tools	Focus groups, online questionnaires, and travel diaries
Estimated dates	Before: Jan-Jun/25 | During/After: Nov-Dec/26
(LI-UC04 Transport and Energy Platform) S7 (Stakeholders)	
Objective	• Strengthen relationships with stakeholders and investigate data availability and expectations on the functionalities and added value of such a platform [Before] • Assess whether the stakeholder expectations were met [During/After]
Target	Municipalities in the Limassol metropolitan area, Ministry of Transport, and Public Transport Operator
Data collection tools	Semi-structured interviews and online questionnaires
Estimated dates	Before: Feb-May/25 | During/After: Apr-May/26

The travel behaviour analysis in the citizen/user survey plans (**LI-UC01 S2, LI-UC02 S4**, and **LI-UC03 S6**) are addressed through a combined travel survey, which will include travel diaries to explore travel behaviour, as well as specific questions for each use-case service.

TAMPERE: Autonomous E-Shuttles & Tram-Feeder Services

The Tampere UCs explore the feasibility of using autonomous vehicles as a way to improve urban transit. **TA-UC01** involves testing a public transport new line served with autonomous buses while **TA-UC02** introduces autonomous shuttles that connects to a tram line, transporting passengers to and from the tram to expand the tram's coverage area and attract more riders. **Four surveys** are planned to support the implementation and assessment of these UCs (see an overview of the surveys inoverview in table below).

Table 6: Overview of Tampere Survey Plans

(TA-UC01 Autonomous e-shuttles with advanced remote control centre and inductive changing) S1 (Stakeholders)	
Objective	• Gather insights from stakeholders to guide the development and implementation of the autonomous bus service, identifying case areas that best serve both the project and the city; it also seeks to identify the stakeholders' opinions about the service feasibility, acceptance, and possible impacts [Before] • Assess whether there was a change in these opinions [During/After]
Target	City and public transport office, companies and stakeholders in the field of ITS
Data collection tools	Semi-structured interviews
Estimated dates	Before: Feb-May25 | During/After: Sep-Nov25
(TA-UC01 Autonomous e-shuttles with advanced remote-control centre and inductive changing) S2 (Citizens/Users)	
Objective	• Collect the residents' opinions on the planned autonomous bus and assess their expectations and concerns prior to its full implementation [Before] • Collect real-time feedback from passengers currently using the service, evaluating whether their expectations were met and their concerns addressed; understand why some residents choose not to use the autonomous services and identify potential barriers to adoption [During/After]
Target	Previous users of the system, potential users (such as university students/staff), and vulnerable users
Data collection tools	Questionnaires and semi-structure interviews
Estimated dates	Before: Feb-May25 | During/After: Sep-Nov25
(TA-UC02 Tram feeder service with advanced remote-control centre and inductive charging) S3 (Stakeholders)	
Objective	• Explore the stakeholders' perceptions about the service and collect insights about which are the best areas to introduce the autonomous

	shuttle service, considering the existing tram lines and the peripherical locations that would benefit the most by this connection [Before] • Assess whether there were changes in the stakeholder perceptions about the service [During/After]
Target	City and public transport office, companies and stakeholders in the field of ITS
Data collection tools	Semi-structured interviews
Estimated dates	Before: Feb-May25 | During/After: Sep-Nov25

(TA-UC02 Tram feeder service with advanced remote-control centre and inductive charging) S4 (Citizens/Users)

Objective	• Gather residents' opinions on the planned autonomous shuttle, evaluating their expectations and concerns before its full implementation [Before] • Capture real-time feedback from current passengers to assess whether their expectations were met and concerns addressed. Additionally, investigate why some residents opt not to use the service and identify potential barriers to adoption [During/After]
Target	Previous users of the system, potential users (such as university students/staff), and vulnerable users
Data collection tools	Questionnaires and semi-structure interviews
Estimated dates	Before: Feb-May25 | During/After: Sep-Nov25

2.3.4. The expected outcomes

The methodologies of the metaCCAZE Social Embracement activities could be applied in before, during or after the implementation of the innovation. Before the implementation, survey findings can guide the service design and be used to define marketing approaches and incentives to increase service adoption. During and after the implementation, the survey findings are used to refine the service and evaluate its impact. Below, we discuss the current development status of the metaCCAZE Social Embracement activities, which align with the timelines of each respective UC. The prepared questionnaires are included in Appendix II.

- **Munich** has finalized draft questionnaires for the stakeholders and citizens/users. Within the next months, the citizen questionnaires will be distributed by physical mail for people living in the streets near the DCM pilots while the stakeholder questionnaires will be shared via email to the users of the DCM app and some drivers from delivery companies.
- **Amsterdam** has launched a monthly focus group involving two key officials from the municipality's boating program (AM-UC01 S1) to share insights, lessons learned, and updates on the legislation. The aim of this focus group is to align the municipality with the project and facilitate knowledge sharing, enabling real-world pilot implementations rather than limiting them to designated protected areas. A questionnaire has been drafted to gather the opinions of other potential users (AM-UC01 S2). This online questionnaire will

be distributed via email, industry events, and meetings. Regarding the multi-modal waste collection system (AM-UC03), some questions on residents' acceptance and satisfaction have been drafted. These questions are planned to be included in the municipality's next systematic survey. Additionally, a draft questionnaire has been prepared to gather stakeholder and citizen perceptions on the mobility credits UC (AM-UC04).

- **Limassol** has conducted focus groups with potential users of the on-demand service (LI-UC01 S2). During these sessions, parents with young children were introduced to the service and asked to complete a questionnaire about their perceptions. So far, at least 30 parents have participated. The findings from this analysis will help develop incentivization and marketing strategies. Additionally, a survey registration questionnaire has been created to begin recruiting citizens for the Limassol travel survey. The next steps involve developing the Limassol travel mobility survey and the e-bike user survey, which will be conducted through the Nextbike app.
- **Tampere** has conducted a Pre-Pilot Implementation Survey to gather feedback from residents on their awareness and experiences with the driverless bus service previously tested in earlier projects. The survey was distributed through known community communication channels, and a total of 18 responses were collected. Among these, 16 respondents had already used the driverless bus service. The results indicated a generally positive reception of the driverless bus service but highlighted key areas for improvement, particularly in accessibility, communication during disruptions, and service efficiency. In the coming months, Tampere will finalize and conduct the before surveys (TA-UC01) S1 and (TA-UC02) S3. The data collected from these surveys will help refine the service design and address any major concerns before the full-scale pilot begins.

To provide a clear overview of the ongoing efforts across the Trailblazer Cities, the table below summarises the **current status of social embracement activities** for each Use Case. It highlights the **survey phase**, **target groups**, and key implementation steps being taken in each context. This summary reflects how each city is operationalising the methodology outlined in T1.5, ensuring that innovations are **informed by user input and grounded in real-world behavioural insights**.

Summary Box: Status of Social Embracement Activities by City

City	Use Cases Covered	Survey Phase	Target Groups	Key Actions & Notes
Munich	MU-UC01 (DCM)	Before Implementation	Citizens near pilot zone, Delivery drivers	Questionnaires drafted; to be distributed by mail (citizens) and email (stakeholders).
Amsterdam	AM-UC01, AM-UC03, AM-UC04	Ongoing (Before/During)	Officials, Users, Residents, Stakeholders	Focus group with boating program officials; multiple draft questionnaires prepared.
Limassol	LI-UC01, LI-UC02 (upcoming)	Before Implementation	Parents, E-bike users, General population	Focus groups conducted; travel survey recruitment underway; Nextbike app to be used.

City	Use Cases Covered	Survey Phase	Target Groups	Key Actions & Notes
Tampere	TA-UC01, TA-UC02	Pre-Implementation	Residents (past users)	18 responses collected; next surveys in development for before full pilot launch.

2.4. Impact monitoring and Evaluation: The Standardized Impact Evaluation Framework (SIEF) [T1.4]

The Standardized Impact Evaluation Framework (SIEF) serves as **the core methodology for assessing the impact of zero-emission shared mobility (ZESM) solutions** demonstrated in the metaCCAZE project. It provides a structured, consistent, and transferable approach for measuring the technical, environmental, economic, and social impacts of the project's Use Cases (UCs) implemented across the 12 LLs. Thanks to its standardized structure and strong foundation in current EU initiatives, the SIEF is not only fit for purpose within metaCCAZE but is also adaptable for broader use in evaluating zero-emission shared mobility solutions—both for passenger and freight transport—beyond the scope of this project.

The SIEF is not just an impact measurement tool; it is a **key enabler of evidence-based decision-making**, guiding cities, policymakers, and mobility stakeholders in adopting and scaling the most effective solutions. Following this introduction, this chapter outlines position of SIEF, and it is role within the metaCCAZE project, European and local mobility strategies.

1. SIEF within the metaCCAZE monitoring and evaluation structure
2. SIEF within European evaluation frameworks and partnerships
3. SIEF within local mobility strategies and goals and integration to CCC and SUMPs

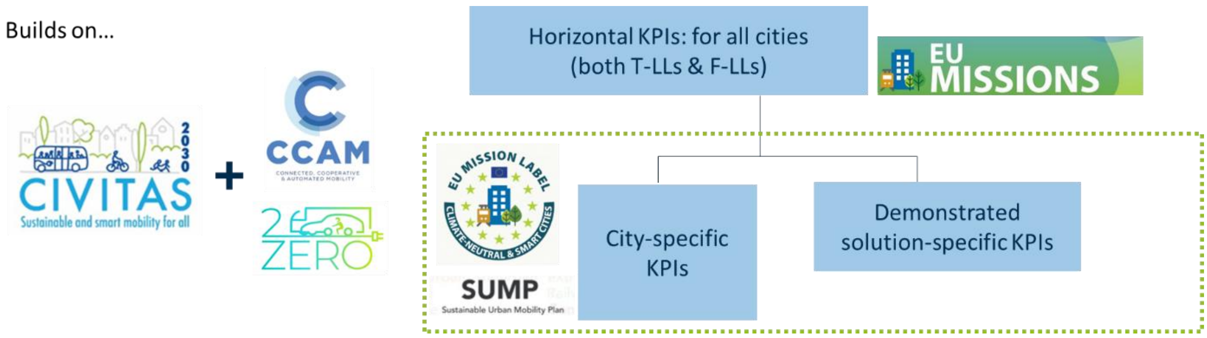


Figure 6: : metaCCAZE Standardized Impact Evaluation Framework

2.4.1. SIEF within metaCCAZE monitoring and evaluation structure

The SIEF is one of the components of the **metaCCAZE monitoring and evaluation approach.** This is a highly interconnected structure including other key activities within the project.

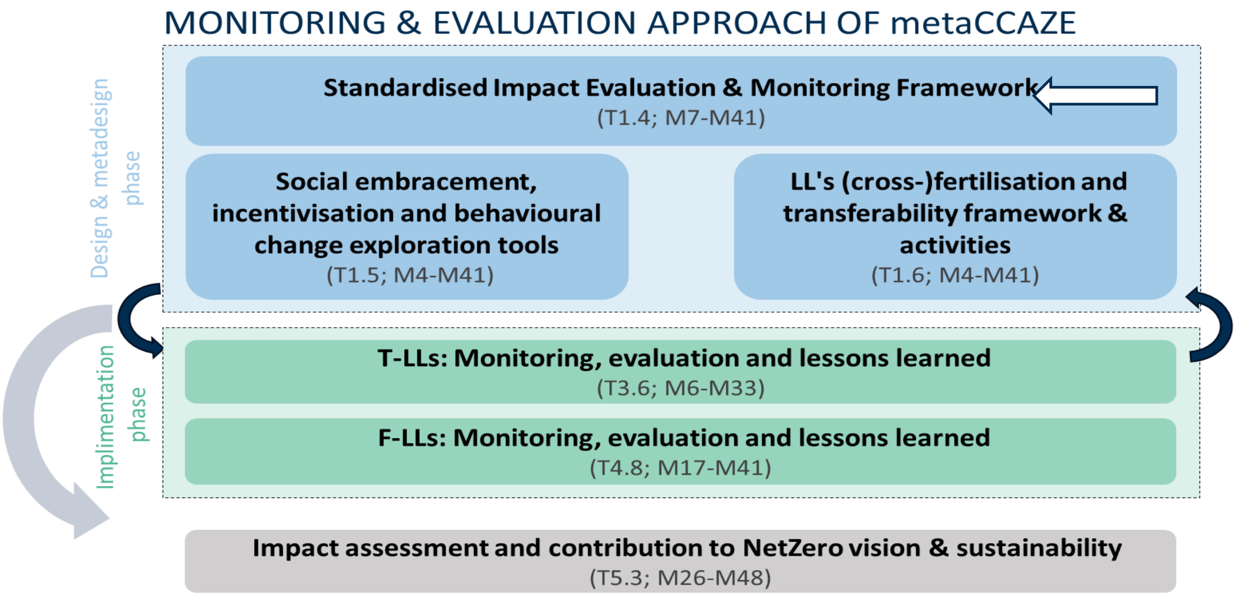


Figure 7: : Monitoring and evaluation approach of metaCCAZE

The **monitoring and evaluation approach** has been illustrated in the figure above and the interdependencies are described as follows:

- **SIEF** (Task 1.4), focusses on impact evaluation to assess how UCs will contribute to accelerate the transition to zero-emission shared mobility.
- Survey-based data collection tools will be used to assess the **social embracement, readiness, behavioural change** and efficiency of the UCs (Task 1.5). To fully understand and complement the impacts of each UC, the SIEF integrates data and indicators from Task 1.5.
- **Transferability framework** (task 1.6). The evaluation results of SIEF in combination with the transferability framework (see D1.2 - Cross-fertilisation and transferability framework and guidelines) will help identify which UCs are most scalable and under what conditions can they be successfully adapted to different cities.

The methodologies developed within these three tasks serve as the reference framework for the evaluation of demonstrations **that will be carried out under Task 3.6 (WP3) for T-LLs and under Task 4.8 (WP4) for F-LLs**. The results of these evaluations will contribute to **Task 5.3 (WP5),** which builds on evaluation data to assess the **impact of metaCCAZE solutions towards NetZero goals and create the MetaSkills Hub**, ensuring that cities and stakeholders beyond the project can access and apply the lessons learned.

2.4.2. SIEF within European evaluation frameworks and partnerships

The SIEF is built upon EU evaluation frameworks, ensuring alignment with ongoing European research, innovation, and policy initiatives. It follows the CIVITAS evaluation framework, while also incorporating insights from the CCAM and 2ZERO partnerships. Indeed, the CIVITAS Evaluation

Framework, which is currently being updated under the MUSE project[1], serves as the structural foundation for SIEF. It provides a well-established methodology for assessing the process and the impact of mobility-related measures that have been implemented by CIVITAS projects. Within this framework, understanding both successes and failures is crucial to enable replication and to build up evidence-based knowledge.

The SIEF, following the CIVITAS approach, starts from these three assumptions: 1) any measure or strategy to be assessed is motivated by one or more goals, 2) given these goals, measures are tested with the objective of producing an impact, and 3) at least one indicator will measure each impact.

Figure 8: CIVITAS approach to impact evaluation

Beyond CIVITAS, the metaCCAZE SIEF integrates KPIs from CCAM and 2ZERO. The "European Common Evaluation Methodology for CCAM[2]", developed within the EC-funded FAME project, provides valuable insights into assessing the performance, safety, and societal impact of automated mobility solutions. Similarly, the "Measuring the Value of the Key Performance Indicators (KPI) of the 2ZERO Partnership[3]", developed within the Le Mesurier project, informs the selection of KPIs related to emissions reduction, energy efficiency, and the transition to zero-emission road transport.

By aligning with these initiatives, the impact evaluation carried out through the SIEF provides evidence-based insights that contribute to the implementation of the Fit for 55 package and the EU Mission for Climate-Neutral and Smart Cities by 2030, particularly in relation to zero-emission mobility, shared transport efficiency, and the decarbonization of road transport.

2.4.3. SIEF within local mobility strategies and goals and integration to CCC and SUMPs

Within its alignment with above mentioned EU initiatives and partnerships, the metaCCAZE evaluation framework supports its LLs in achieving their climate neutrality targets[4]. In fact, majority of the cities participating in the project are MISSION cities and have signed City Climate Contracts (CCCs) as part of their commitment to become climate-neutral by 2030. Additionally, the SIEF aligns with each LL's respective SUMP or similar strategic mobility plans, supporting cities in integrating the project's findings into their long-term mobility strategies. By recognizing that each LL operates within a unique policy and planning context, the project ensures that the selected KPIs reflect both the specific urban mobility objectives of the LLs and their EU climate neutrality commitments.

[1] https://civitas.eu/coordination/muse

[2] https://www.connectedautomateddriving.eu/wp-content/uploads/2024/05/EU-CEM-Handbook_DRAFT_240502.pdf

[3] https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5100a13ba&appId=PPGMS

[4] EU Mission for Climate-Neutral and Smart Cities by 2030

To ensure this integration, metaCCAZE includes a dedicated co-creation activity, LL5, within the framework of Task 1.6.1 (fertilization activities). The details and outcomes of this activity will be further developed in section 2.4.5.

2.4.4. How is this addressed

The metaCCAZE SIEF follows the CIVITAS approach by focusing on **expected impacts** rather than the specific measures applied. This ensures that the effects of different solutions are assessed in a **consistent and meaningful** way and guarantees a framework that **balances methodological coherence with flexibility.**

The need for such adaptability stems from the diverse range of Use Cases (UCs) in metaCCAZE, which span from automated passenger fleet operations and AI-driven transport planning to connected mobility services and logistics optimization. To evaluate these varied interventions in a comparable and structured manner, the SIEF defines **expected impacts and related KPIs** according to the following hierarchy:

- **Project-wide level:** Applicable to all Living Labs and aligned with the overarching project objectives such as improving sustainability and efficiency, accelerating the user-centred deployment of smart systems and services, and increasing social acceptance of ZESM solutions.
- **Solution-wide level:** Shared by UCs addressing similar challenges. For example, automation-focused UCs evaluate common KPIs related to automation performance and operational efficiency, while UCs addressing electrification apply indicators linked to energy efficiency and charging optimization.
- **Context-specific level:** Tailored to the local conditions and implementation characteristics of individual UC.

To ensure consistency and relevance, particularly for the solution-wide and context-specific levels, the expected impacts are derived from multiple project inputs:

- the objectives defined for each UC (below)
- the intended outcomes of the MetaInnovations developed in WP2, ensuring that the evaluation framework captures the added value of advanced technological solutions;
- the local characteristics identified in the Status Quo Maps (Deliverable D1.1 - Trailblazer LLs: status quo map, prototype ZESM use cases for passengers and freight), which ground the evaluation in each LL's real-world context and challenges.

Another core principle of the SIEF is **balancing meaningfulness with feasibility**. Ideally, evaluations should rely on precise and reliable indicators that directly reflect the intended impacts. In practice, however, such precision is not always achievable. Certain variables may be challenging to measure directly while others may only be available through approximations, such as sample-based estimates for indicators like modal split.

To navigate this challenge methodologically, the SIEF requires that all indicators be backed by a clearly defined data source or method. When multiple potential sources are available, the most direct and representative input is selected to ensure evaluations remain as robust and accurate as possible within practical constraints. Based on this reasoning, the metaCCAZE SIEF is structured around three main components:

1. **List of Expected Impacts**

2. **Structured Set of Indicators**
3. **Definition Of Data Sources and Calculation Methods**

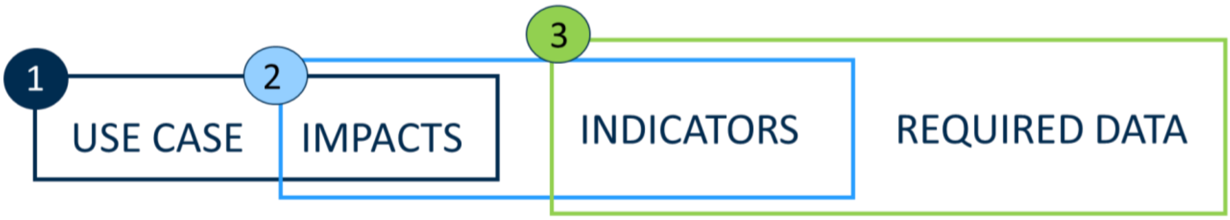


Figure 9: metaCCAZE SIEF main components

First Component of SIEF: List of Expected Impacts

To ensure comprehensive and structured impact assessment, the SIEF categorizes impacts into key thematic domains, following the CIVITAS classification and integrating insights from CCAM and 2ZERO:

- **Transport System**: Examines the effects of UCs on mobility efficiency, modal shifts, congestion reduction, etc.
- **Environment**: Assesses reductions in greenhouse gas (GHG) emissions, air pollution, and urban noise levels, as well as other impact related to the urban environment and liveability.
- **Energy:** Evaluates energy efficiency improvements, integration with smart grids, and shifts towards renewable energy use.
- **Society:** Measures social embracement, accessibility, affordability, and equity of the introduced mobility solutions.
- **Economy:** Measures improvement in operational cost and viability
- **Vehicle and Automation:** Includes CCAM-related impacts such as automation levels, vehicle performance, and operational reliability.

The framework also differentiates between two levels of impact:

- **Direct (first-level) impacts**: These are the effects that are directly expected from the application of a measure. For example, deploying AI-based fleet management for on-demand service is expected to enhance route optimization, reduce waiting times, and improve vehicle utilization.
- **Wider (second-level) impacts**: These are the broader, system-wide effects that emerge as a consequence of the direct impacts. For example, optimizing fleet management and reducing empty trips is expected to increase the attractiveness of shared mobility, leading to higher adoption rates and a reduction in private vehicle ownership.

The definition of these two levels of impact helps to distinguish between the specific goals of each UC which may vary significantly depending on the demonstrated MetaInnovations and MetaServices and the overarching project-wide goals that are shared across multiple Use Cases. The full list of impacts considered in the metaCCAZE SIEF is shown in section 2.4.6, together with the corresponding indicator.

Second Component of SIEF: Structured set of indicators

Each expected impact is linked to specific indicators, ensuring that the evaluation provides quantifiable insights. The selection of indicators is guided by two key principles: **meaningfulness and feasibility**. Indicators must be capable of capturing meaningful changes while remaining practical to measure within the context of the Living Labs. This includes leveraging existing resources such as data identified in the Status Quo Map / Data Map and assessing the capacity to collect new data through surveys, on-site measurements, or technologies developed under WP2. Budget constraints and available resources for data collection are also taken into careful consideration.

A distinctive feature of the metaCCAZE SIEF is its co-creation approach, which ensures that indicators are not only theoretically sound but also grounded in the practical realities of urban mobility. Living Labs and their technical partners have actively contributed to the indicator definition process, aligning them with local priorities, data availability, and operational constraints. This participatory approach is further elaborated in Section 2.4.5, while the final list of indicators and their structure is presented in Section 2.4.6.

Third Component of SIEF: Data sources and calculation methods

Each indicator requires a well-defined data collection approach to ensure that the evaluation process remains robust and comparable across different LLs. The feasibility of data collection is a fundamental criterion in selecting indicators, as unmeasurable indicators provide no practical value for decision-making. This consideration was a central aspect of the co-creation process, ensuring that indicators are realistically obtainable within each LL's existing data ecosystem.

This process is also closely linked to Task 1.5, which develops survey-based tools to assess social acceptance, user behaviour, and public perception. The integration of survey data into the SIEF ensures that both qualitative and quantitative dimensions of impact are captured, reinforcing the framework's ability to provide a holistic evaluation of the UCs.

Additionally, this process is also closely aligned with WP2, as the technologies developed and demonstrated in each LL, such as monitoring drones, AI algorithms, intelligent models, and other innovative tools, directly influence the data that is available and that will feed the indicator.

To ensure comparability, the SIEF suggests common methods for measuring horizontal KPIs (Project-wide and Solution-wide – see section 2.4.6). Meanwhile, data sources and calculation methods for Context-specific KPIs are directly derived from the resources and technologies being tested in each LL. The common methods for horizontal KPIs are detailed in section 2.4.6, while the specific data sources and methodologies used for Context-specific KPIs are reported in the Annex II.

Finally, the SIEF establishes clear guidelines for the evaluation process, ensuring consistency in how the impacts of metaCCAZE's UCs are assessed. The evaluation must begin before implementation, ensuring fair comparison between the pre- and post-intervention conditions. The evaluation process itself is detailed in section 2.4.7.

2.4.5. The interaction with city actors

A key element of the metaCCAZE SIEF is its **co-creation process**, ensuring that the evaluation framework is adapted to the specific characteristics of each LL while maintaining comparability across the project. To achieve this, metaCCAZE engaged the LLs in an iterative co-design process to refine the expected impacts, indicators, and data collection methods.

To complement this process, a significant step **is "LL5 – the metaDesign workshop for defining KPIs and the impact evaluation framework"**, which was organized as part of Task 1.6.1 (fertilization activities). The primary objective of LL5 was to validate and fine-tune the proposed set of KPIs by engaging key stakeholders in each LL, ensuring that the selected indicators are both meaningful and feasible to measure addressing their practicality.

Each T-LL organized a dedicated LL5 workshop, bringing together stakeholders involved in UC implementation, as well as actors responsible for evaluation and monitoring activities within the SUMP and City Climate Contract frameworks. The workshops focused on:

- Reviewing the Evaluation Framework Questionnaire (Excel) shared with the LLs.
- Discussing the KPIs proposed for each Use Case and their relevance to the city's mobility and climate objectives.
- Assessing the methods for measuring these KPIs, including data availability and collection challenges.
- Identifying additional KPIs that may be relevant to the LL's SUMP or City Climate Contract commitments.

The workshops were conducted between November and December 2024, leading to a consolidation of a draft KPI list for impact evaluation. Following this workshop, further rounds of exchanges with LLs and support partners helped refine the list of indicators and data sources in parallel with the ongoing process of finetuning the definitions of the UCs (see methodology outlined in section 2.2).

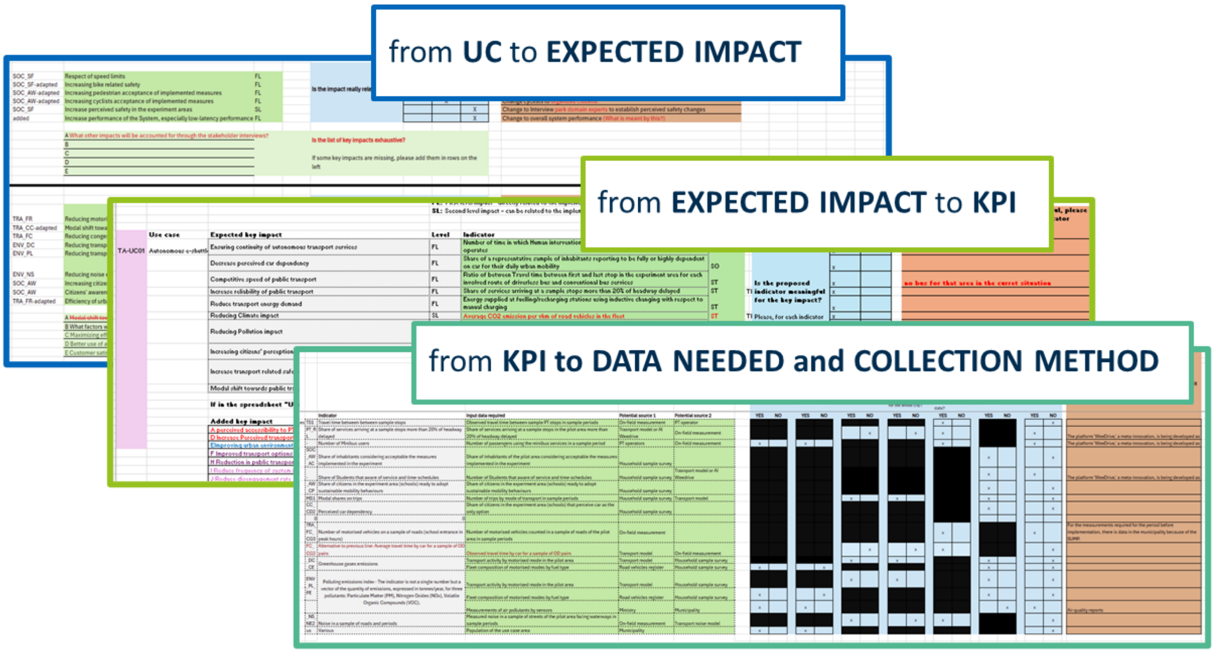


Figure 10: : LL5 – metaDesign workshop for defining KPIs and the impact evaluation framework

The following table summarizes the key discussion points and the relevant outcomes of the LL5 metaDesign activities. Integrating this with the initial proposal led to a refined list of KPIs, which is documented in Annex II.

Table 7: Summary of LL5 Co-Creation Results

CITY	KEY DISCUSSIONS	OUTCOMES RELEVANT TO LL5
Munich (Jan 2025)	Online interviews with mobility department and in-person meeting with a mobility data expert. Focused on stakeholder involvement in surveys and simulation-based indicators.	• Clarified relevant stakeholder groups for social embracement surveys. • Some indicators were discussed to be addressed in relative rather than absolute terms. • Integrated feedback on simulation-based indicators into the updated SIEF.
Limassol (Nov–Dec 2024)	Discussions with Municipality, Ministry of Transport, MaasLab, and CCC researchers. Focused on aligning SIEF KPIs with CCC and SUMP strategies.	• MetaCCAZE KPIs align with 5/7 CCC action plans. • Confirmed coherence in data collection methods between CCC and MetaCCAZE. • Validated the use of social embracement surveys for measuring well-being. • Access to transport models and data was granted for KPI evaluation.
Tampere (Jan 2025)	Workshop with Tampere University, the City of Tampere, and Remoted. Finalized KPI selection and feasibility assessment.	• Ensured alignment of KPIs with project objectives. • Stakeholders validated data availability and measurability of KPIs. • Assessed how selected indicators impact decision-making.
Amsterdam (Dec 2024)	In-person meeting to discuss feasibility of KPIs and challenges in impact attribution.	• Some expected impacts may be difficult to measure (e.g., safety perception with small-scale pilots). • Refined impact definitions, particularly efficiency-related indicators. • Identified potential unintended effects (e.g., congestion from autonomous boats). • Acknowledged challenges in attributing air quality improvements solely to MetaCCAZE interventions.

2.4.6. Set of expected impacts and associated indicators for all T-LLs

Following the process outlined in the previous sections, a final list of expected impacts and associated indicators has been defined for all T-LLs. This chapter is divided into two parts:

- **Horizontal expected impacts and indicators (Project-wide and Solution-wide):** This part presents the impacts and indicators that apply horizontally across the project and solutions. They are organized according to the six thematic domains defined in the SIEF. As previously outlined, all Project-wide and Solution-wide indicators include clear definitions and units of measurement that must be followed by each LL. This standardization is essential to ensure consistent and comparable analysis across different UCs.
- **Context-specific impacts and indicators:** This part presents the complete list of Context-specific impacts and indicators, each assigned to its respective UC. No additional descriptions are included here, as these indicators are tailored to the specific conditions and objectives of each UC.

The comprehensive reference table for each UC is provided in **Annex II,** including the exhaustive list of expected impacts and associated indicators that will be calculated by each LL. Additionally, it provides information on data sources, calculation methods and details on the timing of data collection, testing, and implementation for each LL.

Horizontal expected impacts and indicators

Transport System

IMPACT CATEGORY	EXPECTED IMPACT	L*	INDICATOR	UNIT	H*
1 - Congestion	Reducing road congestion (reduce n° of vehicles)	SL	Number of motorised vehicles on a sample of roads (Traffic counts in peak time of a sample day)	n of vehicles / h	PW
	Reducing motorized freight vehicles activity	SL	Number of road freight vehicles on a sample of roads	n of vehicles / h	SW
	Reducing road congestion (reduce travel time)	SL	Average travel time by a vehicle (bus/car/vessel) for a sample of OD pairs	minutes	PW
	Reducing perceived road congestion	SL	Congestion perception of residents	weighted average	PW
2 - Perceived car dependency	Decrease in perceived car dependency	FL	Share of a representative sample of inhabitants/users reporting to be fully or highly dependent on cars for their daily urban mobility	%	PW
3 - Competitive speed	Increasing Speed of public transport (Reduction of travel times with public transport)	FL	Observed travel time of PT between sample stops in sample periods in the experiment area for each involved route	minutes	SW
	Improving speed of driverless bus service compared to conventional bus service	FL	Ratio of Travel time between sample stops in sample periods in the experiment area for each involved route of driverless bus compared to conventional bus services	Ratio	SW
4 -Reliability of PT	Improving the reliability of public transport	SL	Share of services arriving at a sample stops more than 20% of headway delayed	%	SW
5 - Accessibility to PT	Increasing perceived accessibility to public transport	FL	Share of users perceiving an increase in accessibility to public transport	%	SW
	Increasing number of passengers in public transport	FL	Number of bus (or mini-bus) passengers at specific stops	n of pax	SW
6 - Modal shift	Modal shift towards public transport for commuting trips	SL	Share of public transport on generated commuting trips in the pilot area	%	PW

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	Modal shift towards active modes for commuting trips	SL	Share of active modes on generated commuting trips in the pilot area	%	PW
	Modal shift towards lighter and electrified vehicles (cargo bikes and cargo ships) in freight (or waste collection)	FL	Modal shares on trips (delivering goods or collecting waste) done by lighter and electrified vehicles (cargo bikes and cargo ships)	%	PW
7 - Use of shared mobility	Increasing use of shared mobility	FL	Number of usages of shared vehicles (cars, bikes, scooters, …) per week per inhabitant	n of pax/share per population	SW
8 - Efficiency	Minimization of deadhead distances (passengers)	FL	Kms run by PT with less than 15% passenger load capacity/Passengers traveling by PT by time of day	km/pax	SW
	Minimization of deadhead distances (freight)	FL	Average loading capacity (freight)	freight/km travelled	SW

Note: FL: "First Level" – SL*: "Second Level"- H*: "Hierarch" - PW: "Project-wide" - SW "Solution-wide"*

Description and guidance for each horizontal KPI for Transport System thematic domain:

1. **Congestion relevant indicators:** These indicators measure congestion levels and their perception in areas impacted by the interventions. Since these are second level indicators, results can be influenced by external factors like population size, urban planning and design, or economic activity, and should be interpreted accordingly.
    a. **Number of motorised vehicles on a sample of roads:** (CIVITAS TRA_FC_CG3**)** Measures the number of motorized vehicles on selected road sections during peak hours on a sample day. The indicator is expressed as the average number of vehicles across all monitored sections, considering the number of road sections and monitored hours. The indicator can be calculated through the following approaches:
        - *Transport model outputs: based on O-D routes affected by the UC implementation.*
        - *On field measurements: repeated tests on real roads during peak hours, excluding outliers. The* tests are recommended to be repeated in at least three working days and for each day, three intervals of time including two peak hours must be chosen.
        - *Traffic counts:* The monitoring of traffic by this method should be capable of differentiating between passenger and freight vehicles.
    b. **Number of road freight vehicles on a sample of roads:** the description and the calculation methods follow the same approach as the indicator above, while the target vehicle are freight vehicles only.
    c. **Average travel time by a vehicle (bus/car/vessel) for a sample of OD pairs:** (CIVITAS TRA_FC_CG2) Measures the time necessary to travel between origin-destination points using different vehicles (e.g., buses in Limassol, automated vessels in Amsterdam). Data collection methods are the same as above.
    d. **Congestion perception of residents:** measures citizens' perception of congestion through sample-based surveys (Task 1.5). It is calculated in two steps:

- Determining the share of respondents assigning a score (1 to 5)
- The congestion perception of the citizens indicator will be computed as the weighted average score based on these shares.

2. **perceived car dependency:** (CIVITAS TRA_CC_CD2) This indicator is relevant when a particular measure is aimed at increasing the availability and/or the effectiveness of mobility solutions alternative to private cars. It is measured in two steps:
   - Asking the respondents the share of trips for which no realistic alternative to driving exists.
   - The indicator is computed as the weighted average share of urban trips for which the respondents report no suitable alternative to driving exists.
3. **Competitive speed:** These indicators assess the ability of public transport services—conventional and automated—to offer competitive travel times compared to private vehicles.
   a. **Observed travel time of PT between sample stops:** (CIVITAS TRA_PT_PTS) Measures actual travel time on a sample of departures across selected stops and time periods. The indicator is computed as a distance-weighted average of recorded travel times before and after implementation between selected stops.
   b. **Ratio of Travel time between sample stops in sample periods in the experiment area for each involved route of driverless bus compared to conventional bus services:** This indicator is particularly relevant for comparing driverless bus and conventional bus services on an experimented route. In cases where it is a new route, the indicator can be computed during the test runs and compared with the values obtained at the end of the implementation period.
4. **Reliability of public transport: This indicator "Share of services arriving at sample stops more than 20% of headway delayed" evaluates the regularity and punctuality of services, which are critical for user satisfaction** (CIVITAS TRA_PT_RL). The indicator is a measure of the share of public transport departures arriving at selected sample stops with a delay greater than 5 minutes (or 20% of the headway when the headway is less than 30 minutes). To assess the impact of an intervention, observations should be conducted both before and after the experiment, ensuring consistency in monitoring locations, sample size, and timing. The final indicator is obtained by averaging delay shares across all monitored routes, weighted by route length. The indicator can be computed by using the following approaches:
   - Operator data (arrival and departure times by route and stop);
   - On-site observations at representative stops across different times of the day. To ensure reliability, enough observations must be collected across different times of the day.
5. **Accessibility of Public transport:** These indicators assess improvements in users' access to public transport services following implementation. This could be obtained by following two approaches:
   a. **Share of users perceiving an increase in accessibility to public transport:** This indicator is based on sample surveys (Task 1.5) and captures user perception of improved access to public transport. Before implementation, especially for new services, responses will reflect expectations rather than actual experience.
   b. **Number of passengers boarding at selected stops:** The indicator can be computed by using the following methods:

- *On-field measurements:* involve direct observation and manual or automated passenger counting at selected stops during specific periods. Consistency is required in the selected stops in before and after measurements are.
- *Bus Operator data:* relies on passenger boarding records provided by the transport operator, offering a broader dataset but dependent on the availability and accuracy of recorded data.

6. **Modal shift:** The indicators below help access the effectiveness of the measures promoting a shift from private vehicles to more sustainable transport modes.
   a. **Share of public transport on generated commuting trips:** (TRA_CC_MS2) The indicator will be computed through sample-based surveys (Task 1.5). Respondents must report the main and other transport modes used on a specific reference day. The survey results should provide the number of trips by mode, allowing for the calculation of modal shares. Key methodological aspects include defining trip purposes, distinguishing between main and other transport modes, and ensuring consistency in survey design. The impact of the measure will be reflected in changes in respondents' travel behaviour before and after the implementation of the use case.
   b. **Share of active modes on generated commuting trips:** (TRA_CC_MS2) The indicator will be computed along the same lines as the previous one through sample-based surveys and however, targeting active modes in this case.
   c. **Shares of trips (delivering goods or collecting waste) done by lighter and electrified vehicles (cargo bikes and cargo ships):** The indicator will be computed along the same lines as the previous two through sample-based surveys and however, targeting lighter and electrified vehicles for delivering goods (or for similar purposes like collecting waste in Amsterdam UC).
7. **Number of usages of shared vehicles per week per inhabitant**: (TRA_SH_US1) This indicator measures the usage of shared mobility services like bike-sharing, e-scooters, and car-sharing. The indicator is calculated as the ratio of user registrations obtained from the service provider to the city's population from the census data and represented as per capita usage.
8. **Efficiency:** These indicators assess how effectively transport resources are used, helping to identify opportunities for service optimization and emission reduction. They provide insights into underutilized transport capacity, enabling better planning and service adjustments. Ensuring consistency in monitoring locations, time periods, and data collection methods is crucial for reliable comparisons. Data should be collected across a representative sample of trips, covering different times of the day and varying demand conditions, to accurately measure efficiency improvements.
   a. **Public transport kilometres with low occupancy (<15%):** Evaluates the proportion of vehicle-kilometres run with under 15% passenger load. Data can be obtained from:
      - Transport models, simulating daily demand across routes and times. The model assigns passenger volumes to each route and calculates the proportion of kilometers traveled under low occupancy conditions.
      - Data from Automatic Passenger Counting (APC) systems, ticketing records, and vehicle GPS tracking can provide real-world insights into ridership levels. The indicator is computed by averaging low-occupancy kilometers across all monitored routes, weighted by the total kilometers traveled.
   b. **Average loading capacity (freight):** This indicator measures the average loading capacity of freight vehicles in urban logistics operations, helping to assess how well cargo

space is utilized. This can be computed adapting the following approaches and will have freight or load/km traveled as the unit of measurement:

- *Transport model:* A logistics-based transport model can estimate freight demand and simulate vehicle movements to determine load factors. By incorporating data on shipment sizes, vehicle types, and delivery routes, the model provides an estimate of average vehicle capacity utilization over different time periods.
- *Logistics operator data:* Fleet management systems, IoT sensors, and weigh-in-motion data from logistics companies provide real-world loading information. These systems track cargo weight and volume per trip, allowing for the calculation of the average percentage of vehicle capacity utilized. The indicator is computed by aggregating data from multiple trips and averaging the load factors across different vehicle types.

Environment:

IMPACT CATEGORY	EXPECTED IMPACT	L*	INDICATOR	UNIT	H*
1 - Liveability of urban space	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability	Weighted average	PW
2 - Climate impact	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm	PW
3 - Pollution impact	Reducing Pollution impact	FL	Total pollutants emissions (produced by all vehicles circulating in the area) expressed in tonnes/year, for three pollutants: Particulate Matter (PM), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC).	tonnes/year	PW

Note: FL: "First Level" – SL*: "Second Level"- H*: "Hierarch" - PW: "Project-wide" - SW "Solution-wide"*

Description and guidance for each horizontal KPI for Environment thematic domain:

1- **Reported environmental liveability (perception):** (CIVITAS ENV_US_PL1) Assesses citizens perceived environmental quality, including air quality, noise, green spaces, and overall urban comfort. Data is collected via sample-based surveys (Task 1.5). The indicator is calculated exogenously as follows:
   a. Calculation of the share of individuals assigning a certain score (1 to 5) to the environmental liveability
   b. Calculation of the environmental liveability indicator (weighted average).

2- Average CO2 emission per vkm of road vehicles in the fleet: (CIVITAS ENV_DC_EF2) CO2 Calculates average emissions per vehicle type as produced per vehicle type, divided by the metric of operations (amount of km travelled).

3- **Total pollutants emissions (produced by all vehicles circulating in the area):** Measures total annual emissions (tonnes/year) of key pollutants: PM, NOx, and VOC. The indicator is not a single number but a vector of the quantity of emissions for each pollutant. Two computation approaches apply:

a. Model-based approach (CIVITAS ENV_DC_EF2): Extract pollutant emissions from a transport model. Ensure values are translated in an annual value, regardless of the model's reference period (e.g., hourly, daily).
b. Energy use approach (CIVITAS ENV_PL_PE2): estimated from energy consumption by fuel type. The pollutant emissions are obtained by applying the average emissions factors to the total value of energy by fuel type.

Energy:

IMPACT CATEGORY	EXPECTED IMPACT	L*	INDICATOR	UNIT	H*
1 - Energy demand	Reducing transport energy demand	FL	Modelled energy demand (3 separated numbers on Gasoline, Diesel, Electricity)	litres (Gasoline, Diesel) and Kwh (elect.)	PW
		FL	Energy supplied at fuelling/recharging	litres (Gasoline, Diesel) and Kwh (elect.)	PW

Note: FL: "First Level" – SL*: "Second Level"- H*: "Hierarch" - PW: "Project-wide" - SW "Solution-wide"*

Description and guidance for each horizontal KPI for Energy thematic domain:

1- **Energy demand:** The indicator is the set of values providing the amount of energy in the experiment city for each fuel type. Its is expressed in various units of measurement, depending on the fuel type: 1000 litres for Gasoline and Diesel: 1000 litres and 1000 Kwh Electricity. Two computation approaches apply:
   a. Model-based approach (CIVITAS ENG_EF_ED2): Extract energy demand from a transport model. Ensure values are translated in an annual value, regardless of the model's reference period (e.g., hourly, daily).
   b. Energy use approach (CIVITAS ENV_PL_PE2): estimated from energy consumption by fuel type. The amount of energy supplied should be collected from refuelling stations and, as far as electricity is concerned, operators providing recharging facilities.

Vehicle and Automation

IMPACT CATEGORY	EXPECTED IMPACT	L*	INDICATOR	UNIT	H*
1 - Improve technical functioning.	Reduce frequency of system failures	FL	Frequency of system failures - Count per km driven and their description (i.e., report on the failure and possible causes)	Failures/KM	SW
	Reduce disengagement rate	FL	disengagement rate - Count per km driven (or inverse, kms per disengagement, e.g., 10 km between disengagements)	Disengagement /KM	SW
2 - Driving behaviour	Acceleration sum	FL	Sum of positive accelerations per 100 km, in free driving and in car following	m/s2	SW
	Harsh braking events	FL	Number of ego vehicle decelerations over X m/s² for at least Y s, per distance driven	Number/km or number/h	SW

	Improving Speed of AV	FL	Observed travel time of AV between sample segments in sample periods in the experiment area	m/s	SW

Note: FL: "First Level" – SL*: "Second Level"- H*: "Hierarch" - PW: "Project-wide" - SW "Solution-wide"*

All metaCCAZE UCs working on automation aspects are asked to calculate the following KPIs from the EU-CEM Handbook of CCAM[5].

1- **Improve technical functioning:** Assesses the reliability of CCAM systems installed in vehicles (excluding driver factors). Systems should be pre-tested before project deployment.
   a. **Frequency of system failures:** Number of system failures (malfunctions in driving automation or connectivity systems) per 100 km. Each failure must be reported with a description and possible cause.
   b. **Disengagement rate:** Measures how often control is transferred from the automated system to the human driver, either voluntarily or due to system limitations. Expressed as number of disengagements per km or inversely (e.g., km between disengagements).

2- **Driving behaviour:** Evaluates the motion dynamics of the automated vehicle (ego vehicle) within traffic, reflecting interaction with surroundings and compliance with traffic norms.
   a. **Acceleration sum:** Sum of all positive acceleration events per 100 km, measured during free driving and car-following conditions. Metric: m/s^2 per 100 km
   b. **Harsh braking events:** Number of deceleration events exceeding a defined threshold (X m/s^2 sustained for at least Y seconds), per km or per hour. Metric: Number/km or number/h
   c. **Average Speed:** Measures average speed of the ego vehicle in free-flow conditions. Metric: m/s or km/h

Society:

IMPACT CATEGORY	EXPECTED IMPACT	L*	INDICATOR	UNIT	H*
1 - Safety	Increase transport related safety	SL	Total number of traffic accidents per inhabitant in pilot area	n	PW
2 - Perceived safety	Increase perceived safety of mobility in the experiment area	SL	Reported road safety (perception)	Weighted average	PW
3 - Increasing acceptance	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	PW
	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	PW

[5] https://www.connectedautomateddriving.eu/methodology/common-evaluation-methodology/

	Acceptability of being next to the automated vehicle	FL	Share of respondents that would support: Driving/Walking/Cycling next to the AV	%	SW
	Acceptability to hop on an automated vehicle	FL	Share of respondents that would use an AV as passengers	%	SW
	Increase Customer satisfaction	FL	Level of satisfaction of the residents (or users) with the service	Weighted average	PW
4 - Propensity towards sustainable mobility behaviours	Increasing propensity to adopt sustainable mobility behaviors (change mobility patterns)	FL	Share of stakeholders (citizens/students/employees/relevant group of people) ready to adopt sustainable mobility behaviours	%	PW
5 - Equitable access for all user	Increasing perceived accessibility of vulnerable groups	FL	Perceived level of accessibility by vulnerable groups	Weighted average	SW

Note: FL: "First Level" – SL*: "Second Level"- H*: "Hierarch" - PW: "Project-wide" - SW "Solution-wide"*

Description and guidance for each horizontal KPI for Transport Society thematic domain:

1- **Total number of traffic accidents per inhabitant in pilot area:** This indicator measures the ratio between the number of reported traffic accidents involving road vehicles (including all road users) in the pilot area and the number of inhabitants in that area. The monitoring periods before and after implementation must be of equal length, with a minimum duration of 10 weeks. Although it is acknowledged that minor incidents may go unreported when relying on local police data sources, the indicator still reliably reflects overall safety trends.

2- **Reported road safety (perception):** Assesses how safe respondents feel when moving within the implementation area. Data is collected via sample-based surveys (Task 1.5). The indicator is calculated in two steps:
   a. Calculation of the share of individuals assigning a certain score (1 to 5) to perceived road safety.
   b. computation of a weighted average score representing overall perceived safety

3- **Increasing acceptance:** Several indicators assess respondents' acceptance of the implemented measures (perception of positive impact, overall acceptance, customer satisfaction, etc). Data is collected via sample-based surveys (Task 1.5). The indicator may be expressed in two formats, depending on survey structure:
   a. Weighted average when responses are scored on a 1 to 5 scale.
   b. Percentage when the possible answer is binary (e.g., yes/no).

4- **Share of respondents ready to adopt sustainable mobility behaviours**: Evaluates the willingness of individuals to shift towards more sustainable transport habits, which can support the effectiveness of policy measures. Data is collected via sample-based surveys (Task 1.5), targeting relevant user groups (e.g., citizens, students, employees, stakeholders) specific to each Use Case. The indicator is calculated as the share of "yes" responses to one or more behaviour-change questions. If multiple questions are used, the indicator is the average share across all relevant items. Example questions include:

a. Are you personally willing to reduce your number of motorised trips?
b. Are you personally willing to use public transport instead of a car for at least part of your trips?
c. Are you personally willing to give up your private car(s) and use shared vehicles instead?
d. Additional questions may be adapted to fit the specific Use Case context.

5- **Perceived level of accessibility by vulnerable groups:** Assesses how accessible and inclusive the transport system is for vulnerable groups such as older adults, persons with disabilities, low-income users, and others with specific mobility needs. Data is collected via targeted surveys (Task 1.5). Respondents rate the ease of access to implemented service using a score from 1 to 5. The indicator is calculated as a weighted average of perceived accessibility. Additional qualitative insights may support the interpretation of results.

Economy:

IMPACT CATEGORY	EXPECTED IMPACT	L*	INDICATOR	UNIT	H*
1 - Economic efficiency	Reduce operational cost	FL	Operational costs using (automated vehicles/electric mini-buses), compared to Operational costs using conventional vehicles	€/km	SW
	Reduce operational cost	FL	Monetarised value of travel time	€	SW
2 - Economic viability	Economic viability of the system	FL	Share of stakeholders that consider the system will be / is economically viable	%	PW

Note: FL: "First Level" – SL*: "Second Level"- H*: "Hierarch" - PW: "Project-wide" - SW "Solution-wide"*

Description and guidance for each horizontal KPI for Transport Economy domain:

1- **Economic efficiency:**

a. **Operational cost:** Assesses the change in operational costs when using the new implemented technology (automated vehicles, electric mini-buses, or others) compared to traditional (internal combustion engine) vehicles. The indicator captures key cost components such as energy/fuel, maintenance, staffing (e.g., driver costs), and vehicle depreciation. Costs should be calculated on a per-kilometre or per-vehicle basis and compared over a consistent operational period. The final indicator can be expressed as percentage change relative to conventional vehicle costs.

b. **Monetarized value of travel time:** Estimates the economic benefit associated with reduced travel time due to the implemented solution. The indicator converts time savings into monetary terms, using a standard value-of-time (VoT) coefficient.

i. Travel time savings should be estimated based on real-world data or validated models (see indicator in the transport section), comparing conditions before and after implementation.
ii. The monetarised value is calculated as: Total travel time saved × Value of Time (€/hour)

2- **Share of stakeholders that consider the system economically viable:** Measures the perceived economic viability of the implemented solution, based on stakeholder feedback. Data is collected via targeted surveys or interviews (Task 1.5), using a binary (yes/no) format. The indicator is expressed as a percentage of "yes" responses. Additional qualitative insights may support the interpretation of results.

Context-specific impacts and indicators

IMPACT CATEGORY	EXPECTED IMPACT	L*	INDICATOR	UNIT	UC
Transport System					
Congestion	Reducing road congestion	SL	Average speed on samples of roads (district/streets where the system is implemented)	km/h	MU-UC01 & MU-UC02
	Reducing road congestion	SL	Average number of veh. (traffic) stops in the zone (district/streets where the system is implemented)	stops/time unit	MU-UC01
	Reducing motorised freight vehicles activity	SL	Number of trucks that would replace the amount of freight carried by the vessel	n of vehicles / day	AM-UC01
	Reduction of the time/distance searching for a parking spot (for delivery companies)	FL	Average time searching for a parking spot (for delivery vehicles)	minutes	MU-UC01
Accessibility to PT	minimizing the passengers' waiting time at each pickup point.	FL	average waiting time at each pickup point	minutes	TA-UC01 &LI-UC01
Intermodality	minimizing the passengers' waiting time at the station (after drop-off for intermodal trips)	FL	average waiting time at the station/stop (after drop-off for intermodal trips)	minutes	TA-UC02
	improve physical integration between transport modes	FL	Ratio between the number of passengers interchanging at multimodal hubs and population	n/share per population	LI-UC03
	improve physical integration between transport modes	FL	Ratio between the number of passengers interchanging at tram stop (with the autonomous service) and population of the experiment area	n/share per population	TA-UC02
	improve physical integration between transport modes	FL	Number of sharing stations in the city that can be reached from PT stop/stations in the experiment area in a 5 min walk	n	LI-UC02
Accessibility to city functions	Improving accessibility to city functions (schools) through bike sharing facilities	FL	Number of bike-sharing stations that can be reached within 10, minutes starting from schools in the pilot area	n	LI-UC02
Efficiency	Reduction of total km driven by the On Demand mobility fleet to	FL	Vehicle-Km-Travelled (VKT) of an On-Demand-Mobility Service to	Vkm	MU-UC01% LI-UC01

	transport the same amount of people		transport the same amount of people		
	Maximizing efficiency of waste collection	FL	Distance travelled per unit of waste collected	km/kg	AM-UC03
	Maximizing efficiency of waste collection	FL	Amount of waste collected per unit time or number of households served per unit time	households / hour (kg/hour)	AM-UC03
	Optimize charging grid increasing use during non-peak hours	FL	Time charging on peak hours over time charging on non-peak hours	minutes/ ratio	LI-UC04
User perception of Efficiency	User perception of the time needed to find a parking spot	FL	Share of users perceiving a reduction on the time needed to find a parking spot	%	MU-UC01
Real-time information	Improving Real-time information about disruptions	FL	Share of transport operators whose services are covered by a multimodal trips planning application considering real time disruptions	n	LI-UC03
Enviroment					
Liveability of urban space	Reduce illegal double-lane parking	FL	Frequency (events/h) of double parking in selected streets in the pilot area	events/h	MU-UC01
	Reduce standing time of motorized vehicles in the public space	SL	Observed standing time of vehicles at a complete stop (e.g. due to congestion or road blockages)	minutes	MU-UC02
Energy					
Energy demand	Reducing transport energy demand	FL	Stations using inductive changing with respect to manual charging	kWh, %, Ratio	TA-UC01 & TA-UC02
Social					
Safety	Increase transport related safety	SL	Incident rates of Automated Electric Waterborne Vessels compared to conventional vessels.	On field	AM-UC01
Increasing acceptance	Increasing number of employees participating in the TMC scheme	FL	Number of employees participating in the TMC scheme over total of employees in the companies	n	AM-UC04
Increasing awareness	Increasing awareness of service and time-schedules	FL	Share of Students that aware of service and time-schedules	%	LI-UC01

Equitable access for all user	Fairness of credit allocation across different demographics within the company	FL	Share of users/stakeholders that find the credit allocation fair	%	AM-UC04
Respect of speed limits	Respect of speed limits by relevant transport mode	FL	Share of bicycles/relevant transport mode exceeding speed limits	%	AM-UC02
Economy					
Economic efficiency	Reduce operational cost	FL	Average operational costs per parcel	€/parcel	MU-UC02 & AM-UC01
	Reduce operational cost	FL	Average Delivery time per parcel	minutes/ parcel	MU-UC02 & AM-UC01
	Willingness to pay	FL	Share of users that are willing to pay for the service	%	LI-UC01

Note: FL: "First Level" – SL*: "Second Level"*

2.4.7. Standardized process for evaluation

After setting the final list of expected impacts and associated indicators has been defined for all T-LLs divided into two parts: **Horizontal expected impacts and indicators (Project-wide and Solution-wide)** and **Context-specific impacts and indicators.** The standardized process for evaluation (fourth component in chapter 2.4.4) consists of the **six steps** that must be followed to conduct the evaluation. These steps should be developed appropriately and according to a consistent timeline.

The evaluation consists of comparing the value of the indicators after the pilot is carried out (i.e. after the measures have been implemented and have developed an impact) with the value of the same indicators prior to the implementation of the measures and, particularly with the value of the indicators under the BAU (Business as Usual) conditions (i.e. assuming that the measures were not implemented). To do so, quantitative data related to living lab (either the city or just a relevant part of it) needs to be collected both before and after the demonstration.

Figure 11: : metaCCAZE SIEF, when do we measure

As outlined in chapter 2.4.1 SIEF within metaCCAZE monitoring and evaluation structure, these steps are applied to Trailblazer LLs and Follower LLs alike and will be carried out by each LL partner in collaboration with the respective technical support partners, coordinated by task leaders of Task 3.6 in WP3 and Task 4.8 in WP4 (Monitoring, impact and transferability evaluation, lessons learned). The following step-by-step guidance outlines the sequence of actions to be undertaken.

1 • Step 1 - Baseline data collection (pre-implementation)

The first step involves collecting baseline data for all selected indicators before implementing the UCs. This establishes a reference point to assess any changes that occur after the measures have been deployed.

Baseline data is collected at the city or neighbourhood/UC-specific area level, depending on the LL scope, and may come from:

- Institutional sources (e.g., mobility departments, transport operators).
- Existing analytical tools (e.g., urban transport models).
- New data collection efforts
    - Onsite data collection (e.g., field measurements, traffic counts).
    - social acceptance and behavioural change indicators, which are assessed via Task 1.5 surveys.

The selection of sources will depend on the nature of the KPIs and the data needed, as well as the availability of information from institutional sources, stakeholders, and analytical tools (see results from Data Maps – Task 1.1 in D1.1 - Trailblaser LLs: status quo map, prototype ZESM use cases for passengers and freight) and the budget allocated for new data collection (e.g. all T-LLs have budget to conduct surveys and thereby tracking behavioural changes though tools). Details on data sources are provided in Annex II of each T-LL, while those for F-LLs will be defined in the coming months.

Ideally, the data required to compute the indicators should be collected at a control site where the measures will not be implemented, and which is comparable to the living lab. The data from this second site would help to quantify indicators in the Business-as-Usual (BAU) condition (see below – Step 4). However, this is not a mandatory requirement but an added value.

2 • Step 2 - Implementation of Use Cases

Following baseline data collection, UCs are deployed and tested in the LLs, with implementation coordinated by WP3 for Trailblazer LLs and WP4 for Follower LLs.

3 • Step 3 - Post-Implementation data collection

Once the UCs have been implemented (the trial and implementation period for the UCs has concluded, data collection is repeated using the same methods as in Step 1, ensuring a fair comparison. This step is crucial in evaluating the effectiveness of measures and their broader impacts.

When data is sourced from institutional databases or public repositories, consistency is generally inherent. However, for data obtained through direct measurements such as traffic counts or surveys it is crucial to maintain the same collection protocol. This includes consistent sample sizes, monitored locations, and timeframes covered, to ensure reliable and meaningful comparisons.

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4 • Step 4 - Business-as-Usual (BAU) Scenario

The BAU scenario answers the question: "What would have happened if the UCs had not been implemented?". In other words, it reflects the situation of the LL at the same point in time as the post-implementation data collection (Step 3) but assumes that the measures were not introduced. It is evident that the BAU condition is purely hypothetical and cannot be directly observed. Therefore, it must be estimated using one of the following approaches:

- *Comparable Control Sites:* If a similar area without intervention exists, data from this site can serve as the BAU reference. By definition, the UCs are not implemented in the control site. Therefore, any changes observed there depends on exogenous conditions. If the control site is comparable to the pilot site, it can be reasonably assumed that the same exogenous conditions would have influenced the UC area site as well.
- *Simulation Modelling:* Where available, a simulation model can estimate the BAU scenario by projecting system behaviour over time without the intervention of UCs. By inputting current data and assumptions, these models can forecast outcomes such as energy consumption, emissions, or mobility patterns, providing a detailed BAU scenario for comparison with post-implementation results.
- *Survey based estimation for Social acceptance indicators:* For social embracement indicators (related to Task 1.5), an alternative approach is to include a survey question asking respondents to indicate (hypothetically) what would have been their behaviour if the UC had not beenot implemented.
- *Pre-Implementation Baseline Data:* If neither a control site nor a simulation model is available, the baseline data collected in Step 1 is used as a BAU reference. In this case, if external trends (e.g., natural increase in cycling in the whole city due to external reasons or unrelated factors) are known, adjustments can be made to the baseline data to estimate the BAU scenario more accurately.

5 • Step 5 - Indicator Computation

The selected indicators are estimated based on the data collected before and after the implementation of the UCs. Horizontal indicators (Project-wide and Solution-wide), which apply across multiple LLs, must be calculated following the standardized descriptions outlined in Chapter 2.4.6, while context-specific indicators, tailored to each local context and intervention follow LL-specific methodologies detailed in Annex II.

As the MetaCCAZE SIEF follows the CIVITAS evaluation framework structure, the majority of its indicators align with those established in the CIVITAS framework. For that reason, addition information in KPIs (including many of the LL-specific) can be found in the CIVITAS framework[6] (including definitions, required data sources, and calculation methods).

[6] *The CIVITAS MUSE project is currently developing an interactive evaluation tool, with a beta version already available. Once the final version of this interactive tool is released, MetaCCAZE will be able to use it to further streamline indicator computation and impact analysis, ensuring consistency and comparability with other urban mobility EU projects.*

6 • Step 6 - Evaluation and Interpretation of Results

The computed indicators serve as an input for the final step, where the impacts of the measures are evaluated by comparing the indicator values against the BaU scenario. The MetaCCAZE SIEF does not aim to condense all indicators and their various dimensions (transport system, environment, etc.) into a single outcome. Instead, the impact evaluation is conducted through a reasoned (qualitative and quantitative) analysis of the differences observed across various indicators, interpreting the outcomes within the specific context of the UC implementation. In some cases, impacts could be more evident for certain indicators, while others may show little to no significant change. The objective of this final step is to translate these quantitative findings into a meaningful narrative, outlining the effects of the measures and drawing key lessons from the use cases (e.g. in terms of the effectiveness of the measures applied or their potential for transferability). This step will we carried out only after the trial and implementation period has concluded. The expected outcomes of this evaluation are detailed in the following section.

* • Adittional step to perform CBA and CEA considering SIEF results - Tracking Costs

In addition to data that need to be gathered as outlined in step 1 and 3, the LLs will need to monitor the costs. The data collected will be used as part of Task 5.3 "Impact assessment and contribution to NetZero vision and sustainability: Environmental, land and economic costs and benefits " to perform cost benefit analysis (CBA), cost effectiveness analysis (CEA). The following categories need to be monitored:

1. Infrastructure/ construction costs: These include fixed costs for the construction or renewal of infrastructure, etc. related to a UC.

2. Other fixed costs: These may include other fixed costs of a UC (e.g. equipment, purchases of vehicles, development of software or applications).

3. Operating costs: Operating costs can include any costs dependent on time or usage. Examples include rental costs, staff costs, routine maintenance costs. These should be reported as costs per year paid by a) the city/ municipality, b) other private companies or partners involved in the metaCCAZE project, c) other stakeholders or citizens, if applicable.

4. Revenues: These should include any revenues (per year) achieved from the operation of the metaCCAZE UC (i.e. from fares). These should be reported as revenues per year received by a) the city/ municipality, b) other private companies.

2.4.8. The expected outcomes

The application of the metaCCAZE SIEF is expected to generate valuable insights into the effectiveness, efficiency, and scalability of the UC tested in the LLs. Two perspectives are distinguished in the evaluation process:

- ***Evaluation within cities***: focusing on how UCs perform in their specific urban contexts, This analysis is carried out by respective LL partners and technical support partners)
- ***Cross-comparison between cities:*** enabling cross-LL comparisons to identify best practices and scalable interventions. This is carried out by Task 3.6 and 4.8 leaders under “Monitoring, impact and transferability evaluation, lessons learned”).

Evaluation within cities

At the Living Lab level, the evaluation provides both quantitative and qualitative insights into how effectively the implemented UCs achieve their intended impacts. By comparing post-implementation indicator values with those from the Business-As-Usual (BAU) scenario, the effects of the measures can be assessed across different dimensions. This includes first-level impacts—direct, immediate changes resulting from the measures—and second-level impacts, which refer to broader, system-wide effects that arise as a consequence of the initial changes and may take longer to become visible.

Each LL will analyse and interpret results across the six main impact categories (see Chapter 2.4.4): **(1) Transport System, (2) Environment, (3) Energy, (4) Society, (5) Economy and (6) Vehicle and Automation**. The findings will be synthesized into a final contextual analysis that reflects the local implementation environment, highlighting what worked, what did not, and why. In this sense, the interpretation of results is inherently context-specific: the effectiveness of an intervention is not assessed in isolation but by considering how external factors—such as urban form, infrastructure, user behaviours, or policy context—may have influenced the outcomes observed in the KPIs. These insights will eventually help shape best practices, guide future implementations and identify key lessons learned.

The results are useful for:

- ***Understanding effectiveness:*** determining whether the applied solutions achieve their intended impacts and provides magnitude estimates of these effects. This is particularly relevant for F-LLs and Observer Cities, which can leverage these insights to adapt interventions based on observed performance in T-LLs.
- ***Tracking contributions to long-term targets:*** Many evaluated indicators (e.g., CO_2 emission reductions, modal shift towards shared mobility) align with city-level climate neutrality goals on Climate City Contracts. The broader, second-level indicators provide strategic insights for policymakers on progress towards these objectives.
- ***Assessing technological performance:*** capturing technical performance indicators, offering an empirical assessment of their real-world functionality and adoption.

The final interpretation of results should also consider the resource investment required for each intervention. By comparing the impacts achieved against the resources invested, it is possible to assess whether the tested measures offer a proportional return on investment. Although a full cost-benefit analysis is beyond the scope of the SIEF, Task 5.3 – "Impact Assessment & Contribution to NetZero Vision" will further evaluate the environmental, economic, and sustainability implications of these interventions through their cost benefit analysis (CBA), cost effectiveness analysis (CEA), and life cycle assessment (LCA).

Cross-comparison between cities

Given the wide variety of UCs being tested in metaCCAZE—ranging from e-bike speed control to the implementation of mobility hubs and curbside management solutions—direct comparisons across cities are not always straightforward. However, the SIEF makes a significant effort to define common KPIs for interventions that address cross-cutting themes, ensuring that evaluations remain comparable across different urban contexts. As outlined in Chapter 2.4.6, the evaluation process incorporates two key mechanisms to enable cross-city analysis: "Project-wide KPIs" and "Solution-wide KPIs."

Beyond the use of common indicators, meaningful comparisons between cities require careful consideration of the scale and nature of each intervention. The same impact, measured by the same indicator, may vary substantially depending on local policy frameworks, user behaviour, the extent of the UC implementation, and broader urban infrastructure. For instance, a cycling-related measure implemented in Amsterdam—where cycling is already a dominant mode—will likely have very different effects compared to a similar intervention in Limassol, where private car dependency remains high. These contextual differences must be acknowledged when interpreting the results of cross-city comparisons.

For this reason, the interpretation of cross-comparison between cities should be complemented by the cost benefit analysis (CBA), cost effectiveness analysis (CEA) and Life Cycle Assessment (LCA) developed in Task 5.3 (Impact Assessment & Contribution to the NetZero Vision), as well as the cross-fertilization and transferability activities under Task 1.6. Together, these elements will support a more comprehensive understanding of which combinations of measures are most efficient, scalable, and transferable across different urban environments.

3. Outcomes – The 12 metadesigned Use Cases and BIGMs

This chapter aims at gathering the definition of the project's use cases and their Business Innovation and Governance Model assessment. The order of the use cases is as follows:

- Autonomous electric waterborne vessels for logistics (AM-UC01)
- Adaptive Speed Governance of connected e-bikes (AM-UC02)
- Optimizing intermodality of waste collection in the urban systems (AM-UC03)
- Tradable Mobility Credits (TMC) scheme (AM-UC04)
- Dynamic Curbside Management (DCM) (MU-UC01)
- Establishment and operation of multimodal logistics hubs (MU-UC02)
- On-demand mini-buses service (LI-UC01)
- Shared e-bikes (LI-UC02)
- Multimodal passenger hub (LI-UC03)
- Transport and Energy Platform (LI-UC04)
- Autonomous e-shuttles with advanced remote control centre and inductive changing (TA-UC01)
- Tram feeder service with advanced remote control centre and inductive charging (TA-UC02)

The structure of the outcomes is based on a Why–What–How logic and follows the CEN-CENELEC CWA 17381:2019 standard, with adaptations to fit the metaCCAZE methodology. It includes key considerations across urban challenges, stakeholder responsibilities, infrastructure requirements, financial planning, and risk mitigation. Each section is supported by guiding prompts and visual tools (e.g. flowcharts, stakeholder maps), making the document not only comprehensive but also adaptable to a range of urban contexts. This version is presented as a living document, intended to evolve through continuous updates and hands-on use during the project's lifetime. It is shared here to enable knowledge transfer and support other cities and projects in shaping their own urban mobility innovations using a tested, co-creative framework.

The template is structured into two stages: the first stage and the second stage of the Why-What-How framework. The division is designed to group **mandatory and urgent points/questions** into the first stage for prioritization and clarity.

Guiding hints are provided with each question to help the cities tailor the answers. These prompts are designed to enhance thinking and ensure the Use Case is well-defined.

🚦 **A traffic light system might be used to classify some of the information in terms of accuracy**:

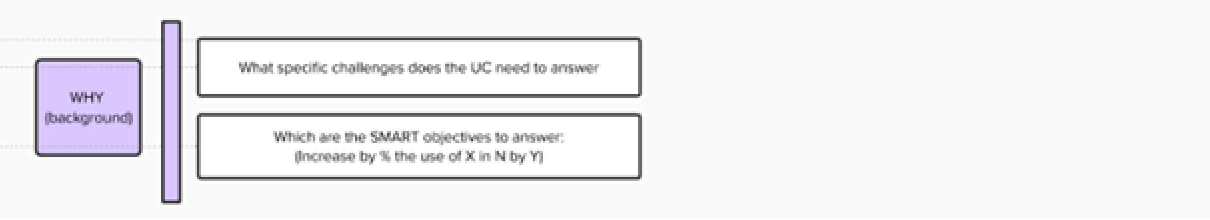
🟢: Confirmed—what you know for sure.

🟡: Needs verification—what you think you know.

🔴: Future-focused—what you don't know (yet)

🟣: Exploratory—what you aim to discover in the Use Case

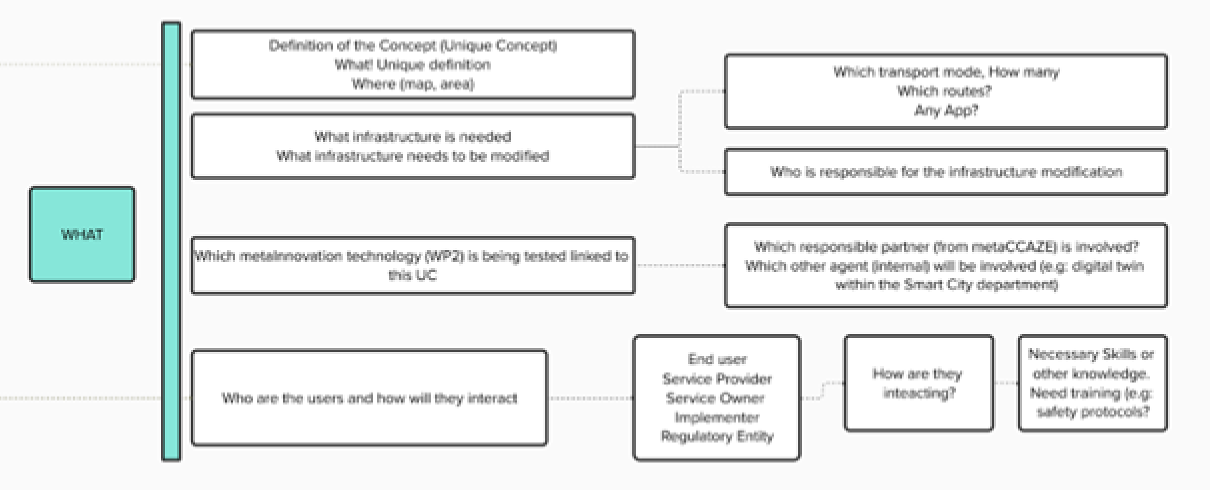
First Stage of Why – What – How Framework



Why: Challenges and Objectives

Questions
❗ What specific challenges faced by the city will this Use Case address? *Including environmental concerns and related climate goals, logistics concerns, traffic issues, safety concerns, and any other problems that the Use Case will help mitigate – e.g: The city aims at decreasing the dependency of car use to achieve the climate neutrality goals*
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case? *Use SMART objectives –Specific, Measurable, Achievable, Relevant, Time-Bound – giving example: increase by % the use of X in N by Y)?* *Feel free to consider the data or evidence supports these challenges (e.g., surveys, reports, or statistics)?*

What: The Concept, Location, and Infrastructure



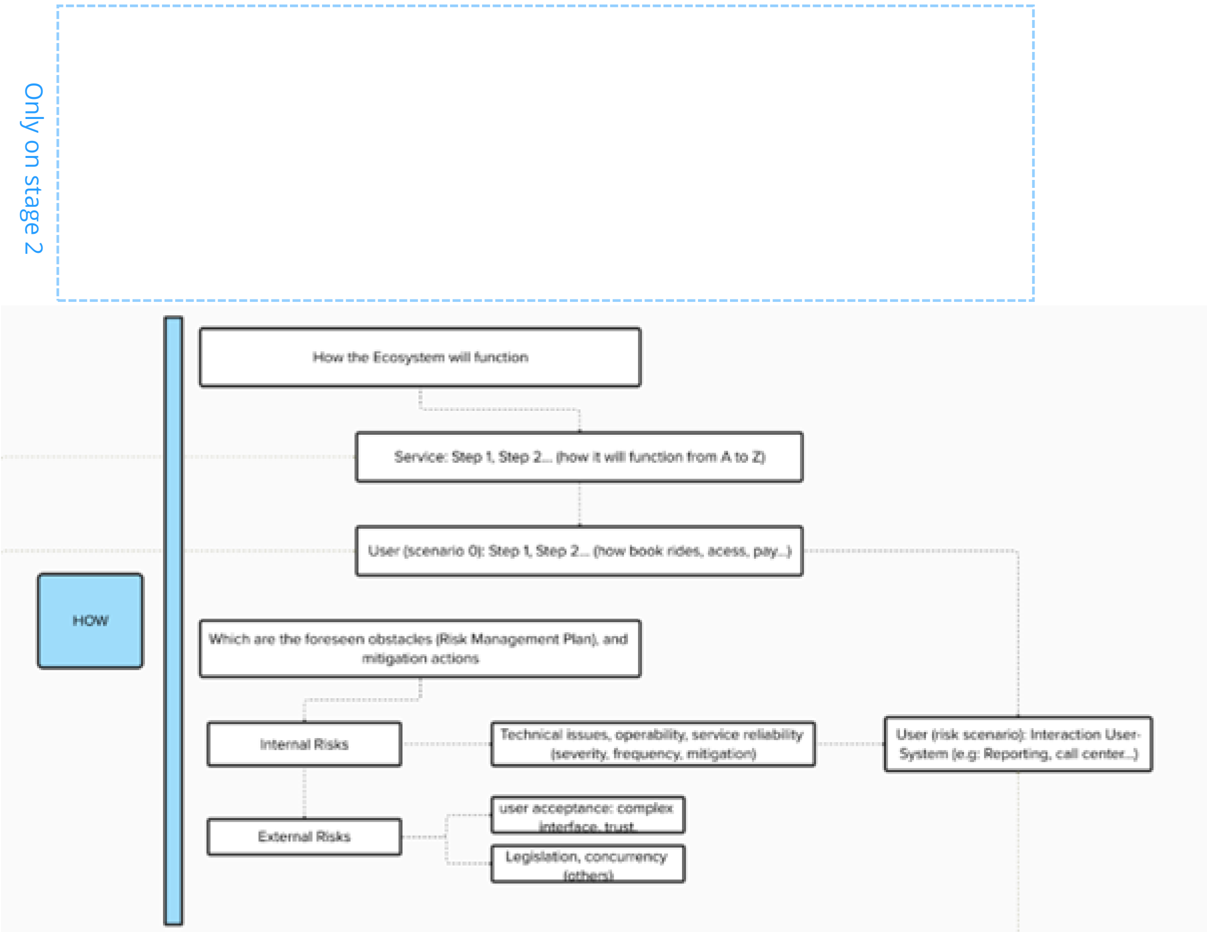
Use Case Code
Use Case Title
❗ Use Case Concept Definition *Unique Concept, Unique Definition – Explain why this UC is unique to other solutions*
❗ Location (and its influence area) *Please describe the location of the solution and its area of influence, including a clear outline of the route(s), and the scope of the project´s influence. Additionally, please list any advantages the location provides and/or reasons for its selection (such as connection to current public transportation systems, economic influence, etc…)*

👁*Additionally, **please provide a map** which clearly displays the above factors*

❗ Which (physical and digital) infrastructure is needed?
👁 *Consider these points while you are answering:*
required new roads, bike lanes, or pedestrian pathways
• *necessity of additional parking facilities, EV charging stations, or transit hubs*
• *development of new apps or digital platforms be required to support the service*
• *Requirement of IoT sensors or real-time monitoring systems*
• *Services to accompany the infrastructure such as:*
  o *public transport and how many, private vehicles, micromobility, sensors…)*
  o *Please include number of vehicles (e.g., buses, shuttles, e-bikes) will be deployed*

❗ Who will be responsible for developing and managing this new infrastructure? • *responsible stakeholder for planning and creating this infrastructure (e.g., city authorities, private companies, PPPs)*
❗ What (physical & digital) infrastructure needs to be modified 👁 *Consider these points while you are answering:* • *modifications needed to make infrastructure more accessible (e.g., ramps, elevators, signage)* • *management and maintenance of the modified infrastructure?* • *Involvement and coordination with other departments, agencies, or private entities*
❗ Who will be responsible for these infrastructure modifications? 👁 *Please indicate the stakeholder/authority/department responsible for any infrastructure modifications.*
❗ Which metaInnovation technology (WP2) is being tested linked to this UC? 👁 *Please consider these points while you are answering:* • *Involvement of the responsible partner (from metaCCAZE)* • *another agent (internal) will be involved (e.g: digital twin within the Smart City department)*

How: Operation, Management and Stakeholder Interaction



<table>
<tr><td>

❗ How the Service will function (under normal conditions - operation on a daily basis)

Please include a Flowchart where you represent how the Service will function from A to Z, listing who is responsible for each part of service, and how they will interact

Consider these points while you are defining how the Service will function:

- *Functionality during peak and off-peak hours*
- *Potential technical restrictions, such as limited operating hours or geographic boundaries*
- *Any technical or operational dependencies, such as dependency on internet connectivity or compatibility with existing infrastructure*
- *Integration with other services you use, such as public transportation or ride-sharing apps*
- *Maintenance or updates for optimal performance*
- *How to be notified for these updates and maintenance*

</td></tr>
<tr><td>

❗ How the User will interact (under normal conditions - operation on a daily basis)

Please include a Flow Chart which represents how the user will interact with the system for example how book rides, access, pay

Consider these points while you are defining how the User will interact:

- *Perception of the usefulness of the solution in daily life*
- *Specific benefits are most appealing to users*
- *Potential difficulties to use the solution*
- *Importance of this solution to easing in users' decision to adopt the new technology*

</td></tr>
</table>

• *Specific features to make the system easier to use for all individuals (for example disable people and elderly* • *Elements of the system interface for a positive impact*
❗ Please review the Prototype stakeholder map and make changes *Once you have defined the service and how users will interact with the system, please review the stakeholder diagram provided below, then make changes* 👁 *Consider these points while you are verifying and making changes on the stakeholder map:* • *All relevant stakeholders are correctly listed.* • *No stakeholders are missing.* • *Roles are accurately defined or, if necessary, adjusted or clarified.* • *Any irrelevant stakeholders are removed.*

// End of First Stage //

Second Stage of Why – What – How Framework -

What: Foreseen Internal Risks and Mitigation Actions

👁 It is important to consider potential risks, both internal (e.g., technical issues, operability, service reliability) and external (e.g., user acceptance, complex interfaces, trust). These risks can help refine how the service functions and identify areas for improvement. For instance, concerns about user trust or acceptance raised as risks can guide the development of more effective interactions between users and the solution described in Section 1.3.

Please identify and define any anticipated risks. Feel free to duplicate the rows as needed to include all relevant risks.

Internal Risk (Technical issues, operability, service reliability):			
	Severity	Likelihood	Mitigation action

❗ How the Service will function (under the anomalous scenario) *Please include a Flow Chart where you represent how the Service will function from A to Z under an anomalous (for example the event of a technical failure (e.g., software glitches, hardware breakdown, for example expectations for system recovery and support* 👁 *Consider these points while you are defining how the User will interact:* • *types of anomalous scenarios are likely to occur (e.g., technical glitches, hardware malfunctions, connectivity issues)* • *external anomalies to consider, such as power outages, environmental conditions, or user misuse (feel free to refer the risks mentioned in section 2.1)* • *anomaly impact on the user experience*
❗ How the User will interact (under the anomalous scenario)

[Please include a Flow Chart where you represent how the user will interact with the system under an anomalous for example reporting, call centre, refund for the ticket, rebooking] *Would you find it beneficial if the system could learn from your behaviours to better respond to future requests?* *Consider these points while you are defining how the User will interact* ***under the anomalous scenario****:* • *Respond time of the system to the input or request* • *Best way to inform the system* • *Providing feedback about user interactions to the system* • *Specific features to make the system easier to use for all individuals (for example disable people and elderly* • *Elements of the system interface for a positive impact*

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severity	Likelihood	Mitigation action
Other external risks (Legislation, competitors (others))			
	Severity	Likelihood	Mitigation action

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated? *Consider these points while you are answering:* • *The budget available from the MetaCCAZE project but also any additional funding / support (provided in both in-kind or as a financial value):* • *the initial investment from the municipality or budget required to undertake this project* • *specific components of the service require upfront investment (e.g., infrastructure, hardware, software development, personnel training)* • *specific stakeholders responsible for covering initial operational costs (e.g., running costs during the pilot phase)*
What is included in this budget? (technology-based, consider running the service) *Please consider these points while you are answering:* • *specific technologies are included in the budget (e.g., IoT devices, software licenses, hardware installations)* • *any recurring costs for maintaining or upgrading these technologies* • *the projected costs for running the service (e.g., electricity, internet, technical support)* • *any costs for staffing, training, or user support services* • *costs for marketing, stakeholder engagement, or public communication* • *testing, monitoring, and evaluation phases accounted for in the budget*
How was the project funded? Under which funding schemas and co-financing? *Please consider these points while you are answering:* • *project funding schema, such as Local government funding, Other public sector funding, Private Sector investment, Bank/financial institutions,*

• *Other (Please specify)*
What is the cost per unit? *Please consider these points while you are answering:* • *You may also consider this alongside the infrastructure needs outlined* • *the cost per unit, such as for each mode of transport and the number of vehicles required*
Do you need any human resources? If yes, what type of human resources are needed? *Please consider these points while you are answering:* • *potential hiring costs* • *salaries of employees directly involved in the project* • *costs related to training or upskilling employees to meet project-specific needs*
Please specify any additional costs not outlined above *If there are any additional costs not mentioned above, please provide details.*
Was the pricing of the proposed service defined? If yes, what is the pricing of the proposed service (for the user) *Please consider these points while you are answering:* • *different pricing tiers for various user groups (e.g., individuals, businesses, public institutions)* • *service free for certain users or under specific conditions (e.g., government subsidies or trial periods)* • *service offer subscription plans (e.g., monthly, annually)*
Are there any incentives planned? If yes, would they motivate users to prefer this mobility solution more frequently? Why? *Please consider these points while you are answering:* • *the external risks, as some of these incentives could serve as mitigation measures for certain identified risks* • *any planned incentives, such as financial discounts, priority access, or rewards programs*

The following chapters will gather the information considered on these fields per use case in the 4 trailblazer cities

3.1. Autonomous electric waterborne vessels for logistics (AM-UC01)

3.1.1. Metadesigned Use Case

First Stage of Why – What – How Framework

Why: Challenges and Objectives

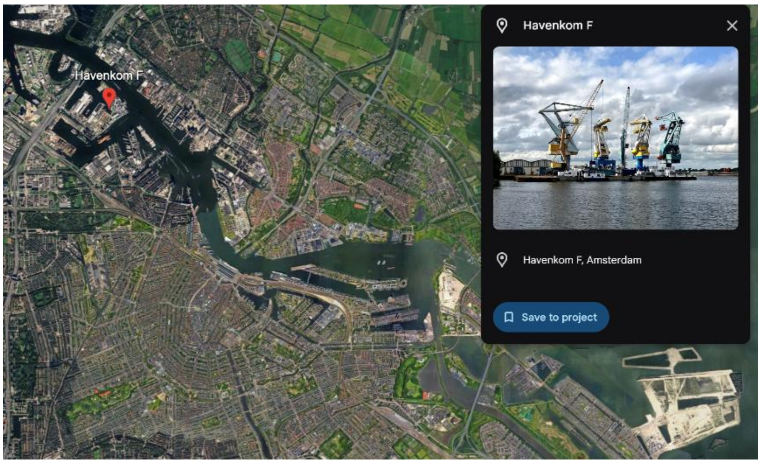
Questions	Considerations

❗ What specific challenges faced by the city will this Use Case address?	🟢 *(Note: effects are expected to be measurable when the use case is scaled to a fleet of vessels). MetaCCAZE use case focusses on testing, demonstrating and operating the technologies with one vessel first.)* **1. Environmental Concerns & Climate Goals** • **Reducing Carbon Emissions from Road Transport**: By shifting freight movement to autonomous, electric waterborne transport, this project reduces CO_2 emissions from trucks and vans, supporting the city's climate neutrality goals. • **Improving Air Quality**: With fewer diesel-powered vehicles on the road, air pollution and noise levels will significantly decrease, enhancing overall urban livability. • **Promoting resource efficiency & sustainability**: The transition to electric and autonomous vessels contributes to reducing reliance on fossil fuels and optimizing resource efficiency. **2. Logistics & Urban Transport Efficiency** • **Road Congestion**: By leveraging the city's waterways for freight and urban logistics, this solution reduces the strain on roads, freeing up space for pedestrians, cyclists, and public transport. • **Reducing Overloading of Vulnerable City Infrastructure**: Heavy road vehicles cause structural damage to bridges and streets in the historic inner city of Amsterdam, leading to costly maintenance and safety risks. Waterborne transport mitigates this issue by offering a sustainable alternative that doesn't make use of this infrastructure. • **Optimizing Last-Mile Delivery**: Autonomous boats can streamline parcel and goods transport, integrating seamlessly into the urban logistics network as a floating hub. **3. Traffic & Safety Concerns** • **Minimizing Heavy Vehicle Traffic & Road Accidents**: Fewer trucks and delivery vans mean a lower risk of traffic collisions, especially in cities with high population densities. • **Waterway Safety with Automation**: AI-driven navigation and collision-avoidance technology are expected to improve maritime safety by reducing human error in vessel operations. **4. Addressing Workforce Shortages** • **Tackling the Shortage of Ship Captains**: The maritime sector faces a growing shortage of captains. Autonomous vessels provide a scalable solution by reducing reliance on manual labour while maintaining safe and efficient operations.

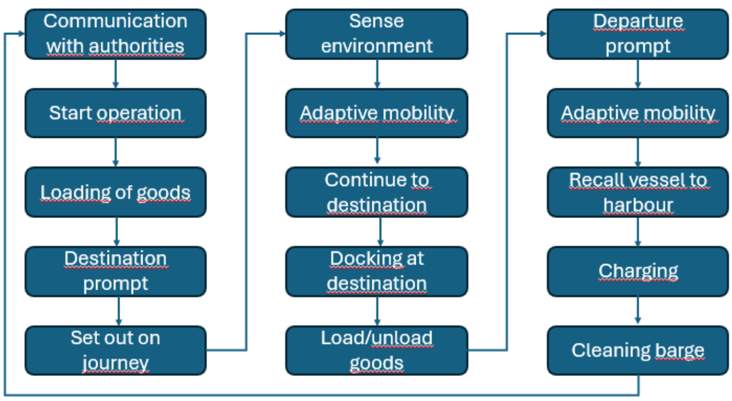
	5. Integration with Smart City Infrastructure • **Data-Driven Mobility & Logistics Management**: The system integrates with existing urban planning and IoT solutions, enabling smarter logistics and transport operations. • **Flexible, Adaptive Transport Solutions**: By utilizing real-time data, the fleet can dynamically adjust to demand, ensuring an efficient and responsive system.
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case?	🟢 **1. Environmental Impact:** 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. **2. Efficiency and Cost Reduction:** Automation 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. **3. Congestion and Traffic Management**: 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. **4. Sustainability and Innovation:** The deployment of Automated 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. **5. Urban Integration**: By exploring the potential for conducting pilots in Amsterdam's city center, 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.

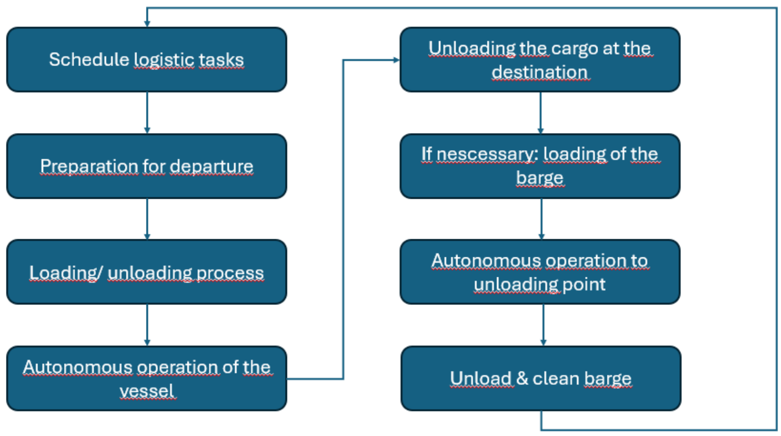
What: The Concept and Its Definition

Use Case Code	🟢 AM-UC01
Use Case Title	🟢 Autonomous electric waterborne vessels for logistics
❗ Use Case Concept Definition	🟢 The electric vessels of ZoevCity are already unique within Amsterdam. These vessels will be equipped with the technologies necessary to enable them to sail autonomously. Autonomous vessels of this size have not sailed before in Amsterdam.

❗ Location (and its influence area)	Automated sailing is only allowed in specific waters in Amsterdam. Initial testing will happen in proximity of the ZoevCity headquarters in Havenkolom F. Additional testing would take place near the headquarters of Roboat at the Marineterrein. Waters inside the city center of Amsterdam cannot legally be sailed autonomously and will involve a skipper.
❗ Which (physical and digital) infrastructure is needed?	• A ZoevCity electric waterborne barge vessel • Two 360 degree motors (front and back) • Sensors, cameras, Lidar, GPS, 5G • Electronics • Software for continuous interpretation of the incomming sensory/camera data and communication to the back-end systems of Roboat.
❗ Who will be responsible for developing and managing this new infrastructure?	🟢 ZoevCity, together with subcontractor Roboat will be responsible for developing this new infrastructure. ZoevCity will maintain ownership of the hardware. Roboat will license its software and computing power to continue the operation of the autonomous features.

How: Operation and Management

❗ How the Service will function (under normal conditions - operation on a daily basis)	

<table>
<tr><td>❗ How the User will interact (under normal conditions - operation on a daily basis)</td><td>🟢The user of the vessel is the owner of the vessel, a.k.a. ZoevCity. Benefits of this new technology are mainly to ZoevCity, needing less skippers to operate. ZoevCity is a logistics service provider. With the autonomous features the vessels can more easily sail at night, enabling more logistic movements at different times. This can benefit the service users. ZoevCity remains responsible for loading/unloading the vessel and will have a person on board to do so.

</td></tr>
<tr><td>❗ Please review the Prototype stakeholder map and make changes</td><td>The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.</td></tr>
</table>

Second Stage of Why – What – How Framework

What: Foreseen Internal Risks and Mitigation Actions

Internal Risk (Technical issues, operability, service reliability):			
Scenario	Severity	Likelihood	Mitigation action
Misinterpretation of camera/sensory images	H	M	Use of sensors (LIDAR, radar, and cameras) to minimize errors. Use AI training and validation with real-world data.
Break-up of communication between the vessel and its control centre	H	L	Use of stable communication protocols (e.g., 4G/5G, satellite). Fail-safe mode where the vessel stops or follows a safe route upon signal loss.
Breakdown of (one of) the engines	H	L	Maintenance protocols with preventive inspections.
Software glitch/ unexpected system crash	M	L	Multiple software backups and real-time error detection. Automatic reboot capabilities and a failsafe mode.

Failure of autonomous navigation system	H	M	Redundant autonomous navigation software and the ability for manual emergency control by a remote operator. Continuous monitoring by a control center.
❗ How the Service will function (under the anomalous scenario)	🟡 **Misinterpretation of Camera/Sensory Images** **Scenario:** The autonomous boat receives incorrect or unclear data from sensors or cameras, which can lead to wrong decisions, such as an unnecessary stop or incorrect manoeuvre. **Impact:** • The vessel's reactions may be slow or incorrect. • Unexpected stops or course corrections may occur, causing logistical delays. **Recovery Process:** • The system detects inconsistencies in sensor data through redundant sensors. • If possible, it switches to alternative data sources (e.g., radar, GPS). • When the error cannot be automatically corrected, a warning is sent to the control room. • The operator in the control center can assess the situation and, if necessary, manually control the boat or activate an emergency stop. • After recovery, the vessel is manually or automatically placed back on the route. **Break-up of communication between the vessel and its control centre** **Scenario:** Communication between the boat and the control center is interrupted by a network connection failure or external factors such as signal interference. **Impact:** • Operators are temporarily unable to monitor or control the boat. • In extreme cases, the boat may continue without external corrections, which poses safety risks. **Recovery Process:** • The vessel switches to a pre-programmed failsafe protocol. • If communication is not restored within a certain time, it switches to autonomous return or a safe stop at a pre-defined location. • The system repeatedly attempts to reconnect through alternative networks or frequencies. • Once the connection is restored, a status report is sent, and the control center, if necessary, takes over command. **Breakdown of (one of) the engines** **Scenario:** A motor fails due to mechanical defects, software issues, or overheating.		

	Impact: • The vessel may have limited or no maneuverability. • Delays in deliveries and potential disruption of water traffic. **Recovery Process:** • The system detects the failure and adjusts the power distribution so that the remaining engine(s) maintain functionality as best as possible. • If necessary, the vessel automatically reduces speed and sends a warning message to the control center. • Operators assess the situation and determine whether the boat can continue safely or if a tugboat is needed. • If the failure cannot be resolved remotely, the vessel is directed to the nearest port or maintenance point. **Software glitch/ unexpected system crash** **Scenario:** The software crashes or exhibits unforeseen bugs, causing the boat's control and decision-making to potentially malfunction. **Impact:** • Possible loss of navigation control or delays in decision-making. • The boat may temporarily stop or remain on a standard safety route. **Recovery Process:** • The system detects the crash and switches to a backup software version. • If the issue is due to a temporary error, the system automatically restarts. • If the issue persists, a warning message is sent to the control center. • Operators can remotely take control of the boat and attempt to manually resolve the issue. • If the failure is critical, a safety procedure is activated (such as directing the boat to a safe zone or activating a tow service). **Failure of autonomous navigation system** **Scenario:** The GPS or navigation system is not functioning correctly, causing the boat to receive inaccurate position data or struggle with navigation. **Impact:** • Risk of course deviation and potential danger to other water users. • Possible delays and reduced efficiency. **Recovery Process:** • The system switches to alternative navigation methods, such as internal chart systems or visual recognition. • If necessary, a stop mode is activated to prevent collisions. • A warning message is sent to the control center. • Operators can manually intervene and navigate the vessel until the system is restored.

	• If the issue cannot be resolved remotely, an external technician is called, and the boat is returned to a maintenance point.
❗ How the User will interact (under the anomalous scenario)	🟡 **Misinterpretation of Camera/Sensory Images** Risk: The autonomous boat receives incorrect or unclear data, leading to incorrect decisions. **User Flow:** 1. Detection: System detects sensory data inconsistencies (e.g., camera misinterpretation). 2. Alert: System sends automatic alert to control center with details of the issue. 3. User Interaction: o Operators manually intervene, assess the situation, and provide feedback on the sensor issue. o If the system can't recover, the operator triggers a manual override or a re-routing command. 4. System Feedback: o The system acknowledges user input and corrects the route. o The operator is informed when the system returns to optimal operation. **Break-up of Communication Between Vessel and Control Center** Risk: Communication is lost between the vessel and its control center. **User Flow:** 1. Detection: System detects loss of communication (no GPS, sensor data, or command from control center). 2. Alert: Automatic switch to failsafe mode with system message sent to control center. 3. User Interaction: o Control center operators try to restore communication remotely. o If unsuccessful, the operator manually directs the boat or calls for external help. 4. System Feedback: o Upon restoration of communication, the system provides a status report. o Acknowledgment of any manual intervention is sent back to the system. **Breakdown of One of the Engines** Risk: Mechanical or software failure results in engine breakdown. **User Flow:**

	1. Detection: System detects engine failure and adjusts power distribution to remaining engines. 2. Alert: System automatically alerts the control center and adjusts speed to reduce strain. 3. User Interaction: o Operators evaluate situation and provide feedback if the boat can continue or requires assistance. o Manual override is triggered if necessary. 4. System Feedback: o The system acknowledges any manual changes and sends a report about the status of the engines. o If recovery isn't possible, external tow service request is triggered. **Software Glitch / Unexpected System Crash** Risk: Software crashes, affecting boat control and decision-making. **User Flow:** 1. Detection: System detects crash or glitch in software and switches to backup protocol. 2. Alert: System alerts the control center about the failure. 3. User Interaction: o Operators evaluate the issue remotely and either resolve it or issue a command for recovery. o If recovery isn't possible remotely, the boat is guided to a safe port. 4. System Feedback: o System informs operator when the crash is resolved or whether manual intervention is needed. o Informs the operator of any backup system engagement. **Failure of Autonomous Navigation System** Risk: The autonomous navigation system fails, leading to potential loss of direction. **User Flow:** 1. Detection: System detects navigation failure and switches to manual mode or failsafe system. 2. Alert: System alerts the control center about the navigation failure. 3. User Interaction: o Operators assess the situation, possibly overriding the system to resume navigation. o If autonomous navigation can't be restored, manual controls are assumed by the operator. 4. System Feedback: o A full diagnostic is sent to control center after issue resolution.

	○ Operators are informed when the system is back online or safe manual control is in place.

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severity	Likelihood	Mitigation action
Complex interface for interference and lack of trust in the system	H	M	🟡Focus on intuitive UI/UX design. Conduct user training and onboarding sessions. Implement feedback loops and system updates based on user input to build trust.
Other external risks (Legislation, competitors (others))			
	Severity	Likelihood	Mitigation action
Limited space for legal operation of autonomous features	M	H	🟢Autonomous features will only operate in legal areas. Together with the City and other stakeholder, 🟡a steering group will be created that will lobby and discuss how to legalize autonomous sailing to a great extent/area.
Competition from other autonomous logistics solutions	H	M	🟢Continual investment in R&D to enhance technology, performance and safety features. Focus on building partnerships with key stakeholders.

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated?	**Running Costs (operational):** 🟢**1. Roboat Subscription:** • **€50,000 per year** for maintaining the Roboat system (outside the MetaCCAZE project). 🟢**2. Costs for the Barge with Spudpaal Thruster:** • **€180 per hour** for the use of the barge with spudpaal thruster. This can vary depending on the required sailing time and specific tasks. 🟢**3. Specific Operational Costs Per Transport:** In addition to the above, there may be variable operational costs depending on the type of transport and associated logistical support: • **Harbor Fees**: Costs for entering and exiting the harbor (e.g., docking fees or the use of harbor facilities).

	• **Crane or Lifting Costs**: If cranes or lifting equipment are needed for loading and unloading, costs can vary depending on the number of lifts and the type of equipment used. • **Fuel Costs**: As the vessels are electric, fuel costs will be lower than for traditional ships, but charging the batteries may still incur costs (depending on the charging infrastructure). • **Personnel Costs**: If personnel are needed for monitoring or operational support, these costs should also be included. • **Insurance**: Any costs for insuring the ship, equipment, and personnel during the pilot phase. 🟡 **4. Example Estimated Transport Cost (per transport):** Let's say a transport takes an average of **4 hours** with the barge: • **4 hours x €180 per hour = €720** per transport for the barge with spudpaal thruster. • **Roboat Subscription per month**: Dividing the yearly €50,000 by 12 months, it's about **€4,167 per month**. 🟡 **5. Estimated Annual Costs Summary:** • **Roboat Subscription**: €50,000 per year. • **Barge with Spudpaal Thruster (e.g., 100 hours per month)**: 100 hours x €180 = **€18,000 per month** = **€216,000 per year**. • **Additional Operational Costs** (harbor fees, crane rentals, etc.) can vary depending on the project, but an estimated **€50,000 per year** is a rough estimate. **6. Total Annual Costs:** • **€50,000 (Roboat Subscription) + €216,000 (barge hours) + €50,000 (operational costs)** = **€316,000 per year**

What is included in this budget? (technology-based, consider running the service)	🟢 **1. Technology-based Costs:**
	• **IoT Devices and Sensors:**
	  ○ Initial cost of sensors on vessels (e.g., for navigation, fuel levels, cargo, etc.).
	  ○ Ongoing maintenance of sensors and IoT devices for monitoring performance, data collection, and communication.
	  ○ Cost of software licenses.
	• **Software Licenses and Infrastructure:**
	  ○ Platform software for vessel control, logistics management, and data processing.
	  ○ System updates and upgrades to ensure software remains current and secure.
	• **Hardware Installations:**
	  ○ Vessel-specific hardware, such as spudpaal thrusters, GPS navigation systems, and other autonomous technologies.
	  ○ Charging infrastructure for the electric vessels.

	• **Communication Technologies:**
	    o Internet and communication services for real-time vessel tracking, data transmission, and communication with the control center.
	2. Recurring Costs:
	• **System Maintenance and Upgrades:**
	    o Ongoing software updates and security patches.
	    o Hardware maintenance for sensors, navigation systems, thrusters, and other critical equipment.
	• **Energy Costs:**
	    o Electricity costs for running the vessels (charging electric vessels and the infrastructure for it).
	• **Internet and Data Services:**
	    o Ongoing internet charges for communication between vessels and the control center.
	3. Operational Costs for Running the Service:
	• **Energy Consumption:**
	    o Since the vessels are electric, the cost of electricity for charging is a recurring operational expense.
	• **Technical Support:**
	    o technical support for troubleshooting any issues related to the vessels, systems, and software.
	    o Monitoring services to ensure the vessels are operating as expected.
	• **Vessel Operations:**
	    o Hourly costs for barge operation (e.g., €180 per hour for the barge with spudpaal thrusters).
	4. Staffing, Training, and User Support:
	• **Crew Training:**
	    o Training programs for operators, technical support staff, and maintenance personnel to ensure proper handling of the vessels and systems.
	• **Staffing Costs:**
	    o Salaries for employees working on the operation, including captains, technical support staff, and administrative roles.
	5. Marketing, Stakeholder Engagement, and Public Communication:
	• Marketing Campaigns to raise awareness of the service (social media, traditional advertising, etc.).
	• Stakeholder Engagement costs to build partnerships with local authorities, businesses, or other partners.
	• Public Communication Efforts including public outreach, information campaigns about autonomous vessels, and ensuring the public understands how the service benefits them.
	6. Testing, Monitoring, and Evaluation:

	• **Testing Costs:**
	  ○ Initial pilot testing of the autonomous barging system to ensure all components work as expected.
	  ○ Testing for scalability, especially if there are plans to extend the service or add more vessels.
	• **Monitoring and Evaluation:**
	  ○ Performance monitoring for both the vessels and the overall service, to ensure that targets are met and service is running efficiently.
	  ○ Evaluation of system performance and customer satisfaction to guide future improvements and upgrades.

How was the project funded? Under which funding schemas and co-financing?	**MetaCCAZE Funding:** • A significant portion of the project was funded through the MetaCCAZE program, which supports autonomous vessel development for urban logistics and mobility. **PK Waterbouw Investment:** • PK Waterbouw contributed its own resources to the project, reflecting its commitment to sustainable mobility solutions and technological innovation in waterborne transport.

3.1.2. Metadesigned BIGM

SECTION	DESCRIPTION
Summary of the BIGM	AM-UC01's BIGM combines a municipality-led governance framework to ensure stakeholders collaboration on safety, legislation, and infrastructure. The municipality aims to support safe and efficient zero-emission logistics via autonomous vessels to benefit both local and logistic businesses. It expects an impact reflected in improved safety, the reduction of emissions and quality of life enhancement of its inhabitants.
Governance Model	The governance model of AM-UC01 coordinates operational, infrastructure, regulatory, and beneficiary stakeholders to deliver logistics services using autonomous vessels on urban waterways. Each group has defined roles: operational stakeholders manage vessels and logistics, infrastructure stakeholders provide technology and support, regulatory bodies oversee compliance and safety, and beneficiaries such as logistics companies and local businesses receive the transported goods (Figure 12).
Business Innovation Model	It centers on the vessel's operator (i.e., ZoevCity), leveraging autonomous vessels for goods and waste transport serving local and logistic businesses. The value proposition of the vessel's operator is aimed to reduce emissions from sailing, improve safety on the water and at the same time reduce the cost of the shipment through autonomous, zero-emission, waterborne logistics (Figure 13).

Changes from Prototype BIGM	**Business Model**: • A more detailed description of the cost structure was included specifying revenue streams and expenses • Added Roboat subscription costs and granular operational expenses (e.g., €180/hour barge use). • Expanded partnerships with Marineterrein for testing. **Governance Model**: • Shifted focal organization from a generic "collaborative group" to the Municipality of Amsterdam. • Formalized steering groups and data protocols for legislative compliance. • The activities of the local businesses potentially interested in the service were included.

Table 8:: AM-UC01- List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Service Provider	Vessel Operator	ZoevCity	Operate/maintain autonomous vessels. Responsible for loading/unloading the vessel	✅ Confirmed
Key Partner	Municipality	Municipality of Amsterdam	Regulatory oversight and infrastructure permits. Keeping the canals navigable for vessels.	✅ Confirmed
	Landowner	Marineterrein	Hub of organisations (e.g., startups, research institutions, and educational bodies), Provides test facilities.	✅ Confirmed
	Port Authority	Port of Amsterdam	Oversees the port's operations.	✅ Confirmed
	Autonomous Vessel builder	ZoevCity	Build the vessels	✅ Confirmed
	Autonomous Vessel Software	Roboat	Provide hardware & software and sensor systems	✅ Confirmed
	National Public works and water management	Rijkswaterstaat	Undertaking projects to improve infrastructure, such as renovating locks and bridges national-wide.	✅ Confirmed

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
	Insurance Company	Collaborator of Roboat	Provide coverage for vessels and operations	✅ Confirmed
	Technology Providers	Suppliers of ZoevCity	Hardware for the vessels	✅ Confirmed
	Charging Stations Owner/Operator	ZoevCity	Operate charging infrastructure to charge the vessels	✅ Confirmed
Customer	Logistics Companies	Logistics Companies (e.g. ZoevCity)	Utilize autonomous vessels for efficient and sustainable goods transportation	✅ Confirmed
	Local Businesses	Local Businesses	Receive and distribute supplies via autonomous vessels	⏳ Future Engagement

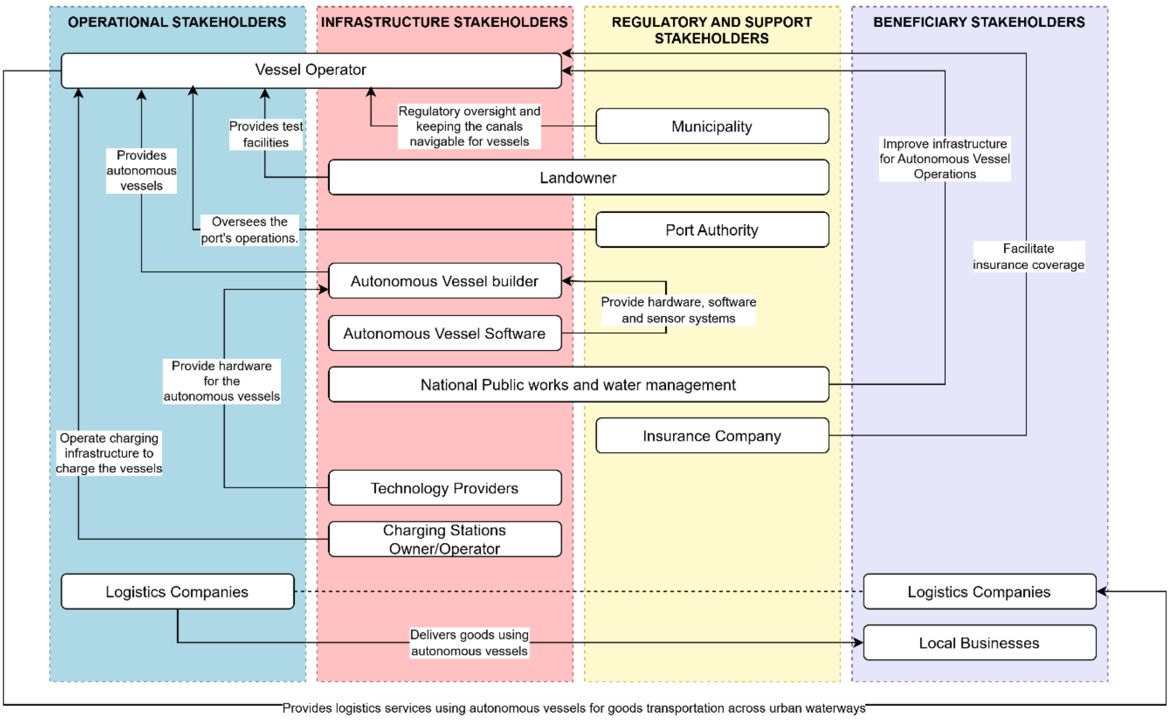


Figure 12: AM-UC01- Metadesigned Governance Model

Co-funded by the European Union

Key Partners	**Key Activities**	**Value Propositions**	**Citizen Relationships**	**Customer Segments**
- Municipality - Landowner - Port Authority - Autonomous Vessel builder - Autonomous Vessel Software - National Public works and water management - Insurance Company - Technology Providers - Charging Stations - Owner/Operator	- Transportation of goods -Route planning and optimization -Infrastructure maintenance -Stakeholder communication and collaboration	**Logistics Companies** '- Improved safety on water - Provide efficient, and environmentally friendly transportation of waste - Cost reduction - Reduce emmissions - Enhance Quality of Life - Community Engagement **Local Businesses** - Reduce reliance on road-based logistics - Receive & distribute supplies via autonomous vessels - Community engagement	-Transparent communication -Responsive customer service - Community engagement initiatives	Logistics Companies Local Businesses
	Key Resources - ICT infrastructure - Skilled personnel - Partnerships and collaborations		**Channels** -Direct collection -Waterborne transport -Digital platforms	
Cost Structure - Technology-based Costs (IoT Devices and Sensors on vessels, licenses) - Software Licenses and Infrastructure (Platform, system updates) - Hardware Installations (Vessel-specific hardware, Charging infrastructure) - Communication Technologies (Internet and communication services) - Recurring Costs (System Maintenance and Upgrades, electricity) - Operational Costs (Technical Support, vessel operations) - Staffing, Training, and User Support (Crew Training, Staffing Costs)			**Revenue Streams** - Fees from logistics companies - Fees from local businesses	

Figure 13: AM-UC01 - Metadesigned Business Model

3.2. Adaptive Speed Governance of connected e-bikes (AM-UC02)

3.2.1. Metadesigned Use Case

First Stage of Why – What – How Framework

Why: Challenges and Objectives

Questions	Considerations
❗ What specific challenges faced by the city will this Use Case address?	🟢 1. High number of accidents and near misses involving cyclists and pedestrians. 2. Reduction in perception of safety amongst cyclists in Amsterdam 3. People who stop cycling due to erosion of safety 4. Higher usage of the park (more e-bikes and bikes) creates higher strain for visitors and maintenance
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case?	🟢 Preserve Vondelpark's heritage as a pedestrian-friendly public space. Address high cycling speeds, especially among commuters and delivery riders on eBikes. Implement speed control measures without altering the park's infrastructure. *(Note: As a heritage site, the city is unable to install the usual physical speed measures, such as speed bumps).* Use Adaptive 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 and city.

What: The Concept and Its Definition

Use Case Code	AM-UC02
Use Case Title	Adaptive Speed Governance
❗ Use Case Concept Definition	The recent proliferation of many new micro-mobilities, such as electric scooters, electric bicycles, eCargo Bikes, and Light Electric Vehicles bring into focus issues of safety, as witnessed by the unprecedented number of accidents and near-misses involving these vehicles. The Townmaking Institute and the City of Amsterdam take a Commons-based PentaHelix approach, engaging Citizen Organizations, Local Government Officials, Bicycle (Motor) Manufacturers, Digital Infrastructure Companies, Vocational Schools to develop the collective necessary solutions to resolve this complex issue. This collective set of solutions is called Adaptive Speed Governance. Adaptive Speed Governance provides place-based, situation-specific, and real-time adaptability to interact with cyclists as they move through the different places in the city at different times. This permits cities to generate dynamic traffic zones for the many different areas of the city such as parks, school zones, business districts, and industrial areas, and change them over the course of the day, week, or season. Cities can pro-actively govern speed regulations for specific micromobilities, and send those instructions directly to the vehicle in real-time, avoiding adding more modality-specific signage or traffic signals. Cities like Amsterdam possess one of the highest densities of traffic lights and signage per resident in the world, and struggle to add more meaningful signals and signage to already crowded urban spaces. Adaptive Speed Governance also works as a "Zero-data" solution, giving confidence to Cyclists that their shared data will never be retained after their journeys are complete. The Netherlands was one the first countries to witness the deterioration of a well-established and organically homegrown cycling culture with rising accidents and near-misses, and most European cities now experiencing these issues as well (see the recent documentary by BBC Panorama, https://www.bbc.co.uk/programmes/m0026sww). The initial response to these issues tends to either seek solutions from a single party, such as expecting eBike manufacturers to make their eBikes safer, deploying more enforcement agents on the street, or banning specific kinds of micromobilities spurred by fatal accidents (e.g. https://en.wikipedia.org/wiki/Oss_rail_accident). Cities that want to adopt Adaptive Speed Governance need the development of their own NextCommons using the nextCommons principles, incorporating their place-based safety-needs for their micromobility modalities that need governance[7]

[7] eBikes, the rebirth of motorcycles: https://www.townmaking.com/search/cls-adaptive-speed-governance/cls-ebikes-the-rebirth-of-motorcycles/cnt-120-years-of-safety-progress

Unsafe at any Speed: https://www.townmaking.com/search/cls-adaptive-speed-governance/cnt-unsafe-at-any-speed

Are eBikes unsafe at any speed: https://www.townmaking.com/search/cls-townmaking-podcasts/cnt-s1e10-ebike-fatbike-safety

What are the nextCommons principles: https://www.townmaking.com/search/cls-townmaking-podcasts/cnt-s1e3-the-nextcommons

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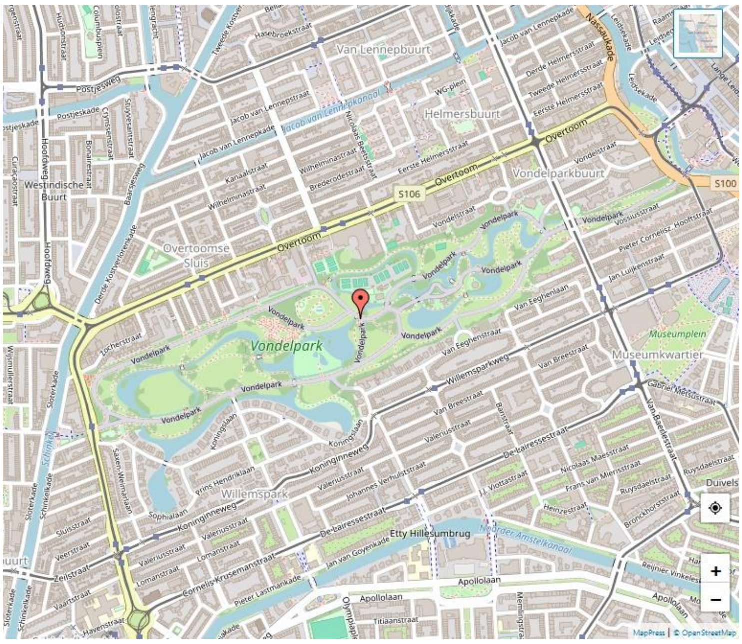
the European Union

❗ Location (and its influence area)	🟢The Vondelpark is situated in the centre of Amsterdam. It is a monumental park in Amsterdam; prohibiting the alteration of public assets in the park (e.g. speed bumps and signage). A ring-shaped cycling path runs alongside the periphery of the whole park, connecting travel arteries between the city centre to the west and south of the city. Cyclists tend to go out of their way to cycle through the park, entering either from the two main entrances on either end, or through the many side streets on its flanks. 
❗ Which (physical and digital) infrastructure is needed?	🟢The Townmaking Institute organizes assets from independent businesses and large enterprises following nextCommons principles. The scoped assets include: - Total Urban Mobilty System (TUMS) intended for Area and Asset Managers, a digital infrastructure (digital) - Infrastructure-connected bicycles and eBikes (physical), initially scoped for 6 units and expanded as necessary together with NextCommons stakeholders. - A dedicated Onboard Unit (OBU) connected to a 5G network, communicating with TUMS, initially scoped for 6 units. *(Note that a mobile app was also developed with the same functionality as the Onboard Unit, but not continued as regulations prohibit Mobile Phone usage while cycling, and a dedicated experience was considered safer.)* - A framework for conducting place-based safety studies, the Safety Clover (intangible) - An Urban Knowledge Base (UKB) to record the knowledge captured while conducting the place-based safety studies (digital), intended for Policy Makers, Area and Asset Managers, contributing businesses, and organized Citizens. The knowledge in the UKB feeds TUMS, and participation by all parties in the PentaHelix ensures evergreen knowledge representation. - Wayflow, an Experience Language for communicating place-based safety information implemented on the Onboard Unit to cyclists (intangible)
❗ Who will be responsible for developing and managing this new infrastructure?	🟢The Townmaking Institute and the City of Amsterdam organize the necessary capital partners who develop the assets and the operational organizations that will operate the asset. *All partners understand the necessity of a "fourth space" of innovation for Societal Resilience (see https://www.embodiedmaking.com/search/cls-knowledge-frameworks/cnt-governance-regimes), and follow the nextCommons principles for guidance (see https://nextcommons.townmaking.com).*

	For the purposes of this project, Townmaking should be seen as the organization that organizes both the knowledge/intellectual capital and the asset operations parties.
❗ What (physical & digital) infrastructure needs to be modified	🟢 No modifications required for physical infrastructure. For scaling, bicycle manufacturers require adaptation to introduce onboard devices. Each new place requires a place-based safety study (e.g. an industrial zone or school zone). A common knowledge base ensures multiple parties can access the same knowledge to dimension context-based information, avoiding the fallacies of "data-driven decisions" and building the required knowledge and information for good decisions.
❗ Who will be responsible for these infrastructure modifications?	🟢 The Townmaking Institute works together with regulatory bodies, like national safety institutions, national authorities, and local governments to determine the best course of implementation in each geography. In the Netherlands, we seek the implementation of the Onboard Wayflow device as a regulated Vignette issued by a local or national authority, realized either as an independent device mounted on the vehicles, or integrated into the vehicle's onboard cockpit experience.

How: Operation and Management

❗ How the Service will function (under normal conditions - operation on a daily basis)	🟢 The Townmaking Institute provides a reference architecture, co-developed by all participants in the Amsterdam NextCommons, that ensures the assets operate and inter-operate together effectively. The Urban Knowledge Base represents the knowledge of the site, containing the Narrative Records and outcomes of the Place-based Safety Studies. Through an API, this knowledge can be obtained by any permitted municipal application. Domain-specific logic for the park to manage traffic is moderated in the Total Urban Mobility System (TUMS) that aggregates the necessary logic for the site and also provides an API for all permitted applications. A connected onboard device on bicycles displays place-based traffic cues and nudges, obtained from TUMS.
❗ How the User will interact (under normal conditions - operation on a daily basis)	

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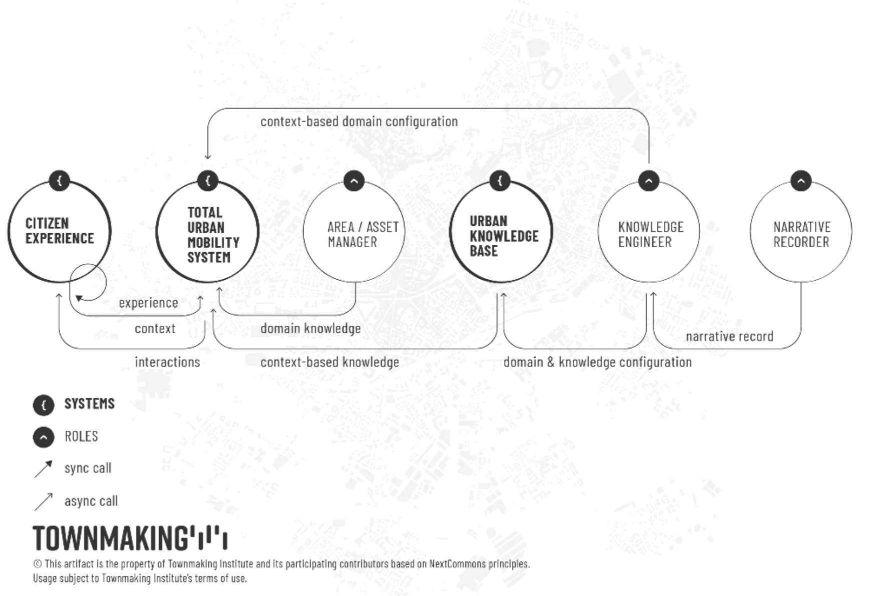

Users either contribute towards generating safety information for citizens, or obtain place-based safety information as they travel through the site. Narrative Recorders conduct site-based research to document the full complexity of the place, and the research is used by Knowledge Engineers to structure site-based Knowledge. The site-based knowledge is curated in an Urban Knowledge Base, accessible by all governance parties working to make the site better or keep the site safer. The Total Urban Mobility System (TUMS) further introduces mobility specific domain logic to ensure place-based safety for micromobility riders such as bicycles, eBikes, and electric CargoBikes.
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<tr>
<td>❗ Please review the Prototype stakeholder map and make changes</td>
<td>The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.</td>
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Second Stage of Why – What – How Framework

What: Foreseen Internal Risks and Mitigation Actions

Internal Risk (Technical issues, operability, service reliability):			
	Severity	Likelihood	Mitigation action
Timely delivery of Safety Information to Onboard Device	H	M	Configured 5G network for timely delivery of context-based information, Predictive catching strategies, Fallback experiences for outages
Connectivity Non-availability (network connectivity is temporarily unavailable	H	L	Configured network for high availability low data thoroughput, fallback experiences

Lack of situational coverage	H	L	Comprehensive Place-based safety studies and Narrative Records to avoid “trial and error” culture.

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<td>❗ How the Service will function (under the anomalous scenario)</td>
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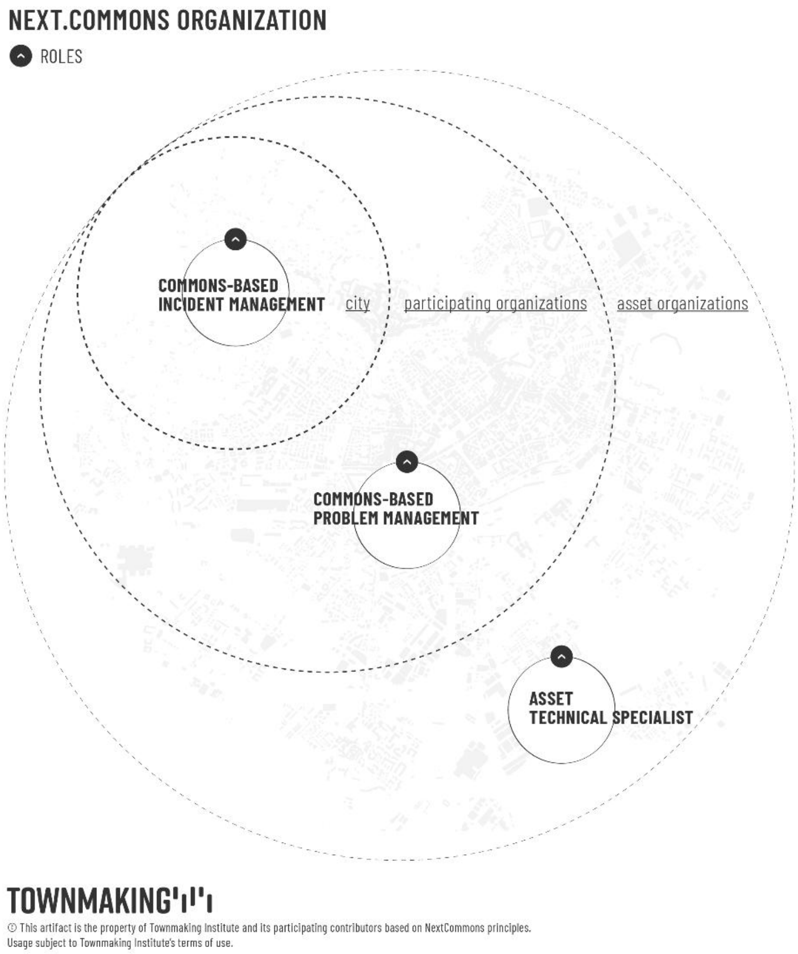
🟢Anomalous situations can occur due to unforeseen circumstances that require rethinking existing service models (despite the service working normally), or due to the incorrect technical operation of an existing service.

For anomalous situations due to unforeseen circumstances, such as a pandemic or environmental damage, new factors may require incorporation into the Wayflow Experience Language. This requires organizing a NextCommons where all parties will be able to act through collectivizing risks through the 4th way (NextCommons), rather than outsourcing it.

For anomalous operations of an existing service, such as non-availability of storage, computational processing, or connectivity, a commons-based organization will operate 1st line support with the city, ideally an insourced operation of the city. 2nd line support will be jointly conducted in a NextCommons by the participating organizations, and 3rd line support with the technical specialists of the contributing asset organizations.



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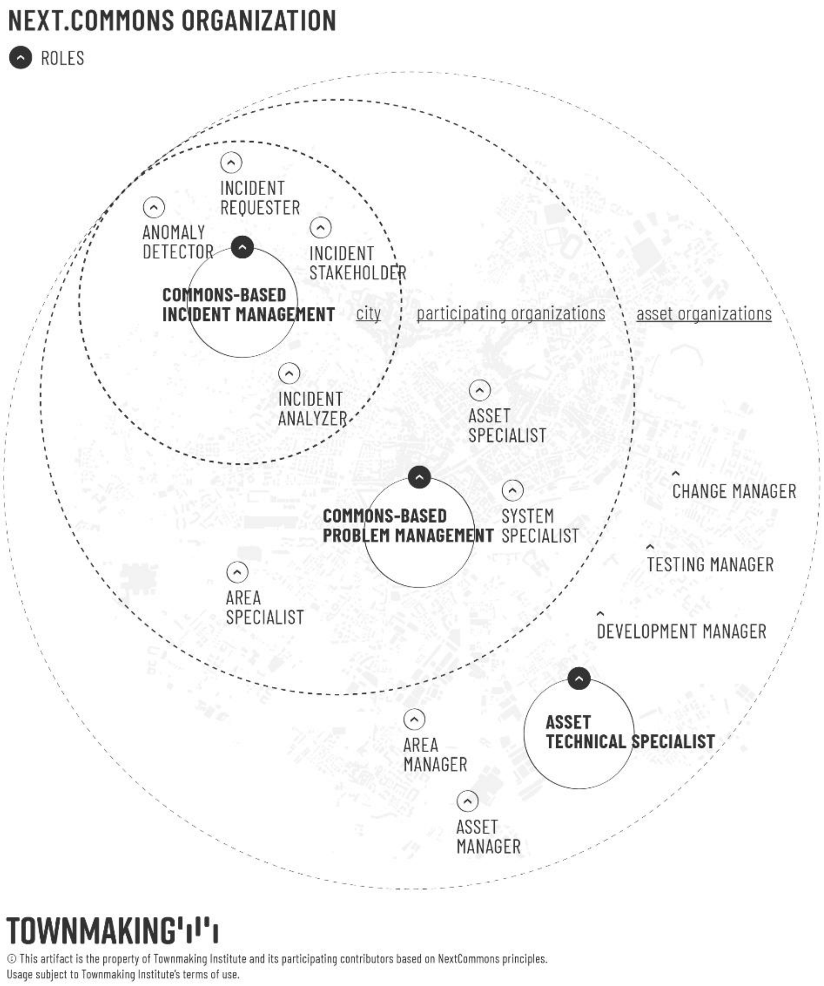
<tr>
<td>❗ How the User will</td>
<td>🟢In anomalous unforeseen situations and anomalous service operations on well-understood situations, we foresee default fallback experiences. For unforeseen situations</td>
</tr>
</table>

interact (under the anomalous scenario)	(pandemics, emergencies, etc.) a commons-based incident management organization interacts closely with a problem-management team (assembled solely for the unforeseen situation) to tackle the situation together with a team with specialists. For service issues on foreseen situations, the anomaly is addressed as an incident raised through the 2nd line and 3rd line teams from contributing asset specialists. 

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
Risk	Severity	Likelihood	Mitigation action
Inability to setup NextCommons in other geographies for scaling	H	M	Setup information programs to explain NextCommons approach to interested cities. Work with metaCCAZE program/project management to establish 4th way, with differentiated governance models. Ensure NextCommons are protected from speculative actors

			(e.g. venture-capital funded startups) to establish place-based sensitivity.
Other External Risks			
Risk	Severity	Likelihood	Mitigation action
Inability to establish socio-political processes for ASG policy	M	M	Work with multi-stakeholder engagements to ensure ASG implementation, follow local governance process with NextCommons to establish place-based safety policies, and ensure the political process strengthens NextCommons.

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated?	Three primary investments are required for a participating city. First the setup of a NextCommons, identifying the potential participating parties (representation from local government, local businesses, knowledge institutions, organized citizens) to organize the capital curation. The second involves investments for identifying a place where public safety is critical, and has deteriorated due to introduction of micro-modalities, and organizing the site-based activities. Finally, investments are required to implement place-based safety regulations and collaborate with other city NextCommons. The NextCommons setup usually requires conducting a Narrative Record, preferably in local language of the region, of around 12 participants. The Townmaking Institute provides the necessary training to establish the Narrative Recorders in the local region, preferably participants of the NextCommons chapter. The training usually requires 40 hours of guided education, and peer-based reviews to follow. Each Narrative Record consists of 2000 to 5000 words, and requires 20 hours to complete. Compensation for the Narrative Recorders should be consumerate with fair local rates agreed by the NextCommons. The setup of the NextCommons usually requires 2 to 3 dedicated sessions with local government.
What is included in this budget? (technology-based, consider running the service)	Dependent on implementing geography-specific NextCommons.
How was the project funded? Under which funding schemas and co-financing?	Funding is typically provided in a PentaHelix approach, with local businesses, government, and capital organizations all contributing towards resolving a societal issue. Actuals dependent on the implementation of the NextCommons in each geography.

What is the cost per unit?	Dependent on implementing geography-specific NextCommons realization.
Do you need any human resources? If yes, what type of human resources are needed?	Each implementing region requires a NextCommons chapter that establishes Narrative Recorders, Knowledge Engineers, and Patternists. Furthermore, the Digital Society work in Townmaking (see *https://digitalsociety.townmaking.com*) provides guidelines for Urban Digitalization, seeking the establishment of Urban Digitalization as a Discipline rather than a trial and error process at the expense of public safety. Independent NextCommons establishment requires a local Digitalization team that incorporates the disciplinary considerations.
Please specify any additional costs not outlined above	Dependent on implementing geography-specific NextCommons realization.
Was the pricing of the proposed service defined? If yes, what is the pricing of the proposed service (for the user)	Public Safety is not a market-based service, and realized through geography-specific NextCommons realization.
Are there any incentives planned? If yes, would they motivate users to prefer this mobility solution more frequently? Why?	Not applicable for Public Safety. The use of the Safety Clover framework determines optimal societal focus.

3.2.2. Metadesigned BIGM

SECTION	DESCRIPTION
Summary of the BIGM	The metadesigned BIGM for Adaptive Speed Governance integrates decentralised, zero-data technology with place-based safety systems in Vondelpark, enabling e-bikes to receive real-time feedback through the Wayflow Onboard Unit whilst ensuring user privacy and community co-governance.
Governance Model	The governance model employs a collaborative approach centred on the Townmaking Institute, which serves in multiple roles whilst maintaining zero-data compliance. It integrates direct feedback from citizen groups and park managers through structured narrative records to continuously improve the system (Figure 14).
Business Innovation Model	The business model reframes traditional value chains as commons-based infrastructure, replacing revenue streams with contribution models and focusing on social good. It emphasises citizen relationships through

	technology-enabled feedback loops and narrative record collection (Figure 15).
Changes from Prototype BIGM	**Business Model**: • Added the Wayflow Onboard Unit (OBU) as a specific technology solution • Incorporated place-based information systems as a key resource • Added decentralised, zero-data compliance as a fundamental value proposition • Integrated narrative records as a key method for continuous improvement **Governance Model**: • Consolidated multiple stakeholder roles under Townmaking Institute (service provider, technology provider, digital infrastructure operator, and eBikes manufacturer) • Added Amsterdam Police and BOA as specific law enforcement stakeholders • Included ODIDO as the specific telecommunications provider • Incorporated citizen safety groups as stakeholders (Fietsersbond and Hart voor het Vondelpark) as formal stakeholders with co-design responsibilities • Implemented the NextCommons framework for knowledge curation and governance • Enhanced zero-data compliance as a core governance principle

Table 9: AM-UC02 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Service Provider	Non-profit organisation	Townmaking Institute	Operates the service, manages the NextCommons framework, curates and records knowledge, and captures data from local safety studies to improve the service.	Confirmed
Key Partner	Municipality	Municipality of Amsterdam	Regulatory oversight and policy alignment	Confirmed
	Technology Provider	Townmaking Institute	Develops the Onboard Unit (OBU)	Confirmed
	Digital Infrastructure Operator	Townmaking Institute	Manages software and backend, ensuring decentralized, zero-data compliance.	Confirmed
	Speed Law Enforcement	Amsterdam Police, BOA (Local Law enforcement)	Addresses compliance and violations	Confirmed

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
	eBikes Manufacturer	Townmaking Institute	Adapts bikes to include onboard devices	✅ Confirmed
	Telecommunication Provider	ODIDO	Provide 5G connectivity	✅ Confirmed
Customer	E-bike riders (Users)	Micromobility Drivers	Users of electric bicycles	✅ Confirmed
	Park Manager	Vondelpark Manager	Manage the park, feedback to the DIO	✅ Confirmed
	Citizen Groups	Fietsersbond (cyclists association), Hart voor het Vondelpark (citizen association), Volunteers of the Park Information Point,	Engagement to provide Narrative Record that reveals complexity with Non-Profit Organization	✅ Confirmed

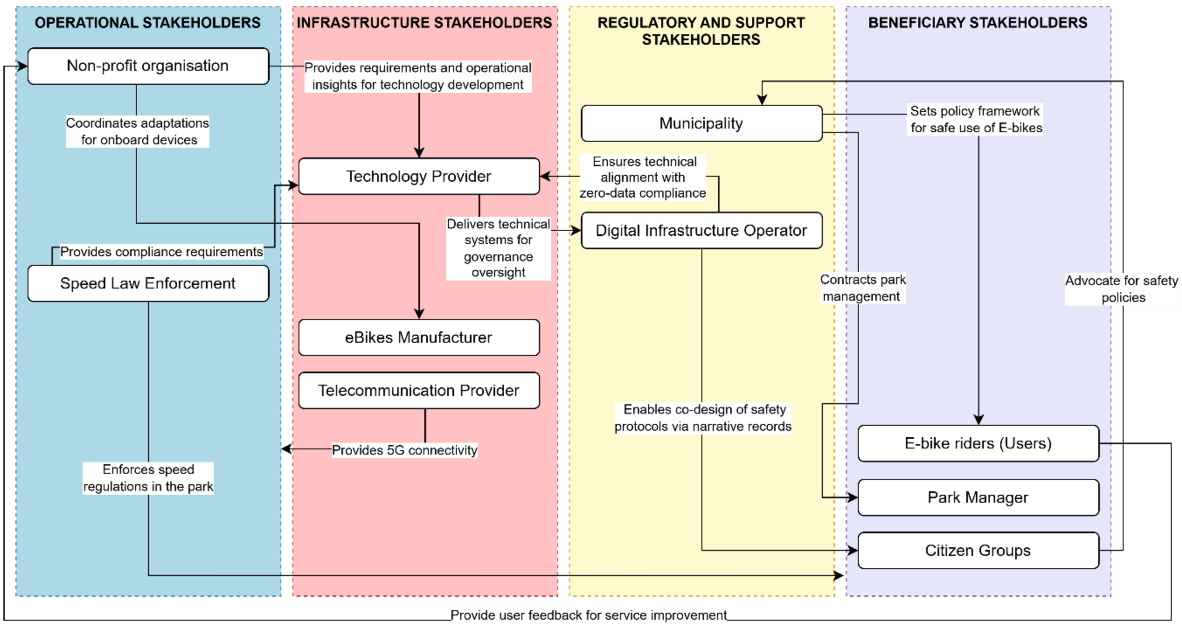


Figure 14: AM-UC02 - Governance Model

Note for the AM-UC02 Business Model

The AM-UC02 Business Model was identified as a contribution-based model and reflects the commons-oriented infrastructure that prioritises social value over profit. Instead of relying on traditional revenue generation, the model leverages contributions from stakeholders such as municipalities, non-profits, and citizen groups. These contributions support the development and maintenance of decentralised, zero-data technologies like the Wayflow Onboard Unit and place-based safety systems. By fostering collaboration and shared responsibility, the model enables adaptive governance and equitable access to urban mobility solutions. This approach aligns with sustainability goals, ensuring long-term benefits for communities while maintaining transparency and inclusivity in decision-making processes. The main differences from the classic business model are:

- Reframed "Customer Segments" as "Citizens Categories" to emphasise public service orientation.
- Reframed “Revenue Streams” as “Contribution Models”

<table>
<tr>
<td rowspan="2">Key Partners
-Municipalities
-Technology providers
- Digital Infrastructure Operator
- eBikes Manufacturer
-Speed Law Enforcement
- Telecommunication Provider</td>
<td>Key Activities
- Collect Records of place-based safety studies
- Conducting safety testing scenarios
- Deploying/operating Adaptive Speed Governance
- Developing the OBU
- Orchestrating NextCommons framework
- Ensuring decentralised, zero-data compliance</td>
<td rowspan="2">Value Propositions
E-bike riders
-Real-time speed safety regulation
- Safety nudges
- Enhanced safety via OBU
Park Managers
- Real-time park safety oversight
- Automated vehicle behaviour adjustments
- Aggregated safety data access
- Reduced management burden
- Continuous system improvement feedback
Citizen Safety Groups
- Co-design safety protocols
- Input into safety governance
- Influence park safety standards
- Transparency and knowledge sharing
- Community representation in public space decisions</td>
<td>Citizen Relationships
-Direct interaction with Micromobility Drivers through the OBU
- Engagement with stakeholders through structured Narrative Records collection
- Feedback loops between park users, management and digital infrastructure operators</td>
<td rowspan="2">Citizens Categories
-E-bike riders (minors, commuters, elderly, parents/carers, delivery riders)
-Park managers
-Citizen-driven communities involved in park safety</td>
</tr>
<tr>
<td>Key Resources
-Commons-based infrastructure for traffic governance
- Place-based information systems
- Narrative Records from stakeholders for continuous improvement
- Decentralised technical architecture
- Park as physical testing environment</td>
<td>Channels
-Connected e-bikes equipped with the OBU
- Audio cues or other non-visual interfaces for safety communications
- NextCommons framework for knowledge sharing and governance
- Place-based information systems embedded in park infrastructure</td>
</tr>
<tr>
<td colspan="3">Cost Structure
-Development and maintenance of the Wayflow technology by Townmaking Institute
- Implementation costs for the system in tha park environment
- Stakeholder engagement, workshops and narrative record collection
- Operation of NextCommons framework and knowledge curation systems
- 5G connectivity and infrastructure maintenance</td>
<td colspan="2">Contribution Models
-Funding partnerships with stakeholder organisations
- Research and innovation grants for smart urban mobility solutions</td>
</tr>
</table>

Figure 15: AM-UC02 Business Model

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

3.3.1. Metadesigned Use Case

First Stage of Why – What – How Framework

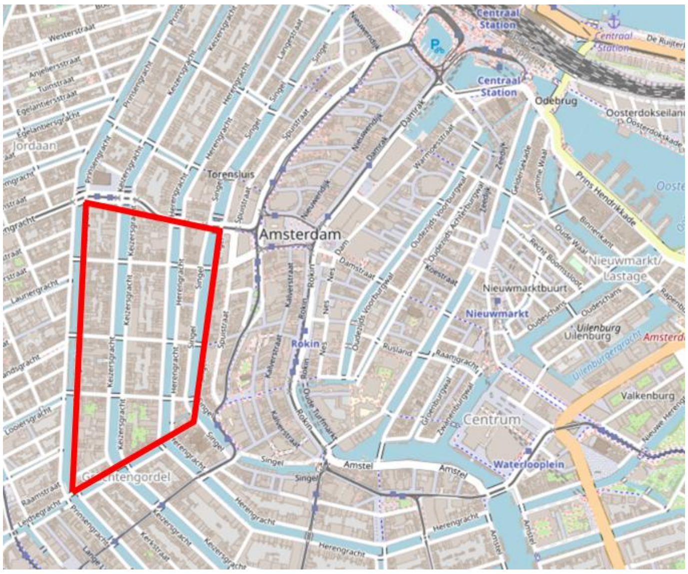
Why: Challenges and Objectives

Questions	Considerations

❗ What specific challenges faced by the city will this Use Case address?	🟢 In large parts of the city center of Amsterdam, residents leave their garbage bags on the street in front of their houses. Standard waste containers cannot be used in this area due to a limited space. The waste is collected by heavy-duty vehicles twice a week. This is problematic, particularly because the bags often contain edible waste, which attracts rats and seagulls. In addition, heavy-duty vehicles add stress to the infrastructure, such as bridges and quay walls. Recognizing these challenges, the municipality has taken steps to limit the access of heavy vehicles to the city center, aiming to protect its historic infrastructure. The municipality aims to place as many underground waste containers (OAIS) as possible. However, in the historic city center, it is not possible to place the containers everywhere due to limited space. In addition, heavy-duty vehicles cannot reach all locations due to weight restrictions. Alternative waste collection approaches must be considered for households that cannot be covered by underground containers. One possible approach is on-demand waste collection in combination with a scheduled service that goes around the neighborhood and stops at designated collection points, where the residents can bring their waste according to the schedule. Cargo bikes and light electric vehicles are used in combination with barges that take the waste outside of the city center via the waterways. This approach is currently being tested in a pilot in De 9 Straatjes area. The on-demand system requires more frequent route planning, and the utilization of cargo bikes and light vans results in a larger number of trips per unit of waste collected. The on-demand and the scheduled collection share the same resources. One of the challenges is, how to optimize the new waste collection system considering these distinct aspects.
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case?	🟢 **Objectives at the use case level:** Maximizing efficiency of the new waste collection system Increase customer satisfaction **High-level objectives of the city** ***(not measurable at the use case level scale):*** Decrease illegal waste disposal Decrease litter, caused by damaged waste bags on the streets. Reduce the weight load on historic infrastructure Improve traffic safety in the historic inner city Reduce emissions by modal shift to light electric vehicles

What: The Concept and Its Definition

Use Case Code	🟢 AM-UC03
Use Case Title	🟢 Multimodal waste collection system
❗ Use Case Concept Definition	🟡 The goal is to optimize routes and schedule for the scheduled waste collection service. A prototype optimization algorithm will be developed to maximize the efficiency of the waste collection logistics.

	A Digital Twin will provide geospatial and mobility data to improve waste collection planning. By analyzing transport flows, road constraints, and demand trends, it will support optimized routing. Basic visualizations will present logistics insights for better decision-making.
❗ Location (and its influence area)	🟡The algorithm will be tested in De 9 Straatjes area. There is an ongoing waste collection pilot in this area. The goal of the pilot is to assess the new on-demand waste collection system in combination with the scheduled service that uses cargo bikes, light electric vehicles, and barges. 
❗ Which (physical and digital) infrastructure is needed?	🟡No new physical infrastructure is needed. A prototype scheduling algorithm will be developed, tested, and validated.
❗ Who will be responsible for developing and managing this new infrastructure?	🟡TU Delft will be responsible for developing the prototype scheduling algorithm. Argaleo wil develop the Digital Twin that will support data analysis by visualizing waste collection patterns and potential optimizations. It will provide insights rather than control operations, ensuring flexibility for stakeholders.
❗ What (physical & digital) infrastructure needs to be modified	🟡The software can run on a personal computer.
❗ Who will be responsible for these infrastructure modifications?	🟡No infrastructure modification is needed.
❗ Which metaInnovation technology (WP2) is	🟢Optimization algorithm for multimodal waste collection logistics.

being tested linked to this UC?	

How: Operation and Management

❗ How the Service will function (under normal conditions - operation on a daily basis)	1. User provides input parameters and runs the planning software 2. Optimal schedule is computed 3. Planners can adjust the schedule accordingly
❗ How the User will interact (under normal conditions - operation on a daily basis)	🟡 Three users of the system: • **Client** – can bring the waste to one of the collection points at specific times. • **Planner –** uses the software to create a schedule. • **Rider** – visits the stops according to the schedule provided.
❗ Please review the Prototype stakeholder map and make changes	The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.

Second Stage of Why – What – How Framework

What: Foreseen Internal Risks and Mitigation Actions

Internal Risk (Technical issues, operability, service reliability):			
	Severity	Likelihood	Mitigation action
Data availability	L	L	Approximation based on alternative data sources (demographic data, etc.)

❗ How the Service will function (under the anomalous scenario)	Out of scope
❗ How the User will interact (under the anomalous scenario)	Out of scope

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severity	Likelihood	Mitigation action

[define risk]	[L. M, H]	[L. M, H]	***Please complete corresponding field***
Other external risks (Legislation, competitors (others))			
	Severity	Likelihood	Mitigation action
[define risk]	[L. M, H]	[L. M, H]	***Please complete corresponding field***

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated?	🟡The budget from the metaCCAZE project will fund the development of the optimization algorithm. Investments into vehicles, software and personal were done by the City of Amsterdam.
What is included in this budget? (technology-based, consider running the service)	🟡The metaCCAZE budget funds the development and operation of the algorithm. For the operational phase after the pilot, any service fees have not been discussed yet.
How was the project funded? Under which funding schemas and co-financing?	🟡The ongoing pilot is funded by the City of Amsterdam. The metaCCAZE pilot on how to optimize the interaction between two different waste collection systems that share the same resources, will be funded by the metaCCAZE EU Horizon program.
What is the cost per unit?	
Do you need any human resources? If yes, what type of human resources are needed?	🟡*The metaCCAZE pilot is plugging in on an existing pilot of City of Amsterdam. No additional personel will be needed.*
Was the pricing of the proposed service defined? If yes, what is the pricing of the proposed service (for the user) •	🟡For the operational phase beyond the pilot, any service fees have not been discussed yet.
Are there any incentives planned? If yes, would they motivate users to prefer this mobility solution more frequently? Why? •	🟡Waste collection is a service provided by the city to its residents. Main incentive for residents to use this service, it a more user friendly and convenient way to get rid of one's waste.

3.3.2. Metadesigned BIGM

SECTION	DESCRIPTION

Summary of the BIGM	AM-UC03's BIGM combines algorithm-driven logistics with public-private governance, prioritising emission reduction and historic infrastructure preservation. Funded by municipal contracts and tech partnerships, stakeholders collaborate on data exchange and are supported by a Digital Twin.
Governance Model	It focuses on public-private coordination: • Municipality is the owner and operator of the waste collection vehicles and services. TU Delft provides an optimized waste collection schedule for cargo bikes in the pilot area. • Data-sharing protocols ensure coordination between barges, e-cargo bikes, and the Digital Twin. • Compliance frameworks enforce weight limits for historic infrastructure and emissions standards. It emphasizes multi-stakeholder collaboration, led by the Municipality of Amsterdam as the entity that initiates and orchestrates the business model (Figure 16).
Business Innovation Model	It centers on the service provider (i.e. the municipal waste collection services) who is expected to collect the waste from residents and local businesses. Its value proposition is focused on improving waste collection services, user satisfaction and reducing operational costs via route optimisation for scalable urban waste solutions (Figure 17).
Changes from Prototype BIGM	**Business Model**: • The specification of customer segments was refined, changing from households, businesses, and municipality to residents and local businesses. • The value propositions were updated to address the new customer segments, residents and local businesses, and the value propositions defined for the municipality were removed. • Added algorithm development costs and Digital Twin integration. **Governance Model**: • Additional key partners were identified and confirmed as a part of the governance model. • Formalised data-sharing protocols and compliance frameworks for infrastructure protection.

Table 10: AM-UC03 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Service Provider	Waste Collection Company	Amsterdam waste department	Operates/maintains waste logistics	✅ Confirmed

Key Partner	Municipality	Municipality of Amsterdam	Regulatory oversight and permits	✅ Confirmed
	Municipality Traffic and Public Space Department	Traffic and Public Space Department (VNOR)	Support through policy and regulations. Provide permits for parking bicycles	✅ Confirmed
	Municipality Department of water management	Sailing Department	Support through policy and regulations. Provide permits for docking the barges in specific locations	✅ Confirmed
	University	TU Delft	Develops routing algorithms for efficiency, analysis of waste volume data	✅ Confirmed
	Digital Twin provider	Argaleo	Manages Digital Twin for data visualisation	✅ Confirmed
	e-Barge Operators	Waternet	Transport waste via waterways	✅ Confirmed
	Cargo bikes operator	Amsterdam waste department	Collects waste from houses and businesses as scheduled, then transports it to barges using cargo bikes.	✅ Confirmed
	Light electric vehicles (LEV) operators	Amsterdam waste department	Collects waste from houses and businesses as per schedule, then transports it to barges using LEVs.	✅ Confirmed
Customer	Users	Residents and local businesses	Bring the waste to one of the collection points at specific times	⏳ Future Engagement

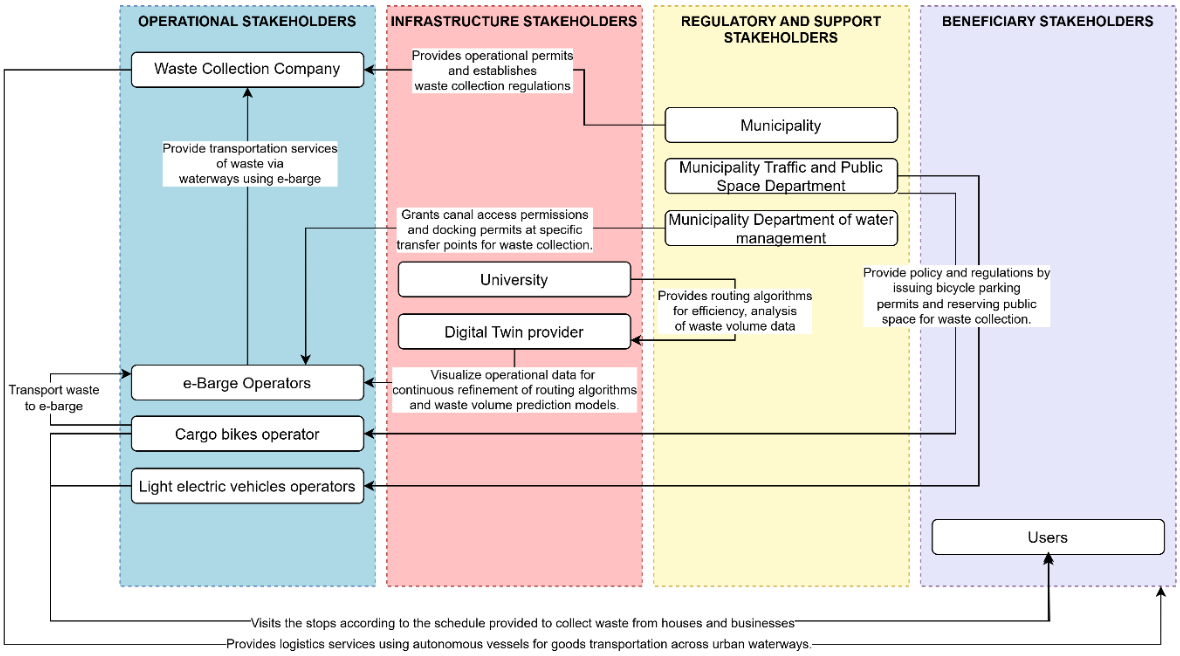


Figure 16: AM-UC03 - Governance Model

Key Partners
- University
- Digital Twin provider
- Municipality
- e-Barge Operators
- Cargo bikes operator
- Light electric vehicles operators
- Municipality Traffic and Public Space Department
- Municipality Department of water management

Key Activities
-Waste collection and transportation
-Route planning and optimization
-Infrastructure maintenance
-Stakeholder communication and collaboration

Key Resources
-Cargo bikes
-Barges
-ICT infrastructure
-Skilled personnel
-Partnerships and collaborations

Value Propositions

Residents
- Public Health Improvement
- Enhanced Quality of Life
- Community Engagement
- Reduced emissions
- Improved safety

Local businesses
- Public health
- Community Engagement
- Reduced emissions

Customer Relationships
-Transparent communication
-Responsive customer service
- Community engagement initiatives

Channels
-Direct collection
-Waterborne transport
-Digital platforms

Customer Segments
- Users (residents and local businesses)

Cost Structure
-Vehicle acquisition and maintenance
- Personnel costs
- ICT infrastructure
- Fuel and energy costs
- Waste processing fees

Revenue Streams
- Service fees
- Taxes

Figure 17: AM-UC03 - Business Model

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

3.4.1. Metadesigned Use Case

First Stage of Why – What – How Framework

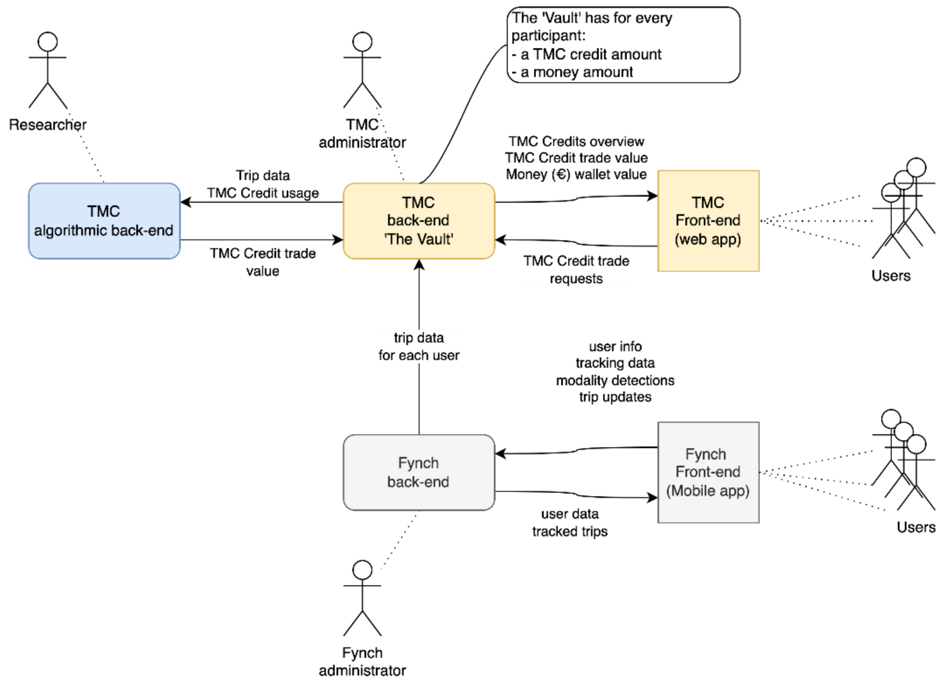
Why: Challenges and Objectives

Questions	Considerations
❗ What specific challenges faced by the city will this Use Case address?	🟢 Transport emissions account for over 25% of global greenhouse gas (GHG) emissions and are a source of global warming. At the same time, they are an air pollutant at the local level. Many companies and organizations have set emission targets for themselves with regards to their employees' impact on the mobility system, but these remain ambitions or time unbound goals, without any consequences if they are not met. Tradable Mobility Credits are a novel idea for 'capping' the GHG emissions and energy spent on transport; by motivating users to take more sustainable transportation such as public transportation and cycling, thereby guaranteeing that the ambitions are met and thus have a real impact on reducing GHG emissions, energy consumption and local pollutants. Despite the theoretical advantages, initial research on such mechanisms in transport shows that people are generally sceptical or negative about these concepts. It lies very far from the current way of thinking about mobility and may be seen by some as a rationing concept that infringes on people's perception of freedom. However, most of that research was conducted by interviews, questionnaires, or simulations. Real-world applications can provide proof-of-concept about the effectiveness and technical feasibility of such system and may lead to an increase in acceptance. In this pilot, we address the usage of TMCs as an internal mechanism of organizations to steer the private mobility of their employees. This is a subset of the full use case of the TMC scheme which is proposed for travellers in general in an urban area. Nevertheless, implementing the system at a company level proves to be more viable for this pilot since we can have their support in implementing the concept. The idea is to provide a budget to the employees of a company with which they have to plan their private mobility. Business trips are managed project by project depending on clients' requirements therefore they are out of our scope. Technical feasibility is a fundamental condition; for a transport innovation to be considered a new (company) policy, it must be seen as technically feasible. For the metaCCAZE program, this use case aims to demonstrate and maximize the technical feasibility of such a concept, conduct a real-life experiment, and increase the acceptability of Tradable Mobility Credits as a measure that organizations can implement to make their employees aware of their mobility impacts and eventually make more sustainable decisions which will help the organizations reach their targets.
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case?	Making travellers aware of alternative modes of traveling, namely for the commuter trips Promoting sustainable and multimodal transportation choices. Testing effectiveness of TMCs on a diverse participant pool (income, home location, gender diversity). Encouraging active, light, and electric transport usage over motorized options, namely the usage of private cars. Fostering shared mobility usage (shared mobility and/or carpooling) for full trips and/or first/last mile public transport.

What: The Concept and Its Definition

Use Case Code	AM-UC04 - Tradable Mobility Credit (TMC) scheme
Use Case Title	Tradable Mobility Credit (TMC) scheme
❗ Use Case Concept Definition	Tradable Mobility Credits in general are a travel demand management policy where a central authority distributes a limited number of credits to travellers with a certain periodicity and expiration that they can use to travel. These credits can be tradable in a market where travellers can either sell or buy them, the system is usually revenue neutral and the charging rates may vary considering the time of day, location, transportation mode, and route chosen according to their impact. The concept of TMC has been extensively studied from a theoretical conceptual level but rarely applied in reality. The dit4Tram project funded by the Horizon Europe has tested the concept as a serious game and a lot of knowledge was obtained from it. The MetaCCAZE should now evolve to a next, more real pilot that brings this closer to real implementation and therefore the market. In this pilot we apply this concept to an organization or several organizations based in the city of Amsterdam where the employees of these organizations will each be allocated a number of credits, based on their needs, but also on their impacts. An app will track the mobility behaviour of the employees in their daily trips, including modes of transport and distances, and calculate the amount of credits spent each day, week and month. This information is shared with an account in the 'credit bank', where the balance will be updated for each of the users. Each user will therefore be able to track what they have been spending and adapt their behaviour as the amount of credits is spent. The credits represent the wider impact of the mobility behaviour. Users can compare their impact, to the impact 'cap' that the company has set for itself or a team. Users must aim to stay under the cap in order to generate benefits for society, If they stay above the cap at the end of the month those credits are turned into virtual money that the employee would have to pay out of their virtual pocket to the pilot's bank. Unspent credit means that the wider public impact of the employee/team's mobility behaviour stayed within the allowed boundaries set by the employer, and these credits can be transformed into virtual money that can be spent on something that benefits that traveller and the community of travellers who have been able to save credits (i.e, virtual money) on that month. In the experiment we can allow the participants to choose what for them would be the next spending of that money in a survey they can fill every month. To incentivize the credit trading during a month the credits price is cheaper to buy than at the end of the month where the account is settled. The same goes for the selling where the employee can have an incentive to sell at a higher price at the end of the month. The price does not change with supply and demand interactions, meaning that it does not change as a commodity market. Description of how the system works: Users (organization's employees that decide to participate in the pilot) receive credits from the system ('credit bank') every month based on their travel needs profile and impact, considering the split working from home and working from the office as well. Those travel needs will be recorded through a dry run month where only information on their mobility behaviour will be collected which gives us an indication of the impact that each traveller has. Users have a travel profile that can be updated to their travel needs if something changes that could affect their travel needs, such as moving houses or different working from home scheme. To prevent hoarding, any unused credits convert to virtual money on the last day of each month and they get their allocated credits on the first day of the month. The system only considers work-bound private trips. Trips in between home-work are also considered, such as picking up kids from school or grocery shopping, When users travel, the Fynch app automatically registers the trip in a database — no manual action is required. However, if the user notices a wrong trip registration, such as different mode use, they can manually correct it. Users can also register if they carpool. The app will then convert the trip taken to the amount of credits it was worth

	and remove the credits from the credit balance. If the user doesn't have enough credits to cover a trip anymore towards the end of the month, the system will purchase the remaining credits from the bank at a slightly higher cost and the virtual wallet will be updated. The user should assume that this cost would have to be paid by him/her. This way it is cheaper for the users to buy credits at the market. In addition, when users sell credits at the market, they get a higher rate than if they let the credits expire, making it more profitable for them to sell the credits at the market. This way, users are incentivized to use the market. In addition, the price of the credits doesn't change based on supply and demand and there is not a limited number of credits (i.e. the 'credit bank' will always allow the user to buy or sell credits, regardless of the actual 'credit cap' that the organisation has set as a target). Users can check the cost of a trip based on their chosen mode of transport and their credit balance. If they don't have available credits in their account, they receive a notification suggesting they buy more credits from the market. Users can buy and sell credits at a fixed virtual price in the market and besides the credit balance, they also have a virtual wallet that can be in deficit. This virtual wallet shows the balance of the money (euros) that has been converted from sold/bought credits. They also receive weekly reports detailing their trips, emissions, credits and money spent and how they compare to other users. Teams are kept small (around 10 people maximum) to reduce anonymity and prevent "free riding". For any issues, users can contact support via a designated email address. 🟡A Digital Twin-based framework may be considered to map modal shifts, credit transactions, and mobility patterns to assess the impact of the TMC scheme. If implemented, visualizations will support evaluation and system adjustments.
❗ Location (and its influence area)	🔴The location of the solution and its area of influence will depend on the partner organizations and the employees that will participate in the experiment. We don't have the partner organizations yet, therefore, we don't have this information.
❗ Which (physical and digital) infrastructure is needed? ○	🟢There will be two platforms used, one of the platforms tracks users' mobility activity, checking their trips and which transport mode they used, such as walking, cycling, public transport and car. This will be done by Fynch who has extensive experience in this type of service. The other platform will handle the mobility credits, where users can check their credit balance, the credit price and sell/buy credits from the virtual market. The latter will be developed by Technolution which is the LL partner in MetaCCAZE.
❗ Who will be responsible for developing and managing this new infrastructure?	🟢The system will be provided by Technolution and Fynch. Technolution will provide the platform with the credit balance and virtual market and FYNCH will provide the platform for trip checking and tracking. Technolution will provide the integration of both platforms. TU Delft is responsible for the algorithms applied in distributing credits and assigning credits to each trip.
❗ What (physical & digital) infrastructure	🟢The system works on a combination of technologies from different partners as described before. The flowchart of cooperation is shown in the picture below:

<table>
<tr>
<td>needs to be modified
•</td>
<td>


Digital systems working together – integrate into one system (flowchart)

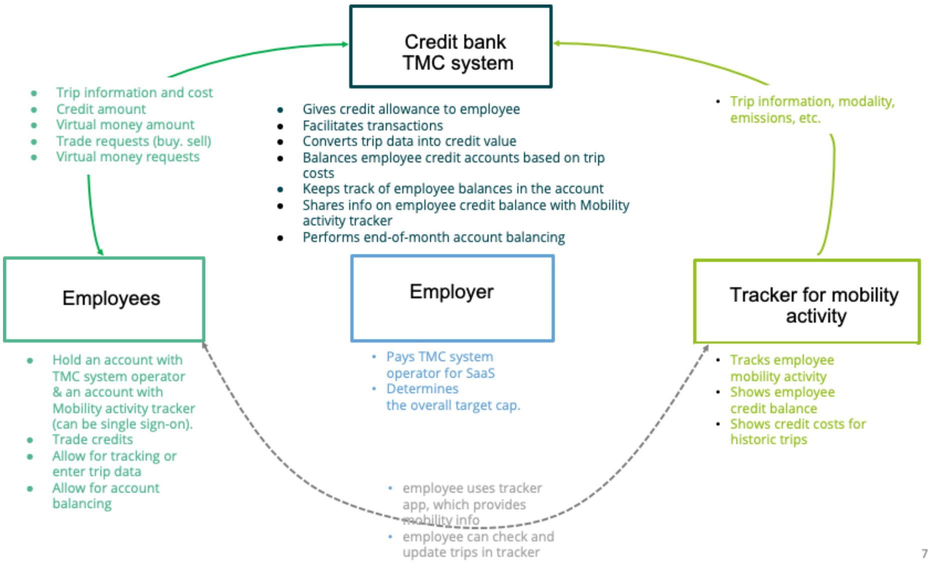
The digital modifications to enable this system to provide the required functionality are:

- Create the TMC Front-end and TMC Back-end (Technolution)
- Create the TMC Algorithmic Back-end (TU Delft input)
- Create an interface between the Fynch Back-end and TMC Back-end (Technolution)
- Develop Front-end specific extensions for user configurations, user settings and trading options. (Technolution)

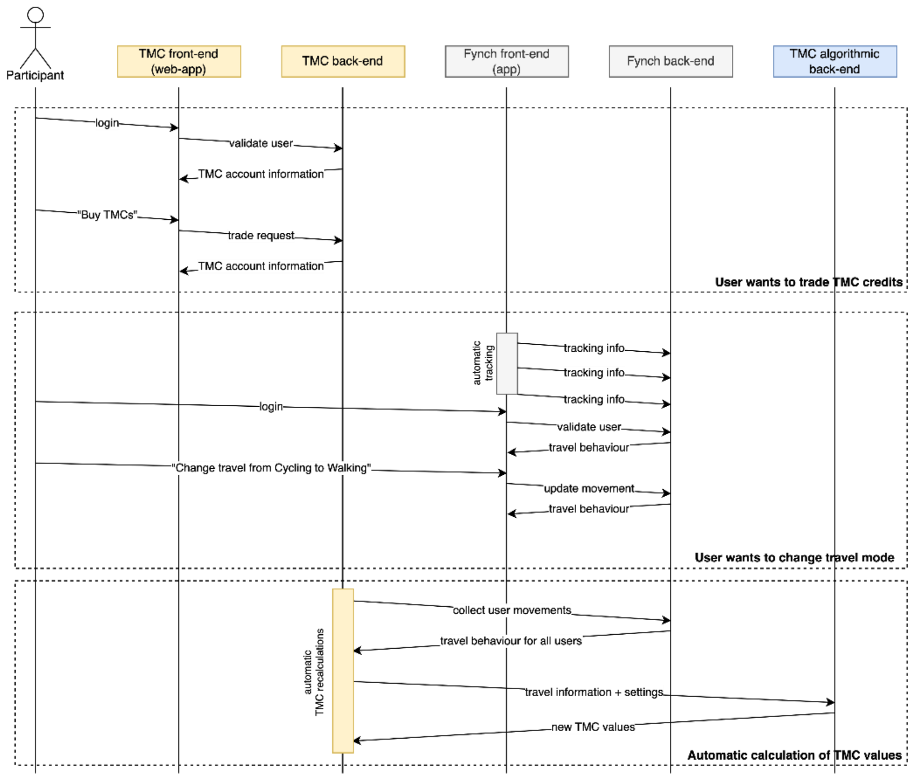
If feasible, digital twin visualisation tools could be used to display credit usage trends and mobility shifts. The potential integration of real-time data is still under evaluation, and the focus remains on retrospective analysis rather than live monitoring.
</td>
</tr>
<tr>
<td>❗ Who will be responsible for these infrastructure modifications?</td>
<td>

- Technolution – platform with the credit balance and virtual market; integration of both platforms.
- Fynch – platform for trip checking and tracking.
- TU Delft – allocation algorithms.
- Argaleo – data visualizations.
</td>
</tr>
<tr>
<td>❗ Which metaInnovation technology (WP2) is being tested linked to this UC?
•</td>
<td>TMC (Tradable Mobility Credits) assignment method for multiple population segments.</td>
</tr>
</table>

How: Operation and Management

<table>
<tr>
<td>❗ How the Service will function (under normal conditions - operation on a daily basis)</td>
<td>


</td>
</tr>
<tr>
<td>❗ How the User will interact (under normal conditions - operation on a daily basis)</td>
<td>
🟢 The following interaction diagram shows the cooperation of the different actors in the system under normal conditions.



Three different aspects have been highlighted:

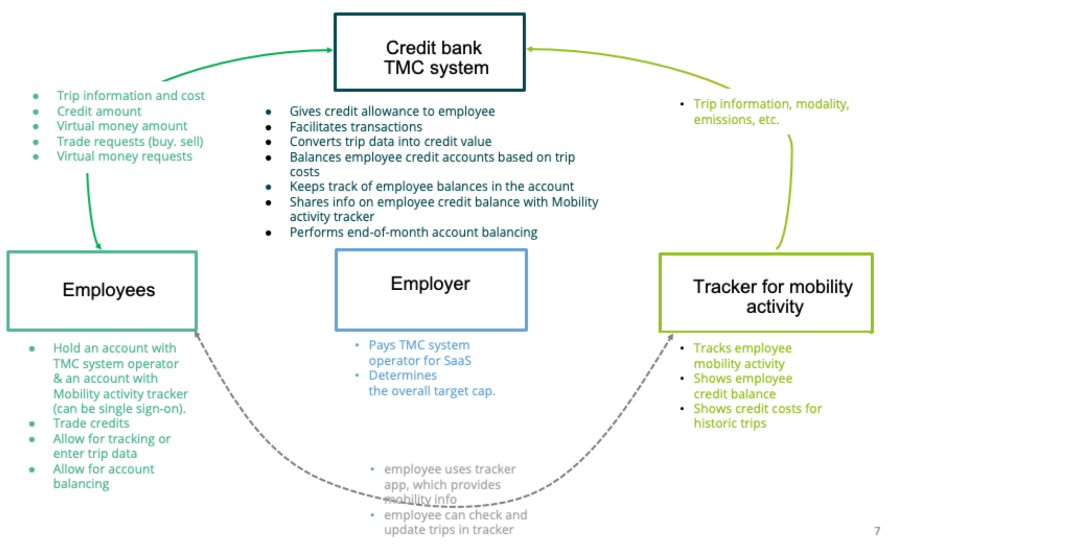
- The participant wants to trade TMC credits
- The participant wants to change a travel mode in a recorded movement
- The system automatically gathers all travelling and mode choices to recalculate the TMC credit value

This list is not to be meant exhaustive as more individual interactions can take place.
</td>
</tr>
</table>

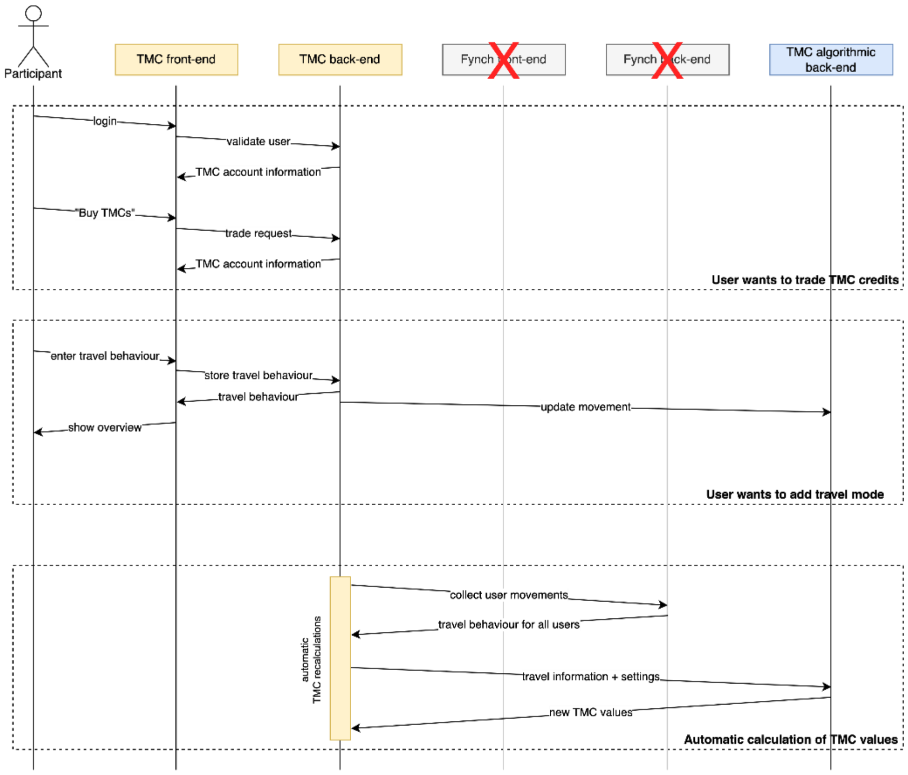
❗ Please review the Prototype stakeholder map and make changes •	The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.

Second Stage of Why – What – How Framework

What: Foreseen Internal Risks and Mitigation Actions

<table>
<tr><td colspan="4">Internal Risk (Technical issues, operability, service reliability):</td></tr>
<tr><td></td><td>Severity</td><td>Likelihood</td><td>Mitigation action</td></tr>
<tr><td>Long development time of the app</td><td>M</td><td>L</td><td>Partner with a company that has developed an app we can use as a foundation. Already found a partner, the partnership is being finalized.</td></tr>
<tr><td>System complexity</td><td>M</td><td>M</td><td>People will receive training at the start in order to understand the system and will be offered opportunities for Q&A with the Regulatory and Operating Entities (TUD, Technolution, Fynch, employer).</td></tr>
<tr><td>❗ How the Service will function (under the anomalous scenario)
•</td><td colspan="3">

The overall flowchart remains identical as the functional approach remain the same. However, the way of entering the participants travel behaviour changes from an automated system to a manual approach. This is explained in the next item.</td></tr>
</table>

❗ How the User will interact (under the anomalous scenario) •	 Without the App as indicated in the Risks, the user will have to work without the App to enter their travel behaviour. No automatic tracking is supported, and more manual interaction is needed.

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severity	Likelihood	Mitigation action
Low Public Acceptance	H	M	The LL is in touch with multiple organizations that are interested in sustainability goals in mobility. People will receive training at the start to understand the reasoning behind the system and pricing principles, to make them aware of the reasoning and principles of fairness.
Other external risks (Legislation, competitors (others))			
	Severity	Likelihood	Mitigation action
Local governments don't have autonomy to introduce mobility pricing in the NL	L	H	The metaCCAZE pilot focuses on organizations, where the employer can set the guidelines for its employees.

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated?	An initial investment is needed to develop the TMC trading platform. The majority of this comes from metaCCAZE project funding.
What is included in this budget? (technology-based, consider running the service)	Next to the investment covering the development of the trading platform, the MetaCCAZE project funding also supports the research efforts in developing the credit allocation algorithm (by TU Delft), the contracting of participating organisations (through TU Delft/Technolution) and the coordination of the overall development and organisation of the pilot study (by AMS Institute).
How was the project funded? Under which funding schemas and co-financing?	The project is mainly funded with metaCCAZE EU Horizon funding, along with in-kind R&D contributions from partners involved.
What is the cost per unit?	To be defined.
Do you need any human resources? If yes, what type of human resources are needed?	For the design and development, the metaCCAZE project staff can execute these efforts. For continuous operation beyond the project, help-desk or user support might be needed. This could be done by a combination of Q&A pages, chatbots or (existing) service desk employees of for example Technolution.
Please specify any additional costs not outlined above	Currently not defined.
Was the pricing of the proposed service defined? If yes, what is the pricing of the proposed service (for the user)	To be decided.
Are there any incentives planned? If yes, would they motivate users to prefer this mobility solution more frequently? Why?	To be defined in collaboration with participating organizations.

3.4.2. Metadesigned BIGM

SECTION	DESCRIPTION
Summary of the BIGM	AM-UC04's BIGM combines decentralised governance with a credit-trading ecosystem, using real-time data and employer partnerships to reduce transport emissions. A Digital Twin platform supports analyses and visualisations. Partners are funded through SaaS fees and grant funding.

Governance Model	It emphasises decentralised oversight: • Municipality & TU Delft) monitors emissions caps and system fairness. • Compliance framework in regard to credit limits, provides benefits for those who comply. Multi-stakeholder collaboration led by AMS Institute as the entity that jointly orchestrates the business model while municipality advises the stakeholders (Figure 18).
Business Innovation Model	The focus is on Technolution, the service provider managing the credit trading platform via a web interface. The primary customers are employers with plans to incentivize their employees towards sustainable urban mobility. The value proposition emphasizes providing additional insights into a company's mobility needs and behaviour, easy emission reporting for businesses and additional benefits to employees based on their mobility behaviours. Revenue is expected to come from partnerships (Figure 19).
Changes from Prototype BIGM	**Governance Model**: • Additional key partners were identified and confirmed with a representative from the municipality as a part of the governance model. • Replaced the "Central Authority" with a multi-stakeholder steering committee. • Intended data sovereignty protocols **Business Model**: • Customer segments were revised: The focus shifted from individual users to employers and employees. • Value propositions were refined: Specific value propositions were tailored for employers and employees, eliminating those previously aimed at individual users. • Added SaaS revenue streams and explicit algorithm/Digital Twin costs. • Expanded partnerships with Argaleo and TU Delft for technical integration.

Table 11: AM-UC04 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Service Provider	Trading platform technology provider	Technolution	Manage credit trading platform (Through a web platform)	✅ Confirmed

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Key Partner	Municipality	Municipality of Amsterdam	Regulatory oversight and policy alignment	✅ Confirmed
	Trip tracking technology provider	FYNCH	Provide the platform for trip checking and tracking (through a mobile app)	✅ Confirmed
	Digital Twin Providers	Argaleo	Operate Digital Twin for data visualisation for modal shift and mobility patterns	✅ Confirmed
	University	TU Delft	Algorithm for Credit allocation	✅ Confirmed
Customer	Employers	Employers	Allocate credits and promotes employee compliance (distributes a limited number of credits to users advised by TU Delft)	⏳ Future Engagement
	Employees	Employees	Track, balance & trade credits via the Fynch app	⏳ Future Engagement

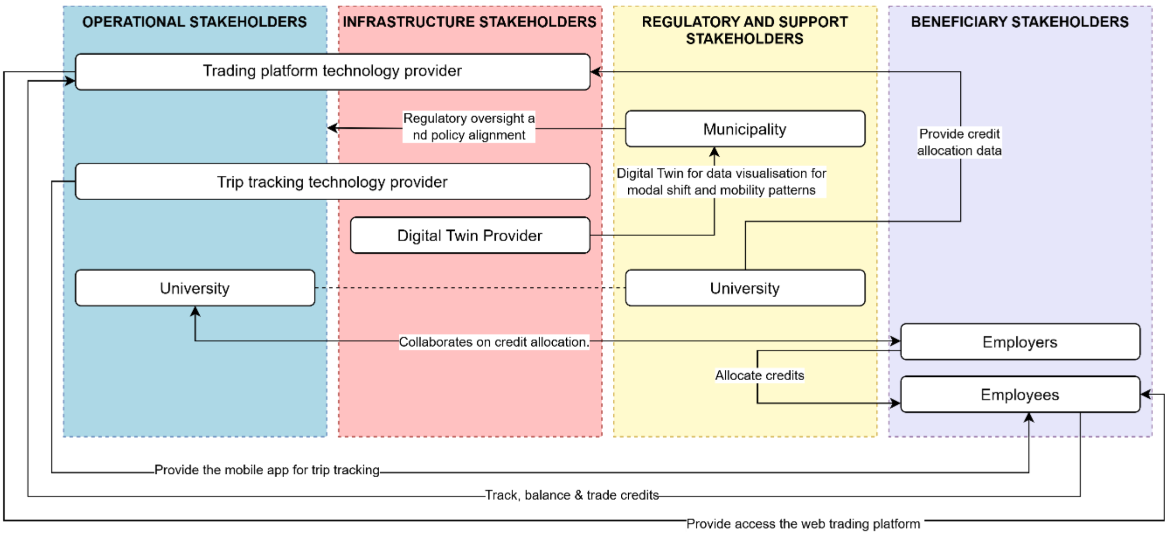


Figure 18: AM-UC04 - Governance Model

Key Partners	**Key Activities**	**Value Propositions**	**Customer Relationships**	**Customer Segments**
- Trip tracking technology provider - Digital Twin Providers - University - Municipality	- Credit Management - Platform Development and Maintenance - User Engagement and Education - Data Analysis and System Optimization	**Employers** - Additional sources of income - Improve health - Reduced traffic congestion and improved air quality **Employees** - Additional sources of income - Improve health - Reduced traffic congestion and improved air quality	- Transparent Communication - User Support - Feedback Mechanisms	- Employers - Employees
	Key Resources - Digital Twin Platform - Credit Trading Marketplace - Data Analytics Capabilities - Partnerships and Collaborations		**Channels** - Digital Twin Platform - Mobile Application - Web platform (for trading) - Public Awareness Campaigns	

Cost Structure	**Revenue Streams**
- Technology Development and Maintenance - Data Management and Analysis - User Support and Education - Administrative and Operational Costs	- Potential Partnerships

Figure 19: AM-UC04 - Business Model

3.5. Dynamic Curbside Management (DCM) (MU-UC01)

3.5.1. Metadesigned Use Case

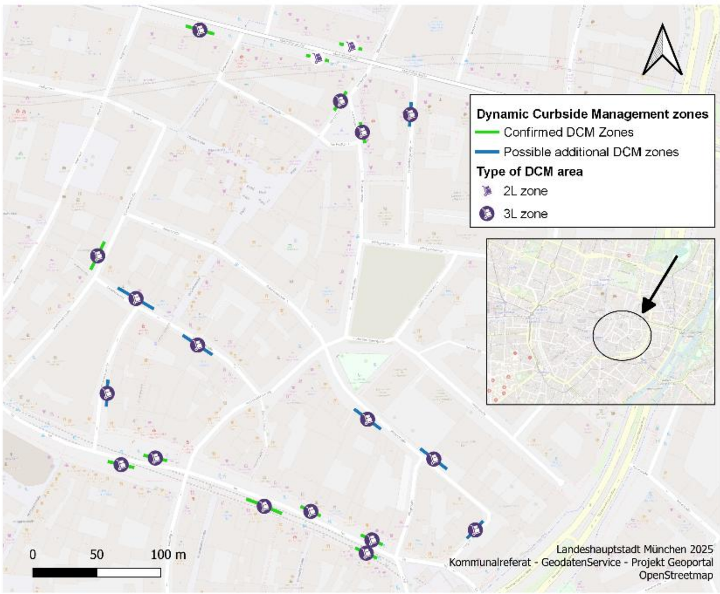
First Stage of Why – What – How Framework

Why: Challenges and Objectives

Questions	Considerations
❗ What specific challenges faced by the city will this Use Case address?	🟢 By participating in the metaCCAZE project, the City of Munich intends to address the following challenges: • **Growth of the logistics sector**: The rise of online shopping has significantly increased the number of delivery vehicles in the city. Due to the limited availability of loading bays for freight pick-up and delivery, these vehicles often **cruise to find suitable stop locations or resort to double parking**. This leads to safety issues, increased congestion and emissions, and reduced urban livability. • **Parking difficulties for other commercial vehicles**: Besides delivery vehicles, other commercial vehicles (e.g., local vendors, public utilities, and shared mobility services) also struggle to find convenient parking or stop locations. • **Limited real-time knowledge of curbside occupancy**: City authorities lack real-time data on curbside occupancy. Additionally, curbside use regulations are static, meaning space is assigned to different uses without considering real-time demand. This results in **curbside supply-demand imbalances** and **inefficient use of space**.
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case?	🟢 In alignment with the Standardised Impact Evaluation Framework (SIEF) from T1.6: • Reduce road congestion • Reduction of the time/distance searching for a parking spot (for delivery companies) • Mitigate transport visual impact (reduce illegal double-lane parking) • Reduce GHG and pollutant emissions • Increase urban environmental liveability (quality of public space)

What: The Concept and Its Definition

Use Case Code	MU-UC01
Use Case Title	Dynamic Curbside Management (DCM)
❗ Use Case Concept Definition	This project aims to establish a dynamic curbside management (DCM) system in selected districts of Munich, where curbside spaces will be digitally mapped, managed, and monitored. By utilizing sensor technologies and real-time availability monitoring, we can effectively ensure more efficient and convenient use of the curbside by logistics companies, local vendors, public utilities, taxis, on-demand mobility services, etc. Additionally, a connected, semi-automated, small zero-emissions vehicle—Rickshaw—for last-mile passenger and freight transport will be further developed. This vehicle will be used as a demonstrator of the DCM areas for pick-up/drop-off operations and to prototype the autonomous reservation of slots for these processes. The Use case follows a twofold approach:

	• <u>Local-level</u> dimension: the monitoring and booking technologies will be piloted, exploring regulatory changes and challenges, understanding stakeholder interactions, and gaining insights into the real-world operation of the system. • <u>Network-level</u> dimension: This focuses on investigating how to scale the concept to larger areas and exploring its systemic effects. This use case will mark the first attempt to implement dynamic curbside management in the city of Munich, and one of the pioneering efforts in Europe.
❗ Location (and its influence area)	🟢 The pilot locations for the Dynamic Curbside Management (DCM) UC were selected based on the following criteria: • Areas with high parking pressure for different stakeholders and/or with limited space available for parking and negative impacts on traffic flow • High demand in terms of business activity, services provided (e.g. mobile nursing service), and high population density • High traffic activity of urban logistics services • Availability of existing "*3L zones*" (regulated areas where vehicles loading, delivering, or carrying out services can perform stops) or "*2L zones*" (where vehicles loading or delivering can perform stops). The UC will be implemented in the *Altstadt* district (old town), where numerous 3L zones are already in place. Twelve zones with a total of 38 sensors have been selected in the area between *Tal* and *Maximilianstraße* streets. Additionally, seven more zones, with close to 30 sensors, are still under consideration and might be included if additional funding becomes available, either from external sources or relocated from a different metaCCAZE chapter.  We anticipate that the impacts of the DCM zones—such as reductions in double parking and congestion—will primarily be localized within the immediate vicinity of each DCM location (approximately 100 meters). This limited impact range is attributed to the nature of the vehicles that are expected to predominantly utilize these areas, such as delivery trucks and local vendors, which typically require parking in close proximity to their final destinations due to freight transport constraints. As the locations are concentrated within a single district, zonal impacts may emerge. However, the extent of these broader impacts remains uncertain.

<table>
<tr>
<td>❗ Which (physical and digital) infrastructure is needed?
o</td>
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Required physical infrastructure

Each zone consists of a minimum of 2 parking spaces (each space is approximately 6-8m long by 2 m wide). Each space can host vehicles of up to 12 tons. Each DCM zone has specific markings and signage to highlight its special use. Potentially, the interface area between the DCM zone and the sidewalk might be adapted (substituting curbstone with a small ramp) to facilitate the movement of trolleys. Each of the parking spaces in the DCM has an occupancy sensor (see Figure 20) that can detect the presence of vehicles in the space.

Figure 20. Vehicle occupancy sensor. Credits: Smart City System Parking Solutions GmbH

Required digital infrastructure

Real-time monitoring dashboard that displays occupancy of the DCM zones (SCSPS). Dedicated smartphone app and API to communicate occupancy to users and, potentially, allow the reservation of DCM zones.

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<tr>
<td>❗ Who will be responsible for developing and managing this new infrastructure?</td>
<td>

Responsibilities

- **LHM**: responsible for setting up and implementing physical infrastructure, markings, and signage (if required); enforcement of parking regulations.
- **SCSPS**: sensor affixation, maintenance, dashboard provision and integration.
- **STR**: app/ API development and integration with sensor data; development and maintenance of user interface.

</td>
</tr>
<tr>
<td>❗ What (physical & digital) infrastructure needs to be modified</td>
<td>

Physical infrastructure

The exact changes in the infrastructure depend on the current situation of each of the DCM zones. There are two different cases:

- Implementation of **new** parking zones (in principle, not considered in the project)
    - Markings and signage
    - Transformation of existing parking zone/sidewalk into a DCM area.
    - Sensor installation.
    - Potentially, curbside adaptation to be checked
- Use of **existing 3L zones** or areas assigned to specific parking needs, and **new parking zones**
    - Sensor installation.

</td>
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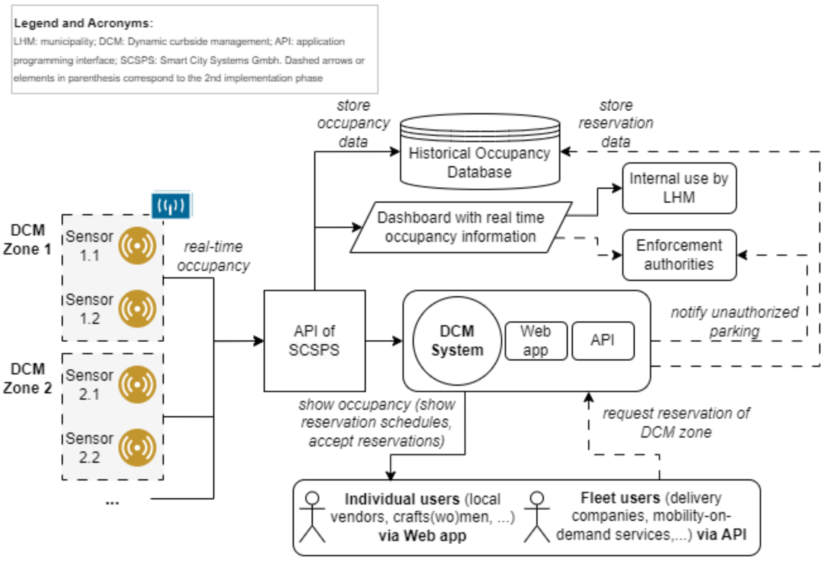
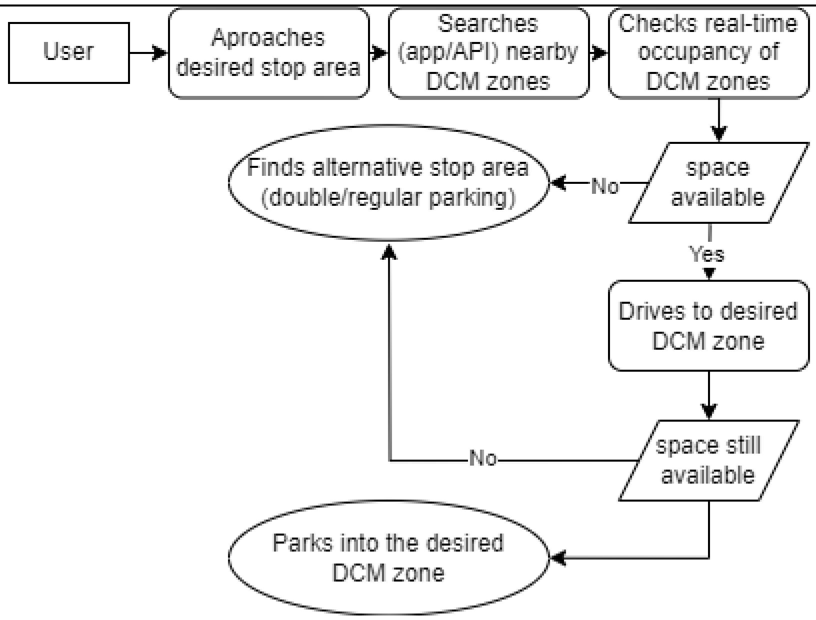
</table>

	○ Adaptation of marking and signage (partially already existing) **Digital infrastructure** • The dashboard for the real-time monitoring needs to be implemented (SCSPS). • The smartphone app and API needs to be developed (STR)
❗ Who will be responsible for these infrastructure modifications?	**Physical infrastructure** • **LHM Mobility Department:** identification of feasible locations as described above; integration of data analyses and stakeholder feedback; monitoring of infrastructure capacity utilisation. • **LHM Building Department:** alignment and implementation of markings and signage • **LHM Communal/ Municipal Department**: enforcement of parking zone restrictions and regulations • **SCSPS**: implementation, testing, and maintenance of sensors (in alignment with LHM departments) **Digital** • **SCSPS:** development and maintenance of the dashboard for the real-time monitoring. • **STR:** development and hosting of the smartphone app and API
❗ Which metaInnovation technology (WP2) is being tested linked to this UC? 1)	Munich Living Lab will test three MetaInnovations, all linked to this use case (MU-UC01) and conducted by the Technical University of Munich (TUM). These metainnovations are: • Further Development of e-fleet operation framework FleetPy to account for user-operator interaction during PUDO processes (stochastic and heterogenous PUDO duration). • Development of algorithms to decide the optimal network of dynamically managed curbside areas (focus on electric, shared-mobility, on-demand ride-pooling services) • Integration into Digital Twin Platform

How: Operation and Management

❗ How the Service will function (under normal conditions - operation on a daily basis) •	

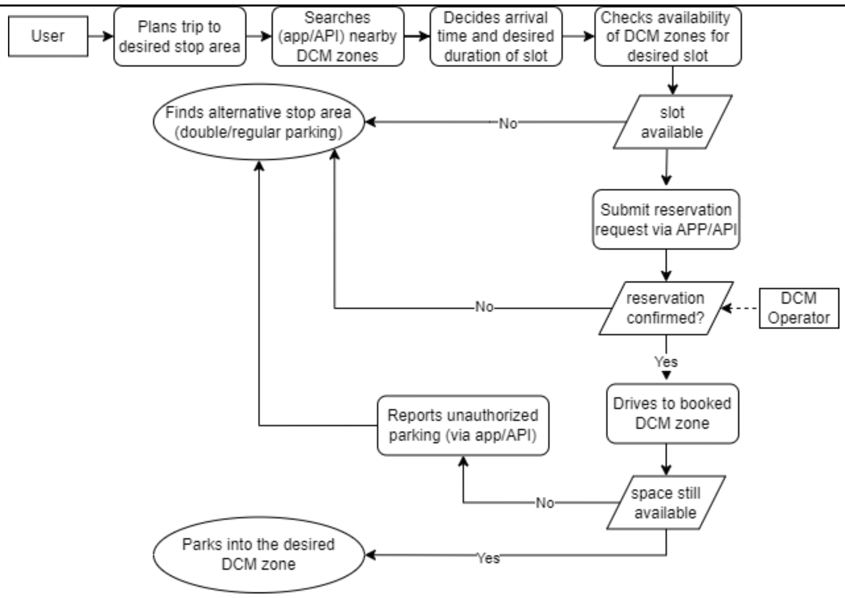
	The sensors installed in each of the DCM zones collect real-time occupancy information, which is remotely accessed via the API of SCSPS. This real-time information is sent to a database that collects all historical curbside occupancy data. This dataset can be used in the future for curbside demand analysis and prediction. The real-time occupancy is also portrayed in a digital dashboard that can be used by the mobility department of LHM for real-time curbside monitoring. Potentially, this dashboard can be also made accessible to parking enforcement authorities to facilitate enforcement tasks. Finally, the occupancy data is transmitted to the core DCM system, which manages the curbside, and monitors curbside supply/demand. Users interact with the DCM via a web app (for small fleets) or API (for large fleets, in which the monitoring of curbside availability can be integrated into their own fleet management and navigation software). In the first implementation stage, users can access the information on real-time curbside occupancy. In the second implementation stage*, in some of the DCM areas, users will be also shown a reservation schedule, and they will be able to request the reservation of the curbside for pre-defined slots. The maximum duration of each reservation will depend on the typology of the user, as decided by the municipality. **The second implementation stage has not yet been confirmed and will depend on the establishment of a suitable legal framework that permits curbside reservations.*
❗ How the User will interact (under normal conditions - operation on a daily basis)	In the **first implementation stage**, users will receive real-time information about curbside availability. The standard interaction will proceed as follows: 1. The user checks, via the web app or API, which DCM zones are near their intended destination. 2. For each DCM zone, the user can view its current status (e.g., fully occupied or available). 3. If all nearby DCM zones are occupied, the user must seek an alternative solution, such as double parking or using a regular parking spot. 4. If a DCM zone shows availability, the user can drive to the desired zone. Upon arrival, two scenarios may occur: o The DCM space is still available, and the user parks. o The DCM space has been occupied, requiring the user to find another DCM zone or resort to alternative parking.



In the **second implementation stage**, users could have the ability to reserve DCM zones in advance. The interaction process will be as follows:

1. The user checks the availability of DCM slots for their desired time and location via the web app/API.
2. If slots are available, the user submits a reservation request through the platform.
3. The DCM operator reviews the request, either accepting or rejecting it, and updates the reservation status. A reserved space will then be marked as unavailable to other users.
4. Upon arrival at the reserved DCM zone, two scenarios may arise:
    - The reserved zone is available. The user parks and "checks in" via the app/API.
    - The reserved zone is unlawfully occupied. In this case, the user reports the violation through the app, prompting the DCM operator to dispatch enforcement agents to sanction the offender.

If feasible, the system will assign an alternative DCM zone nearby. If no alternative is available, the user must resort to double parking or regular parking.

	
❗ Please review the Prototype stakeholder map and make changes •	The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.

Second Stage of Why – What – How Framework

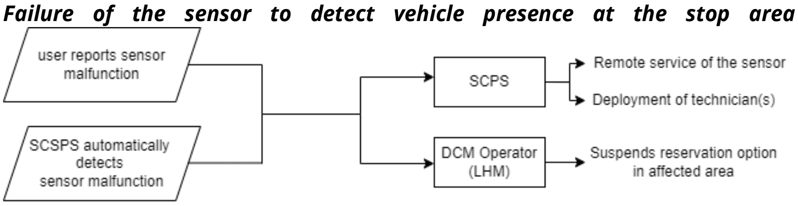
What: Foreseen Internal Risks and Mitigation Actions

Internal Risk (Technical issues, operability, service reliability):			
	Severity	Likelihood	Mitigation action
Failure of the sensor to detect vehicle presence at the stop area	H	L	Twofold: 1) During the "Integration and Testing phase" (M18-M22), the sensors will be tested at TUM's "Mobility Innovation Campus". There, the sensor's ability to detect different types of vehicles (delivery and standard vehicles, delivery bikes, rickshaws, etc.) will be evaluated. 2) During the demonstration phase, the operational status of the sensors will be automatically verified and IT support will be deployed if anomalies occur.
App/API Failure or Connectivity Failure	H	L	If the users are unable to book slots via the smartphone APP or API (either due to a server failure or connectivity issue), "static" use regulations will be enforced. These regulations will be equivalent to the standard loading-bays regulations.
Unauthorized use of the DCM areas (affecting the	H	M	When unauthorized users are detected occupying the DCM areas, this will be notified to parking enforcement authorities. If an existing

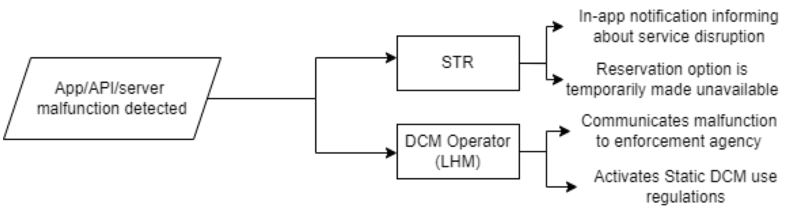
reliability of the reservations)			reservation is affected, an alternative reservation in a nearby zone will be automatically generated.

<table>
<tr>
<td>❗ How the Service will function (under the anomalous scenario)</td>
<td>

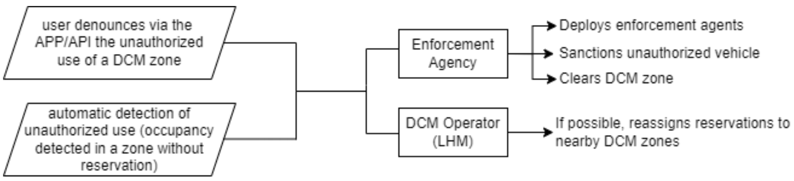
Failure of the sensor to detect vehicle presence at the stop area



App/API Failure or Connectivity Failure



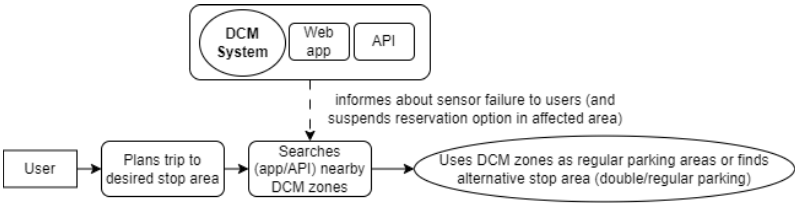
Unauthorized use of the DCM areas (affecting the reliability of the reservations)



</td>
</tr>
<tr>
<td>❗ How the User will interact (under the anomalous scenario)</td>
<td>

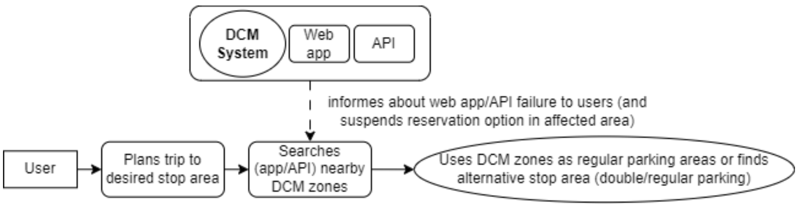
Failure of the sensor to detect vehicle presence at the stop area

The reservation and real-time occupancy information in the affected zone is suspended. Therefore, the user can i) use an alternative DCM zone, ii) drive to the zone and, in case it is available, use it as a regular (not Dynamically managed) stop area. This means that the standard use regulations apply (these are the regulations already used in Munich for short-term delivery zones).



App/API Failure or Connectivity Failure

Similarly, the app temporarily does not provide real-time occupancy information nor allows reservation. The users have to use the DCM zones as regular (not Dynamically managed) areas.



Unauthorized use of the DCM areas (affecting the reliability of the reservations)

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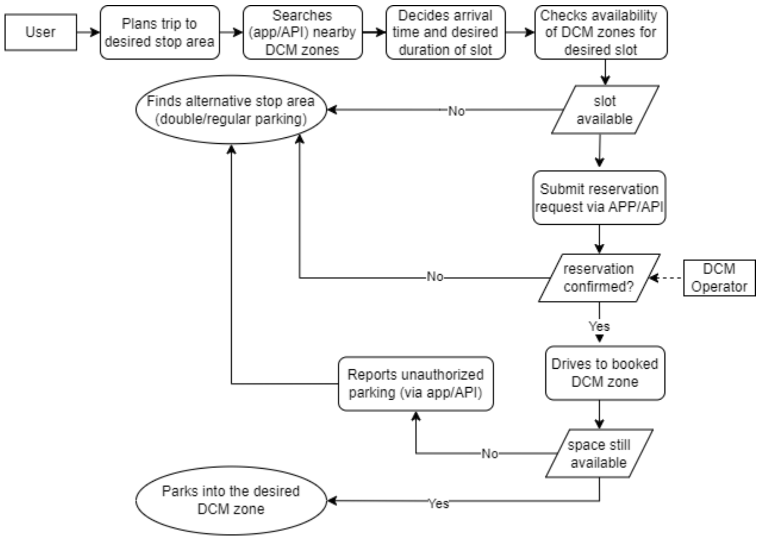
</table>

Co-funded by the European Union

	This diagram was already used for a previous section, but I think it also covers the interaction under this anomalous scenario. 

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severit y	Likelihoo d	Mitigation action
User acceptance	M	M	Before implementing the use case, the living lab partners will communicate with relevant stakeholders and potential users to explain the use case in detail. Additionally, during the project implementation, we will regularly interact with them to identify any potential sources of dissatisfaction.
Public acceptance (neighbours, and local businesses)	H	M	Before implementing the use case, the living lab partners will conduct communication activities targeting local residents and businesses. These activities aim to help them understand the goals of the use case and how it will positively affect them, thereby increasing their acceptance.
Other external risks (Legislation, competitors (others))			
	Severit y	Likelihoo d	Mitigation action
Current German road traffic legislation and limited ability re. implementation of reservation function	M	M	In general, the German road traffic legislation (Straßenverkehrsordnung) does not allow to restrict public (parking) space for specific users; certain exemptions are possible and are evaluated for application in metaCCAZE. In order for the dynamic curbside management to yield the benefits outlined in the grant agreement, different implementation steps are envisaged to manage curbside areas dynamically: (1) Implementation of sensors and respective dashboard provide continuous updates on capacity utilisation of

			parking space and implications for the implementation of new managed parking spaces; (2) App/API integration provides users with parking zone status and hence the ability to reduce search traffic for free spots; user categorisation also yields additional information (e.g., who is using the spot, for how long, during which times of the day); (3) Advance reservation of parking zones as the last step of the process.

How: Investment, Cost and Pricing

What kind of initial investment might be anticipated?	Exploratory—what you aim to discover in the Use Case The investments for this UC are fully supported by the metaCCAZE budget (including the 30% private contribution of the profit legal entities). According to the Grant Agreement: • Sensor development, installation, and maintenance 17,700€ (SCSPS) • Cost for marking and signalling: Not detailed • Cost of development and maintenance of the APP/API: not detailed • Cost of equipment for the connected, semi-automated, small zero-emissions demonstrator vehicle (Rickshaw): Not detailed (and shared with MU-UC02)
What is included in this budget? (technology-based, consider running the service)	Exploratory—what you aim to discover in the Use Case As previously explained, this budget considers: • the development, installation, and maintenance of the occupancy sensors • the developing and maintenance of the API/web App • the acquisition of additional equipment for the demonstrator vehicle The budget allocation to other purposes (e.g., marketing, communication, unexpected expenses, etc.) is not yet known
How was the project funded? Under which funding schemas and co-financing?	The metaCCAZE project and hence the Munich Living Lab partners are funded within the Horizon Europe funding programme, under the call HORIZON-MISS-2023-CIT-01, representing a research and innovation action. Here, the participating institutions are subject to a 100% or 70% funding rate, depending on their institution's status. LHM and TUM: 100% EU funding STR, SCSPS, SDAG: 70% EU funding
What is the cost per unit?	Exploratory—what you aim to discover in the Use Case The cost per unit cannot be easily precisely determined. An estimation of the acquisition cost of each sensor could be obtained at the end of the project, once the total number of sensors installed is confirmed. However, the rest of the costs (e.g., API/web app development) cannot be assigned to each sensor.

Was the pricing of the proposed service defined? If yes, what is the pricing of the proposed service (for the user)	During metaCCAZE project, due to the limited temporal and spatial scope of the use case and its prototype nature, the use of the DCM zones will be provided at no cost. Potentially, if DCM is expanded in the future to the whole city, pricing could be included (but this is out of the scope of the project).
Are there any incentives planned? If yes, would they motivate users to prefer this mobility solution more frequently? Why?	There is no financial incentive envisioned for the users of the DCM areas. The main motivation for users to participate in the system is that it will grant them access to well-located curbside zones that can be booked in advance, thus reducing the uncertainty in their operation.

3.5.2. Metadesigned BIGM

SECTION	DESCRIPTION
Summary of the BIGM	Business Innovation and model optimising curbside space use via real-time monitoring and dynamic pricing, reducing congestion and emissions while improving logistics efficiency using Service-Dominant Business Model Radar (SDBM/R).
Governance Model	Collaborative framework led by LHM Mobility Department, with STR/SCSPS handling tech and TUM providing research support. Roles split across regulatory, infrastructure, and operational categories (Figure 21).
Business Innovation Model	Uses Service-Dominant Business Model Radar (SDBM/R). Revenue from curbside fees and municipal subsidies; costs include sensor maintenance and app development (Table 13).
SDBM/R Co-Created Value in use	Optimized Curbside Usage
Changes from Prototype BIGM	**Governance Model**: • Added TUM as an enriching partner for algorithm validation. **Business Model**: • More detailed description of the technical infrastructure, including sensors and digital platforms. • Expanded list of stakeholders, including specific roles for technology providers and regulatory authorities. • Greater emphasis on the integration of a semi-automated Rickshaw as a demonstrator. • More specific information on revenue streams and pricing models.

Table 12: MU-UC01 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Focal	Dynamic Curbside Management (DCM) Operator	Landeshauptstadt München (LHM) / Mobility Department (Mobilitätsreferat)	Manages system operations and customer service	✅ Confirmed
Core Partners	Municipality	Landeshauptstadt München (LHM)	Oversees transportation, logistics, and inclusion.	✅ Confirmed
	Parking Enforcement Agency	LHM / Department of Safety and Order, Prevention & Traffic Monitoring (Sicherheit und Ordnung, Prävention Verkehrsüberwachung)	Enforces parking regulations.	✅ Confirmed
	Mobility department	LHM / Mobility Department (Mobilitätsreferat)	Identifies feasible curbside locations and integrates stakeholder feedback.	✅ Confirmed
	Infrastructure department	LHM Building Department (Baureferat)	Implements physical infrastructure (markings, signage).	✅ Confirmed
	Technology provider (Sensors and communication technology)	Smart-city Systems (SCSPS)	Provides sensor technology for real-time curbside occupancy monitoring.	✅ Confirmed
	Technology provider (Mobile App and Parking monitoring)	Stadtraum (STR)	Develops the DCM mobile app/API for booking and monitoring.	✅ Confirmed
Enriching Partners	Scientific Supporter (algorithms)	Technical University of Munich (TUM)	Develops algorithms for optimal curbside network design.	✅ Confirmed
	Rickshaw Operator	Technical University of Munich (TUM)	Demonstrates integration of semi-automated vehicles with the DCM system.	✅ Confirmed
Customer	Logistic companies	Logistic companies (e.g. SCHENKER AG - SDAG)	-Utilize the DCM system for deliveries, -Navigate to find booked loading bays	✅ Confirmed

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
	Public Garbage collection company	Abfallwirtschaftsbetrieb München (AWM)	Coordinates waste management with the DCM system.	⏱ In Discussion
	Taxi Companies / on demand mobility companies	Taxi Companies / on demand mobility companies	Use dedicated curbside zones for pickups/drop-offs.	⏳ Future Engagement
	Local businesses (Retail, Hotels)	Supermarkets, craftspeople, hotels and suppliers	Manage supplier deliveries and guest pickups.	⏳ Future Engagement

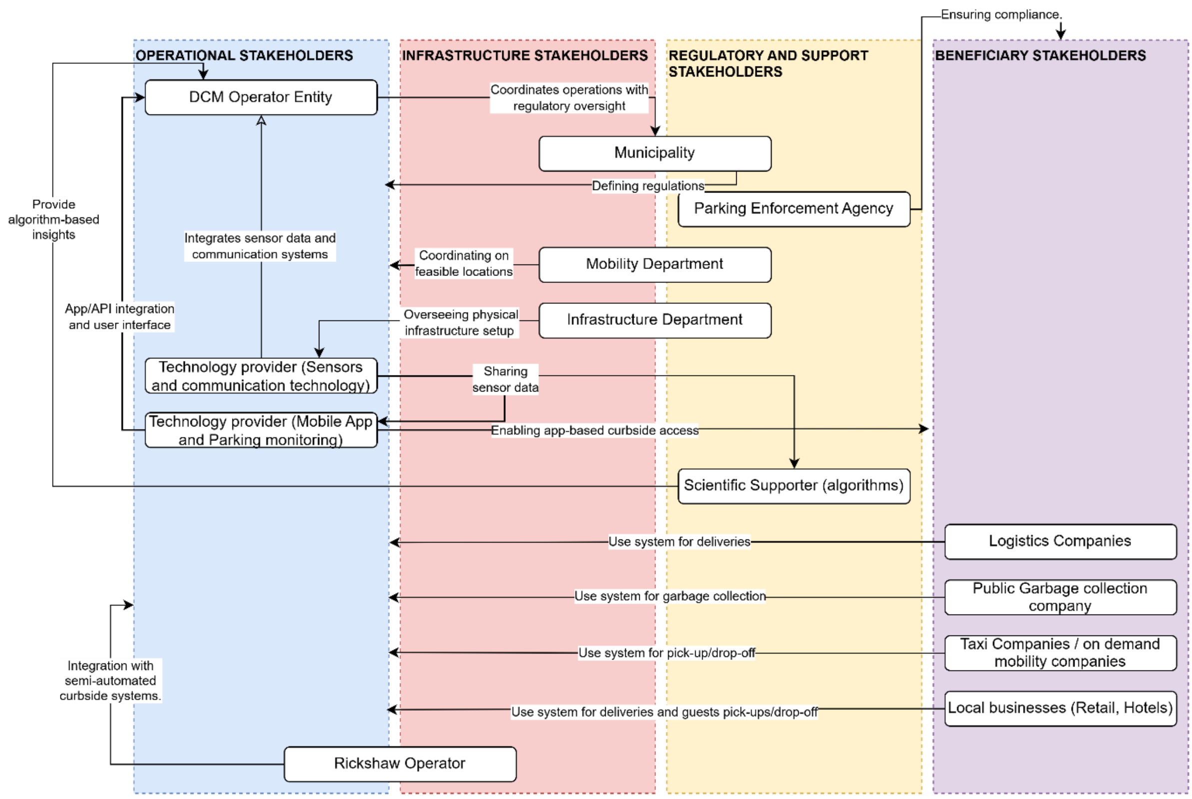


Figure 21: MU-UC01 Governance Model

Note for the MU-UC01 Business Model: Service-Dominant Business Model Radar (SDBM/R) – shown as a table for ease of reading.

Table 13: MU-UC01 Business Model

STAKEHOLDER TYPE	COST (−) / BENEFIT (+)	CO-PRODUCTION ACTIVITY	VALUE PROPOSITION
Dynamic Curbside Management (DCM) Operator	− Operational costs for staff, customer service, and system maintenance. + Reliable system performance and user satisfaction. + Service fees to the users	Operating the web app/API, resolving technical issues, and onboarded new companies.	Seamless curbside management and real-time support for users.
Logistic companies	− Potential Subscription fees for platform access and penalties for non-compliance. + Lower operational costs, reduced fines, and alignment with sustainability goals.	Booking slots via the app/API and adhering to time limits.	Guaranteed curbside access, reduced delivery times, and fuel savings.
Public Garbage collection company	− Costs for system integration and staff training. + Cleaner public spaces and optimized collection routes.	Aligning waste pickup schedules with curbside availability.	Efficient waste collection scheduling and reduced road blockages.
Taxi Companies / on demand mobility companies	− Potential subscription fees and penalties for overstaying. + Improved customer satisfaction and reduced idle time.	Booking zones via the app and adhering to time limits.	Priority access to high-demand curbside areas.
Local businesses (Retail, Hotels)	− Training staff to use the DCM system. + Faster deliveries and enhanced customer experience.	Using the app to reserve slots and coordinate with suppliers.	Dedicated curbside slots for deliveries and customer convenience.
Municipality	− Administrative costs for policy enforcement and system integration. + Streamlined curbside use, reduced emissions, and enhanced public safety.	Regulatory oversight, stakeholder coordination, and system monitoring.	Policy alignment, reduced congestion, and improved urban livability.
Parking Enforcement Agency	− Operational costs for enforcement personnel and tools. + Improved compliance and safer curbside zones.	Monitoring violations, issuing fines, and updating enforcement protocols.	Ensures compliance with curbside rules, reducing illegal parking.
Mobility department	− Costs for data analysis tools and stakeholder engagement. + Efficient curbside supply-demand balance and reduced congestion.	Analysing infrastructure capacity, integrating data, and updating Digital Twin platforms.	Data-driven curbside allocation and optimized space utilization.

STAKEHOLDER TYPE	COST (−) / BENEFIT (+)	CO-PRODUCTION ACTIVITY	VALUE PROPOSITION
Infrastructure department	− Infrastructure setup and maintenance costs. + Reduced driver confusion and improved traffic flow.	Installing signage, modifying road layouts, and maintaining infrastructure.	Clear curbside demarcation and user guidance.
Technology provider (Sensors and communication technology)	− Sensor procurement, installation, and maintenance costs. + Data transparency and dynamic curbside management.	Sensor installation, maintenance, and integration with dashboards.	Accurate, real-time curbside occupancy data.
Technology provider (Mobile App and Parking monitoring)	− Software development and maintenance costs. + Increased adoption by logistics companies and reduced administrative workload.	App development, API integration, and user support.	User-friendly interface for curbside booking and fleet management.
Scientific Supporter (algorithms)	− R&D costs for algorithm development and testing. + Optimized curbside allocation and reduced supply-demand mismatches.	Developing algorithms, simulating scenarios, and refining e-fleet operations.	Data-driven curbside allocation strategies and integration with Digital Twin.
Rickshaw Operator	− R&D costs for vehicle adaptation and testing. + Insights for future scalability of automated curbside management.	Piloting vehicle-curbside system integration at TUM Mobility Innovation Campus.	Testing innovative last-mile solutions in non-public areas.

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

3.6.1. Metadesigned Use Case MU-UC02

First Stage of Why – What – How Framework

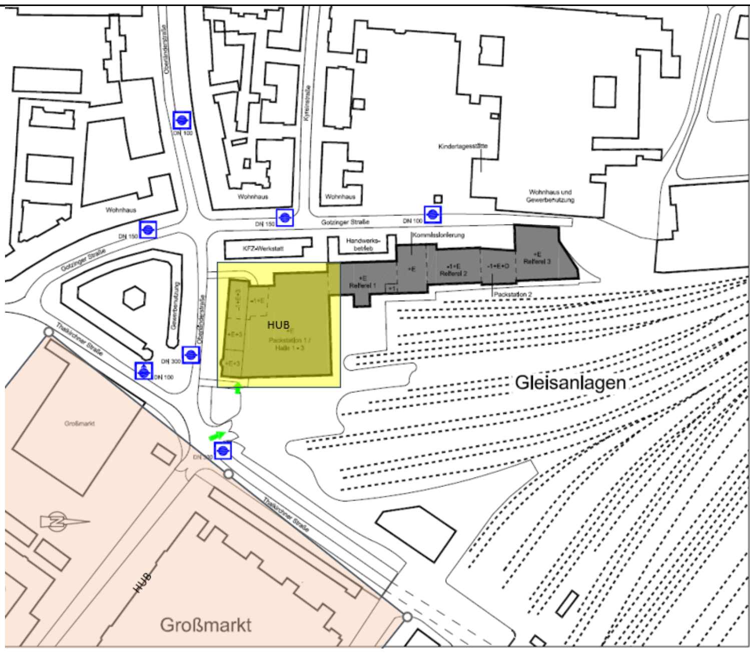
Why: Challenges and Objectives

Questions	Considerations
! What specific challenges faced by the city will this Use Case address?	• Traffic congestion caused by large delivery vehicles stopping in the street to perform drop-offs. • Blockage of bike paths and sidewalks by stopped delivery vehicles. • Emissions from conventional delivery vehicles. • Noise pollution from conventional delivery vehicles. • Logistical challenges of delivering parcels in crowded urban areas with large inflexible conventional delivery vehicles.

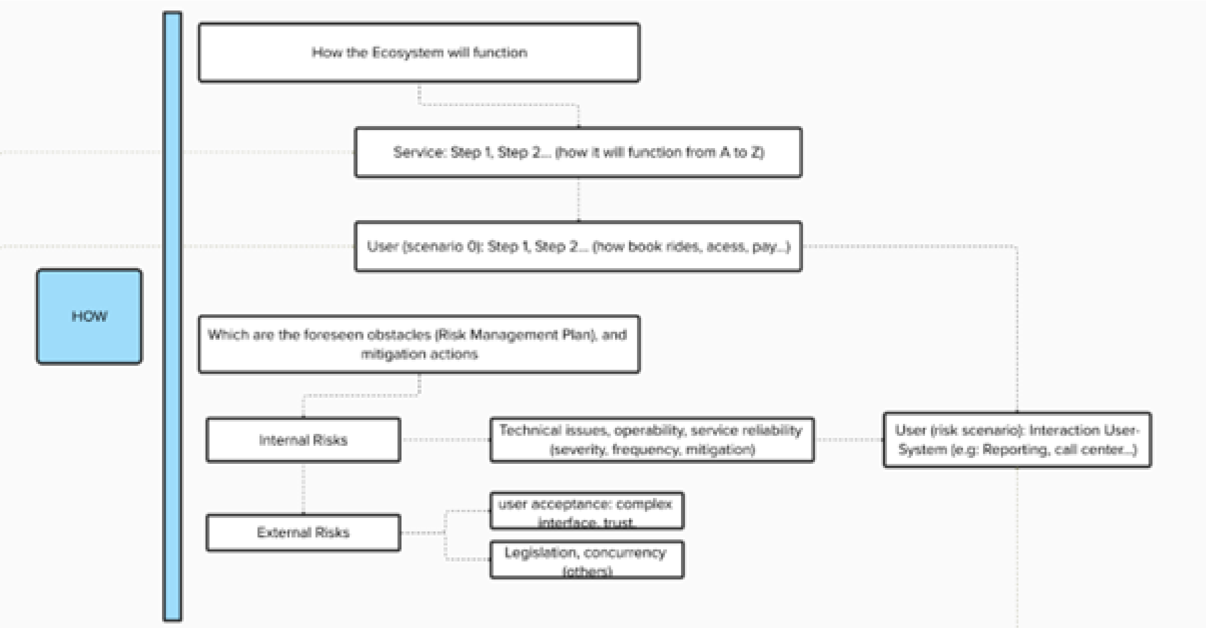
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case?	***In alignment with the Standardised Impact Evaluation Framework (SIEF) from T1.6:*** • Reduce road congestion • Reduce motorized road freight vehicle activity • Reduce the standing time of motorized vehicles in the public space • Reduce climate and pollution impact • Increase urban environmental livability • Increase operators' acceptance of implemented measures • Make parcel delivery more economical

What: The Concept and Its Definition

Use Case Code	MU-UC02
Use Case Title	Establishment and operation of multimodal logistics hubs
❗ Use Case Concept Definition	This case study aims to evaluate the use of logistic hub(s) that enable the last-mile delivery of parcels and freight via cargo bikes. Depending on the location, the study will integrate several logistics partners, including the classical CEP services, delivering parcels mainly to private households, as well as innovative freight services by heavy-duty freight bikes. Space permitting, we will test the integration of related services, such as battery swapping and repair services, as well as exhibition space to demonstrate the bicycles used for the services.
❗ Location (and its influence area)	🔴 Future-focused (the exact location of the MLH is still not decided) The location of the logistic(s) hub is still in the process of being decided. Feasible locations are based on the following criteria: • Central Location: The hub must be situated in a central area of the city where delivery demand is high and the distance from the hub to customers is short, maximizing the efficiency of cargo bike deliveries. However, this also means that available locations are limited and rental prices are high. • Loading Facilities: The locations must have loading gates and/or ramps suitable for cargo bikes (e.g., specific slope and width requirements) and be shared among various logistics partners. • Hub Size: The size of the hub should be appropriate for the number of committed logistics partners. • Rental Availability: The location must be available for rental for at least two years, and ideally beyond the end of the metaCCAZE project. This is crucial for convincing partners to participate. Until January 2025 we negotiated a lease contract for a 3000 sqm logistic space that could host several service providers in one hub (Figure X). The space was previously used as a warehouse and is, therefore, fully equipped with loading doors and ramps providing access for the cargo bikes. It is centrally located in an industrial zone next to the "Großmarkthalle", a wholesale market, which ensures good access for large trucks and little negative impact on citizens.

	
❗ Which (physical and digital) infrastructure is needed? o	The Logistics Space is ready to use, including required access, gates, and ramps for bike access. Modifications: see below.
❗ Who will be responsible for developing and managing this new infrastructure?	This will be defined once the exact location is selected. In principle, the City of Munich will sublet the hub to various logistics providers, each responsible for managing their own infrastructure. Overall site management may fall under the landlord's responsibility, depending on the terms of the rental agreement.
❗ What (physical & digital) infrastructure needs to be modified 2)	1) TBD: an application for change of usage may be required from the local planning authority, since the type of usage is slightly different than with the previous tenant. 2) Markings and signage to manage access for trucks and cargo bikes 3) Acquisition of fire-safe battery charging containers 4) Acquisition of cargo bikes 5) Partitions to separate and demarcate the operational areas of the various partners
❗ Who will be responsible for these infrastructure modifications?	1) LHM 2) LHM 3) Logistic partners/ Hub Users 4) Project Partner B4B and Logistic partners/ Hub Users 5) Project Partner B4B and Logistic partners/ Hub Users

How: Operation and Management



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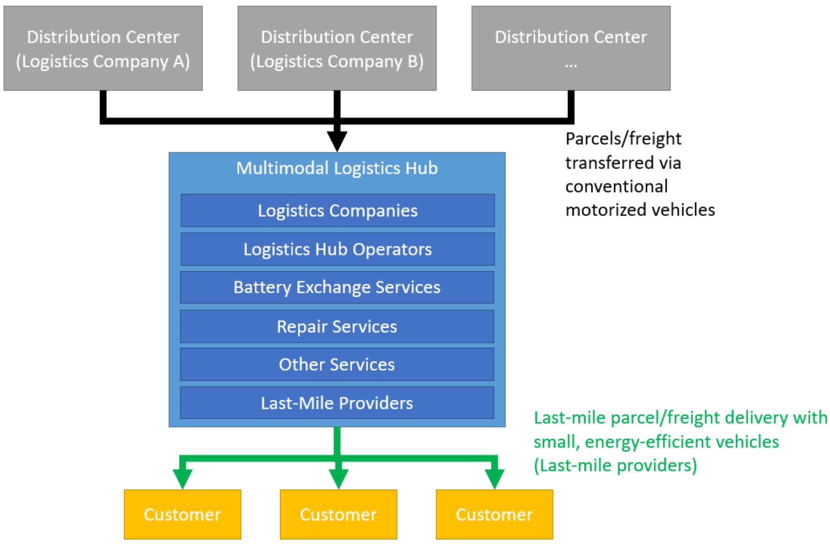

Each logistics company will be responsible for transporting cargo from their distribution centers (outside Munich's city center) to the Multimodal Logistics Hub using conventional motorized vehicles (e.g., trucks and vans). There, freight and parcels will be sorted and assigned to last-mile routes. Last-mile delivery may be handled in-house by the logistics companies or outsourced to specialized providers, using small, zero-emission vehicles such as cargo bikes. Maintenance and charging of these vehicles can be managed either by the last-mile providers themselves or by external service companies.
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<tr>
<td>❗ How the User will interact (under normal conditions - operation on a daily basis)</td>
<td>The multimodal logistics hub concept seamlessly replaces the existing delivery chain from the perspective of the end user, and therefore no special interaction with the system is necessary. Customers place orders or schedule parcel deliveries through existing channels and receive them just as they already do. This concept serves both "B2C" (Business-to-Customer) and "B2B" (Business-to-Business) delivery.

The other major "users" of the system are the logistics companies and last-mile providers (which, in some cases, are one and the same). Also for these users,</td>
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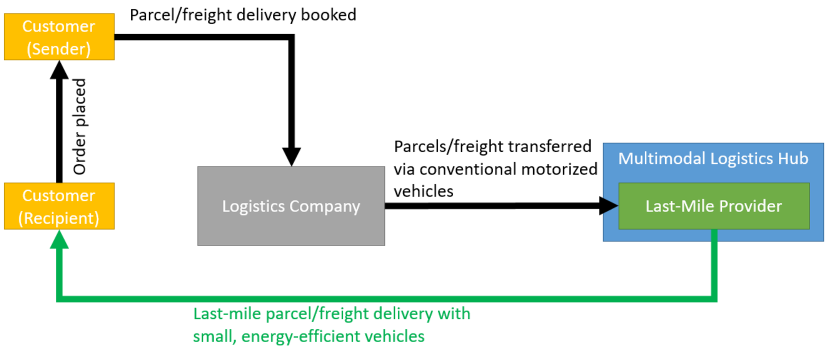
	there is relatively little adaptation necessary with respect to interaction with the system. The multimodal logistics hub provides a single location where multiple providers can operate in close proximity, facilitating interactions. The interactions between the providers will, however, still be handled by agreements made directly between the respective providers. Additional services, such as battery exchange or repair services, can be integrated into the hub for all participating logistic partners. 
❗ Please review the Prototype stakeholder map and make changes	The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.

Second Stage of Why – What – How Framework

What: Foreseen Internal Risks and Mitigation Actions

Internal Risk (Technical issues, operability, service reliability):			
	Severity	Likelihood	Mitigation action
None	N/A	N/A	***N/A.***

❗ How the Service will function (under the anomalous scenario)	***N/A***

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severity	Likelihood	Mitigation action

Dissatisfaction of logistics and/or last-mile providers	M	L	Discussions will be held with logistics and last-mile providers prior to full implementation in order to ensure that their needs are met by the multimodal logistics hub facility. Lessons learned from an existing implementation in Munich (Viehhof) will also be applied. The likelihood of major issues is, therefore, expected to be low.
Lower than expected profitability for logistics and/or last-mile providers	H	M	Logistics hubs can be rolled out slowly initially to allow time for a transition from conventional delivery vehicles (which have already been purchased by providers) to small energy-efficient vehicles. This allows the costs of conventional vehicles to be covered before they are retired.
Risk of not being able to find and rent a suitable location	H	H	Involve real estate agents (extra cost, not included in the calculation). Flexibility regarding hub size (one large hub or several smaller ones) -> additional acquisition and management efforts to engage and manage additional logistic partners
Risk of drop-out / withdrawal of logistic partners (various reasons – profitability / startup insolvency..)	H	H	Building a network of logistic partners and related services and providers for potential replacements
Other external risks (Legislation, competitors (others))			
	Severity	Likelihood	Mitigation action
Risk of long and expensive approval process and/or rejection	H	M	Clear communication with planning authority early during site selection process.

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated?	The investments for this UC are fully supported by the metaCCAZE budget (including the 30% private contribution of the profit legal entities). According to the Grant Agreement: • LHM has 400,000€ assigned to the rental, furnishing, and operating costs of the logistic hub. The exact allocation of this budget to specific categories is not yet known, as the location of the logistics hub is not confirmed (i.e., it could be a big hub or several smaller hubs, which would lead to different investment needs). • B4B has 15,000€ allocated to the purchase and equipment of a cargo bike that will be used as demonstrator of the UC. • Cost of equipment for the connected, semi-automated, small zero-emissions demonstrator vehicle (Rickshaw): Not detailed (and shared with MU-UC01)

What is included in this budget? (technology-based, consider running the service)	As mentioned above, the budget is expected to include: • rental, furnishing, and operating costs of the logistic hub (a more detailed description is still not known). • acquisition of cargo bike(s) by B4B • equipment costs for the connected, semi-automated, small zero-emissions demonstrator vehicle (shared with MU-UC01)
How was the project funded? Under which funding schemas and co-financing?	The metaCCAZE project and hence the Munich Living Lab partners are funded within the Horizon Europe funding programme, under the call HORIZON-MISS-2023-CIT-01, representing a research and innovation action. Here, the participating institutions are subject to a 100% or 70% funding rate, depending on their institution's status. LHM and TUM: 100% EU funding B4B: 70% EU funding

3.6.2. Metadesigned BIGM

SECTION	DESCRIPTION
Summary of the BIGM	The BIGM for MU-UC02 establishes eco-friendly, multimodal logistics hubs aimed at decarbonising last-mile delivery through the use of e-cargo bikes and semi-autonomous rickshaws. Supported by European funding and stakeholder partnerships, this initiative prioritises scalability, emissions reduction, and urban congestion alleviation.
Governance Model	LHM coordinates hub operations, while last-mile providers and retailers ensure service delivery. City authorities provide regulatory oversight to maintain standards and compliance (Figure 22: MU-UC02 Governance Model).
Business Innovation Model	The SDBM/R framework generates revenue from logistics fees and partnerships. Key costs include hub operational expenses, maintenance and charging infrastructure (Table 15).
SDBM/R Co-Created Value in use	Eco-friendly last-mile delivery
Changes from Prototype BIGM	**Governance Model**: • Integrated semi-autonomous rickshaw testing with TUM **Business Model**: • Expanded list of stakeholders, including specific roles. • Greater emphasis on the integration of a semi-automated Rickshaw as a demonstrator. • More specific information on revenue streams and pricing models.

Table 14: MU-UC02 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Focal	Logistics Hub Operator	LHM / Mobility Department (Mobilitätsreferat)	Develop/manage hubs and ensure operational efficiency.	✅ Confirmed
Core Partners	Municipality	Landeshauptstadt München (LHM)	Promote sustainable logistics through regulations and incentives.	✅ Confirmed
	Logistics Companies	Logistics companies	Deliver goods to hubs using vans/trucks.	✅ Confirmed
	Last-mile providers	Last-mile Providers (e.g. b4b Logistics)	Use electric cargo bikes for final delivery to consumers.	✅ Confirmed
	Electricity Provider	To be assigned	Supply energy for hub charging stations.	📪 To Be Contacted
	Local Businesses	Retailers	Offer sustainable delivery options to customers.	✅ Confirmed
Enriching Partners	Bike service providers	Bike service providers (e.g. Service Group)	Repair/service cargo bikes and manage charging/battery exchange at the hub.	⏱ In Discussion
	Rickshaw Operator	Technical University of Munich (TUM)	Test semi-automated parcel delivery solutions in non-public areas.	✅ Confirmed
Customer	Consumers	Consumers	Receive goods via sustainable delivery.	✅ Confirmed

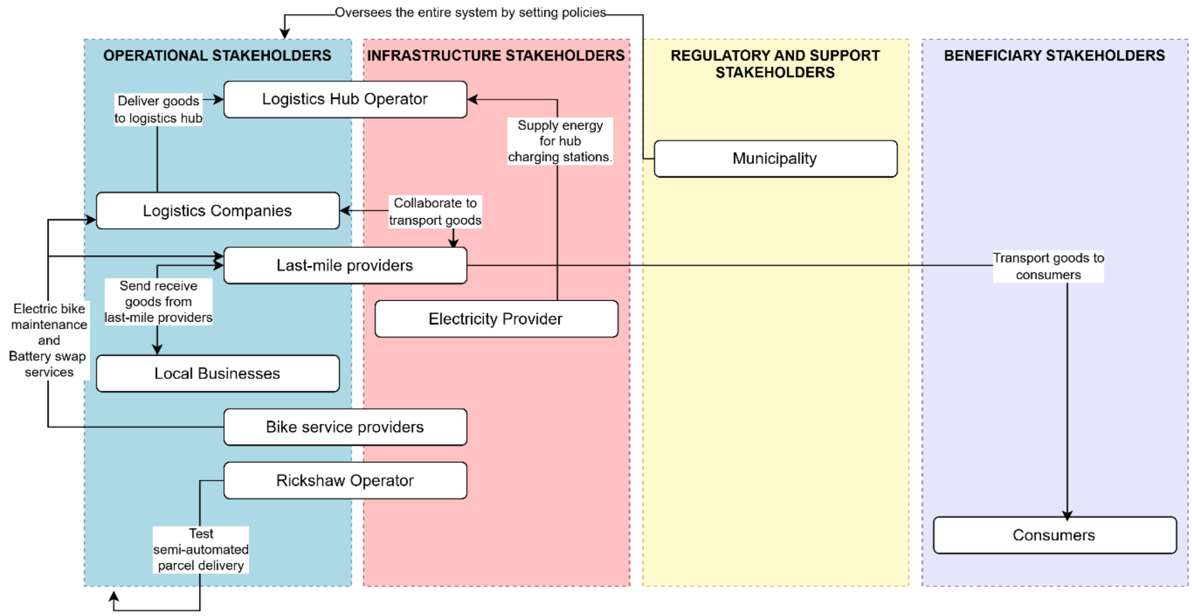


Figure 22: MU-UC02 Governance Model

Note for the MU-UC02 Business Model: Service-Dominant Business Model Radar (SDBM/R) – shown as a table for ease of reading.

Table 15: MU-UC02 Business Model

STAKEHOLDER TYPE	COST (−) / BENEFIT (+)	CO-PRODUCTION ACTIVITY	VALUE PROPOSITION
Logistics Hub Operator	− Hub setup, maintenance, and staffing costs. + Optimized urban logistics and reduced traffic congestion. + Fees from the logistics companies	Select hub locations, manage operations, and integrate last-mile providers.	Centralized infrastructure for efficient goods transfer between transport modes.
Municipality	− Administrative costs for policy enforcement. + Improved air quality and progress towards EU emissions targets.	Provide funding, permits, and incentives for hub infrastructure.	Policy alignment with climate goals and reduced urban emissions.
Logistics Companies	− Costs for adapting logistics processes to hub-based delivery. + Reduced fuel costs and improved delivery efficiency.	Coordinate delivery schedules with hub operators.	Efficient bulk delivery to hubs, reducing road congestion.

STAKEHOLDER TYPE	COST (–) / BENEFIT (+)	CO-PRODUCTION ACTIVITY	VALUE PROPOSITION
Last-mile providers	– Acquisition and maintenance costs for e-bikes. + Access to restricted urban areas and alignment with sustainability goals.	Transport goods from hubs to end customers using cargo bikes.	Eco-friendly last-mile delivery with minimal emissions.
Electricity Provider	– Costs for grid upgrades and renewable energy integration. + Increased adoption of renewable energy sources.	Maintain charging infrastructure and ensure grid stability.	Reliable power supply for e-bike charging and hub operations.
Local Businesses	– Potential partnership fees or revenue sharing agreements. + Competitive advantage and increased sales.	Promote the service to customers and integrate it into sales platforms.	Enhanced customer satisfaction through green logistics.
Bike service providers	– Labor and equipment costs for bike servicing. + Long term service contracts and reduced downtime.	Perform maintenance, battery swaps, and charging station management.	Ensure operational reliability of e-bike fleets.
Rickshaw Operator	– R&D costs for vehicle adaptation and testing. + Data to optimize automated delivery systems.	Integrate rickshaws with hub operations at TUM's Mobility Innovation Campus.	Pilot innovative last-mile delivery methods for future scalability.

3.7. On-demand mini-buses service (LI-UC01)

3.7.1. Metadesigned Use Case

First Stage of Why – What – How Framework

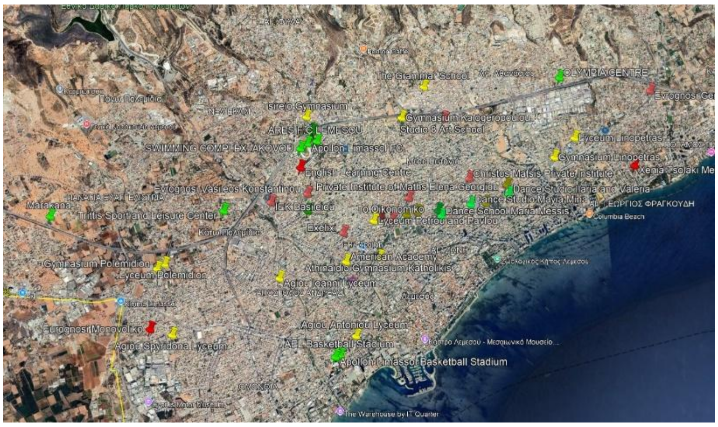
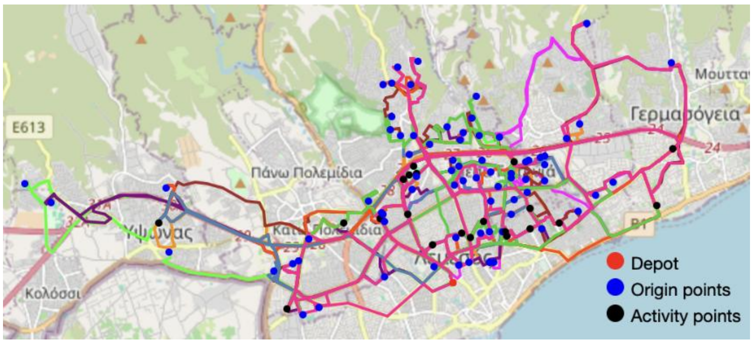
Why: Challenges and Objectives

Questions	Considerations
❗ What specific challenges faced by the city will this Use Case address?	🟢 The city aims to decrease dependency on car use, as 92% of trips in Limassol are currently made by car (SUMP, 2019). A particular challenge is faced with the underage students who participate in numerous after-school activities (tutorial lessons and sports etc.), and they are typically escorted by their parents' private vehicles. The city experiences its highest traffic volumes during school drop-off and pick-up times, as well as when parents transport their children to after-school activities (15:00 to 19:00).

	This fact is due to two main reasons: 1. The transport alternatives to private vehicles in Limassol are limited and sometimes unreliable, and 2. The culture (behaviour) is car-oriented, and citizens do not trust and are reluctant to use the other transport alternatives. As such, with this use case, metaCCAZE aims to: - Design and offer a reliable shared mobility service that can compete the convenience of private vehicles. - Design marketing and awareness campaigns to start changing the car-oriented culture in the city and shift as many as possible trips from private cars to the shared mobility service. Reliable shared mobility services can significantly reduce the carbon footprint compared to individual car rides. These efforts align with the city's goals to improve traffic congestion, reduce transport-emissions and achieve climate neutrality.
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case?	• Reduce the number of vehicles in the network (especially during the afternoon-evening pick hours) • Improve traffic flows (especially during the afternoon-evening pick hours) • Increase the modal split of shared modes (including public transport) • Reduce air pollutants • Reduce average daytime noise emissions (in dB) • Optimization of transportation demand and supply (match demand and supply) • Incorporate smart technologies into sustainable transportation strategies • Improve the well-being of citizens and especially families (that may also have disabled kids).

What: The Concept and Its Definition

Use Case Code	🟢LI-UC01On-demand mini-buses service
Use Case Title	🟢On-demand mini-buses service
❗ Use Case Concept Definition	🟢An on-demand mobility service will be launched in the city, featuring mini-buses and private vans. Initially, it will serve teens (12-18) for their after-school activities, expanding later to tourists and city employees. The uniqueness of this use case relies to: - it is a door-to-door on-demand service (like ridehailing services), but it operates with mini-buses aiming to group demand and match it with vehicles that have more capacity. - AI algorithms will match demand to supply; AI crowdsourced dynamic routing algorithms will navigate bus drivers to the pick-up locations; and real-time information will be offered to users about the rides and locations. - the fact that this service tries to tackle the two major challenges that Limassol faces in terms of transport: 1. To offer a reliable and convenient alternative to private vehicles, and 2. To offer a reliable and trustworthy service that has been co-designed with citizens to cover their travel

	needs, as well as several of their latent/behavioural car-oriented attitudes. **Climate Neutrality:** Aims at reducing the number of private cars on the road network and as such congestion and transport-emissions. **Policy Support:** Demonstrates innovation in shared mobility and transport-emission reduction, making it eligible for grants or funding under green and smart city initiatives. **Expandability**: The on-demand model can be scaled to serve different demographics or areas, from schoolchildren to seniors, or even office commuters. **Reduced Individual Costs**: Sharing rides lowers transportation costs for users compared to private vehicles or taxis. **Dynamic Routing**: Unlike traditional fixed-route buses, the service adapts routes based on real-time demand, offering personalized travel experiences. **Customized Scheduling**: Users can book rides according to their needs, making it especially appealing for students and working parents
❗ Location (and its influence area)	 🟢 The service will be implemented in the metropolitan area of Limassol, extending beyond the municipality itself. This approach ensures that the service's impact will benefit the entire city, contributing to the climate neutrality goals outlined in the city's Climate Contract.  NOTE: *The city-wide coverage will be achieved gradually till the end of the project. Initially the service will be available to a certain number of citizens in certain areas of*

	the city. This is due to the fact that the metaCCAZE project has access to a limited number of mini-buses (at this moment 7 conventional internal combustion engine (ICE) vehicles and 2 electric ones that will be offered by EMEL). However, given also the metaDesign activities involving parents, it is expected that the demand will be high and the number of buses provided by EMEL within the metaCCAZE project, will not be enough to cover the demand. As such, MaaSLab has started discussions with EMEL and other bus operators within the city to include more buses in the service. The more buses enter the service, the wider the coverage of the city will be.

❗ Which (physical and digital) infrastructure is needed?	🟢 **Physical infrastructure:**
	• Mini-buses (**around 7 conventional ICE vehicles and 2 ones** offered by EMEL).
	
	🟢 **Digital infrastructure:**
	• The on-demand platform that will be named WeeDrive and consists of:
	  ○ A mobile application for citizen to pre-book trips
	  ○ A mobile application for the bus-drivers to navigate them to the pick-up locations
	  ○ A web-based system, where:
	    ▪ the bus companies register their fleet (characteristics of each mini-bus) and their drivers (details of drivers).
	    ▪ Monitor which buses are assigned to drivers & where the buses and drivers are in real-time.
	    ▪ Do bus scheduling
	    ▪ Monitor the kms of the buses and hours of operation.
	    ▪ Submit invoices and get paid.
	  ○ The Intelligence (backend) of the platform:
	    ▪ AI-based crowdsourced dynamic routing algorithms
	    ▪ Fleet scheduling
	    ▪ Supply and demand matching algorithms
	    ▪ AI recommendation and incentivitation engine

❗ Who will be responsible for developing and managing this new infrastructure?	🟢 Developing software: MaaSLab Managing service: MaaSLab Offering fleet: EMEL (and potentially other bus operators that are not partners of the consortium) Managing fleet: EMEL + MaaSLab
❗ What (physical & digital) infrastructure needs to be modified	🟢 Digital infrastructure will be developed from scratch Physical infrastructure: buses to be leased
❗ Who will be responsible for these infrastructure modifications?	🟢 Digital infrastructure - Responsible: MaaSLab Physical infrastructure: EMEL
❗ Which metaInnovation	• AI recommendation and incentivitation engine (ST2.1.2) • Supply-demand matching algortithms (ST2.6.4)

technology (WP2) is being tested linked to this UC?	• Integrate and Plan: Digital Twin Platform for Optimization (T2.7)

How: Operation and Management

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<td>❗ How the Service will function (under normal conditions - operation on a daily basis)</td>
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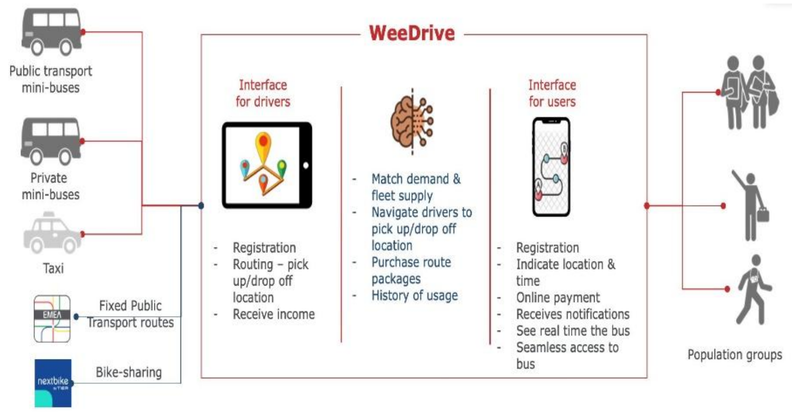

🟢The service will enable the registration of parents and the invitation of other family members. The users will be able to set weekly schedules about student's after-school activities. An online questionnaire is currently ongoing, where parents can input their children's schedules. Operating hours will be defined based on these schedules.

The geographical boundaries will be determined by the demand for the service and the availability of the fleet. Discussions and interviews have been held with two other private operators, who have expressed interest in participating in this service to cover a larger geographical area.

There is need for internet connectivity only during the booking process. The students can complete their rides without internet connectivity or carrying mobile devices.

The application to be used is being developed from scratch and will include real-time updates to keep both parents and drivers informed. EMEL, a partner in the MetaCCAZE project, will provide the fleet for the service.

Maintenance and updates will be handled by MaaSLab. The user experience will be seamless. The mobile application will be updated through the Play Store for Android devices and Apple Store for iOS devices.

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<td>❗ How the User will interact (under normal conditions - operation on a daily basis)</td>
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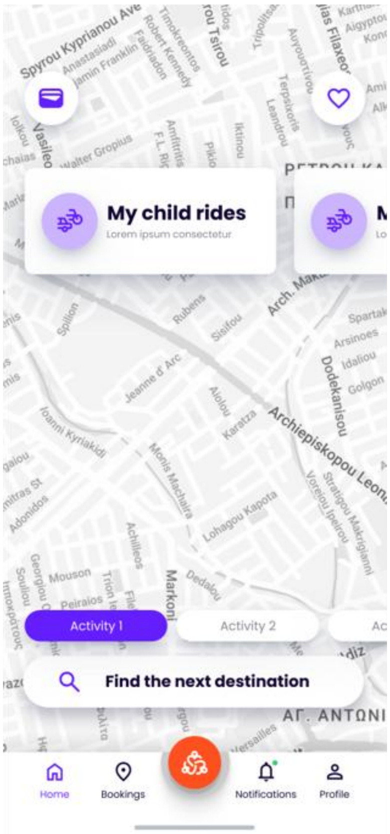

1. **Start**
2. **User Registration**

- Create Account
- Set Up Profile
- Add Student Details – register student
- Accept the student’s interface

3. **Schedule Input**

- Enter Weekly Activities
- Specify Locations & Times

4. **Booking a Ride**

- Select Date & Time
- Pick up/Drop off locations
- Confirm Booking

5. **Notifications**

- Receive Ride Confirmation
- Get Driver & Vehicle Details

6. **Real-Time Tracking**

- Monitor Ride Status
- Estimated Arrival Updates

7. **Payment**

- Process Payment
- Receive Receipt

8. **Feedback**

- Provide Comments
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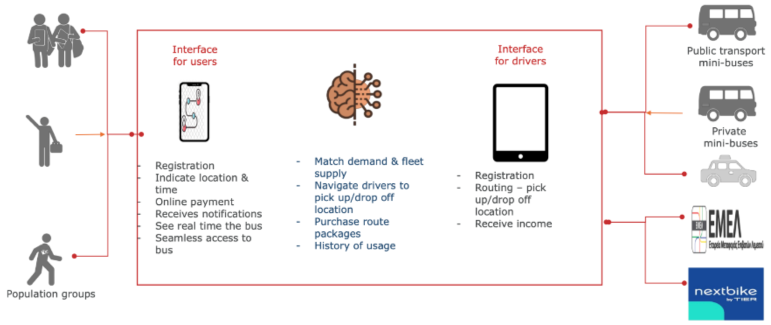
<tr><td></td><td>
</td></tr>
<tr><td>❗ Please review the Prototype stakeholder map and make changes
•</td><td>🟡There is potential to include additional bus operators and taxi drivers who are not consortium partners as operational stakeholders, to ensure coverage of the entire metropolitan area of Limassol.

The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.</td></tr>
</table>

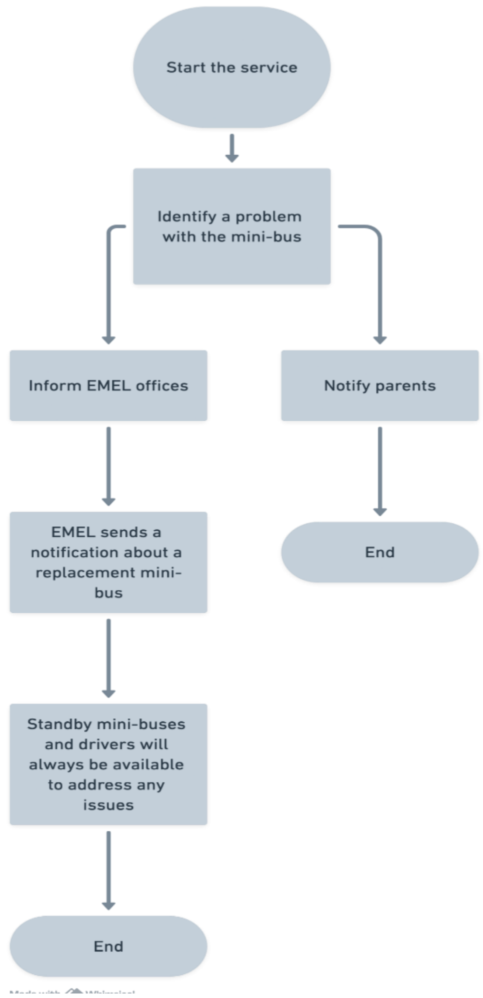
Second Stage of Why – What – How Framework

What: Foreseen Internal Risks and Mitigation Actions

Internal Risk (Technical issues, operability, service reliability):			
	Severity	Likelihood	Mitigation action
Appropriate number of buses will be used	Low	Low	Through the citizen survey the possible number of users will be identified The Energy and Transport platform (UC4) will contribute
Technical issues (Application Failure)	Low	Low	Ensure the app/platform is user-friendly, robust, and secure against data breaches. Users can provide feedback for the service and the application, as well Online tutorials for using the app The system will be operational without requiring an internet connection or the use of the application.
Issue with mini-buses or drivers	Medium	Low	EMEL will always have standby professional drivers and mini-buses

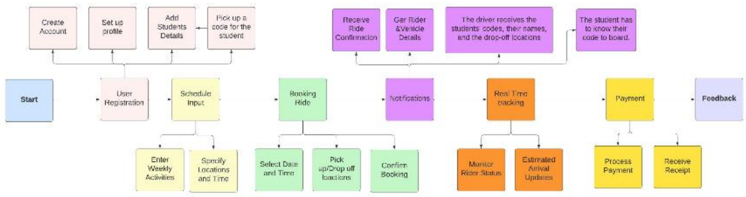
			available to replace those with issues. It is its policy.
EMEL cannot find a sufficient number of electric buses.	Low	Low	The service will use a mixed fleet of two electric minibuses and seven conventional ones.

<table>
<tr>
<td>❗ How the Service will function (under the anomalous scenario)</td>
<td>Issue with mini-buses or drivers (Risk 3)



1. Start the service.
2. Identify a problem with the mini-bus.
3. Inform EMEL offices.
4. Notify parents.
5. EMEL sends a notification about a replacement mini-bus.
6. The replacement will take place within a specific time window (maximum waiting time of 10 minutes)
7. Standby mini-buses and drivers will always be available to address any issues.
</td>
</tr>
</table>

<table>
<tr>
<td>❗ How the User will interact (under the anomalous scenario)</td>
<td>
Technical issues (Application Failure) - The student has not his mobile device and there is not internet connectivity (Risk 2)



1. **Start**
2. **User Registration**

- Create Account
- Set Up Profile
- Add Student Details – register student
- Pick up a code for the student

3. **Schedule Input**

- Enter Weekly Activities
- Specify Locations & Times

4. **Booking a Ride**

- Select Date & Time
- Pick up/Drop off locations
- Confirm Booking

5. **Notifications**

- Receive Ride Confirmation
- Get Driver & Vehicle Details
- The driver receives the students' codes, their names, and the drop-off locations
- The student has to know their code to board.

6. **Real-Time Tracking**

- Monitor Ride Status
- Estimated Arrival Updates

7. **Payment**

- Process Payment
- Receive Receipt

8. **Feedback**

- Provide Comments
</td>
</tr>
</table>

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severity	Likelihood	Mitigation action
User Acceptance	Medium	Low	Successful Marketing campaign Citizens survey and focus groups to determine needs that will be answered through the Use Case Accessibility and inclusivity

			The test phase will make the service more popular and will increase its acceptance There is any other service like this within the city
Pricing	Medium	Low	The pricing will be determined through research into policies such as pricing per kilometre and pricing per hour The additional transport modes may be subsidized by the government.
The use of the app for users and drivers	Low	Low	There will be training tutorials for professional drivers There will be training tutorials online for parents and students Provide clear instructions for guardians, students, and schools to minimize operational errors
Trust	Medium	Low	Parents will have the ability to view all necessary driver characteristics. Parents will have the ability to view the mini-bus status.
Other external risks (Legislation, competitors (others))			
	Severity	Likelihood	Mitigation action
Competitors	Medium	Low	There is no service like this within the city. There are mini-vans for student transportation, but these are owned by private schools and do not operate as an on-demand service. Furthermore, the service will also be used for after-school activities.
Privacy Policy	Medium	Low	Only registered and verified parents can access the app. The registration for students will be applied after their parents give the permission through the app. Encrypt all sensitive data (e.g., user profiles, booking details) in transit and at rest. Align with data protection law, GDPR. User will give their permission to register and use the app through the acceptance of "Privacy Policy"

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated?	**Initial investment:** • Development platform • Development application • Software licenses • Personnel training • Hirings employees • Professional Drivers • Minibuses • Marketing campaign • Focus Groups – citizens engagement • Operational costs • Stakeholders' engagement • Electricity bill for charging e-buses • Internet connectivity • Technical support
What is included in this budget? (technology-based, consider running the service) •	During the duration of the project the following actions will be funded: • Software licenses for developing the platform • Application interfaces' s for parents and drivers • Routing • Schedule charging • User and driver training • Marketing campaign • Testing and monitoring • Personnel for professional drivers • Stakeholder engagement (including stakeholder surveys) • Citizen's engagement (including Social Survey) • Electricity bill for charging e-buses • Internet connectivity • Technical support
What is the cost per unit?	We estimate that the fleet will consist of seven conventional minibuses and two electric minibuses. The cost per unit will be specified after analysing the cost per kilometre and per hour.
Do you need any human resources? If yes, what type of human resources are needed?	• Professional drivers for e-buses – Directly involved in the project • Marketing campaign – Directly involved in the project • Training costs – Directly involved in the project
Was the pricing of the proposed service defined? If yes, what is the pricing of the proposed service (for the user)	The pricing for the service will be determined after analysing policies such as pricing per kilometre and pricing per hour. Subscription options will be available, with parents having the option to purchase weekly subscriptions. In the initial phase, the service will be available only for students. Therefore, pricing concerns for businesses and public institutions do not apply.

	A test phase will take place, but no final decision has been made regarding ticketing for that period.
Are there any incentives planned? If yes, would they motivate users to prefer this mobility solution more frequently? Why?	At the beginning of the service, rewards programs may be applied to make the service more popular and increase acceptance by parents and students. In this way, the risks which has to deal with citizens acceptance can be mitigated.

3.7.2. Metadesigned BIGM

SECTION	DESCRIPTION
Summary of the BIGM	The updated Business Innovation and Governance Model (BIGM) for LI-UC01 On-Demand Mini-Buses clarifies the roles of stakeholders, their collaborations and revenue streams for a sustainable service.
Governance Model	Regulatory oversight by municipality, operational management by service provider, and infrastructure coordination with technology partners (Figure 23).
Business Innovation Model	On-Demand Mini-Buses focuses on providing a flexible, AI-driven routing, door-to-door transport service optimised for after-school activities. Revenue streams include user fees and potential subsidies, while stakeholders collaborate to ensure reliable operations and infrastructure support (Figure 24).
Changes from Prototype BIGM	**Governance Model**: • The governance structure now explicitly mentions MaaSLab as responsible for developing and managing the digital infrastructure (WeeDrive) and EMEL as the primary fleet provider, with potential for partnerships with private operators to expand capacity. • The governance model now includes discussions with additional private operators to expand the fleet beyond the initial nine mini-buses provided by EMEL (7 conventional mini-buses and 2 electric mini- buses). **Business Model**: • Platform Branding: The updated document introduces "WeeDrive," a dedicated platform for managing bookings, dynamic routing, and payments, which was not explicitly named in the earlier version.

Table 16: LI-UC01 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Service Provider	Technology Provider	MaaSLab	Develop and manage the "WeeDrive" digital platform, including routing, scheduling, and payment systems.	✅ Confirmed
Key Partner	Public Transport Operator	EMEL	Provide and manage the fleet of mini-buses.	✅ Confirmed
	City Authorities	Municipality of Limassol	Coordinate stakeholders, align with urban mobility policies, and promote shared mobility.	✅ Confirmed
	Extracurricular schools	Extracurricular schools	Offer various extracurricular activities to students	⏳ Future Engagement
Customer	User (Students)	Students	Use the service for after-school activities.	⏳ Future Engagement
	User (Parents)	Parents	Book the service and monitor children's routes.	⏳ Future Engagement
	User (Tourists and city employees)	Tourists and city employees	Book the service for city mobility needs.	⏳ Future Engagement

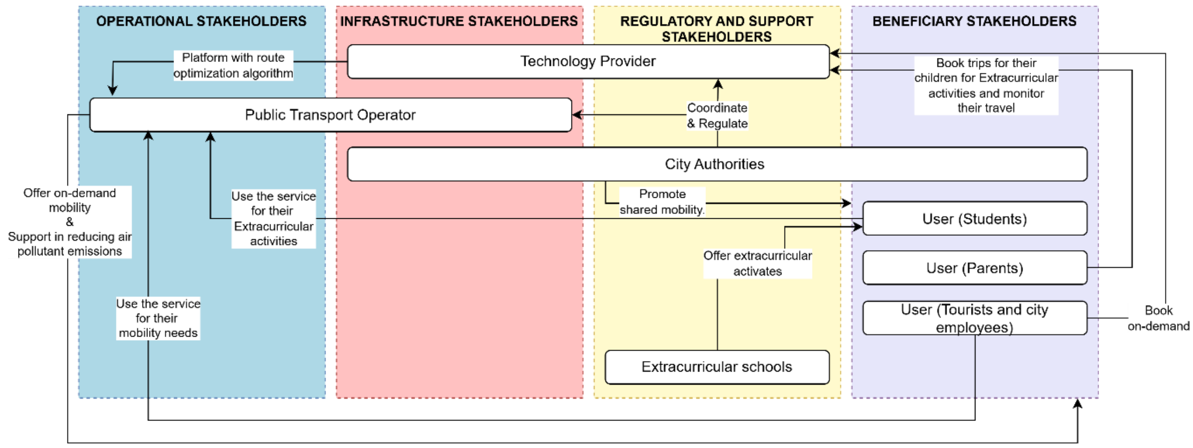


Figure 23: LI-UC01 - Governance Model

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
-**Technology Provider** (Develops and manages the digital platform including routing, scheduling, and payment systems) - **City Authorities** (Coordinate stakeholders, align with urban mobility policies, and promote shared mobility initiatives) -**Extracurricular schools** (Scheduling coordination)	-Operating and maintaining the mini-bus fleet -Route optimisation and scheduling using AI algorithms -Platform development and technical maintenance -Stakeholder coordination and alignment with urban mobility strategies -Marketing and promotion of the shared mobility concept **Key Resources** -Fleet of mini-buses - Digital platform (web-based and mobile applications) - Technical expertise and development capabilities - Operational staff (drivers, support personnel) - City infrastructure and designated stops	- **Students**: Safe, reliable transportation to after-school activities without parental supervision - **Parents**: Peace of mind through ability to book and monitor children's routes in real-time - **Tourists and City Employees**: Convenient, flexible mobility solution for navigating Limassol - **Extracurricular Schools**: Increased accessibility and attendance at programmes	- Self-service through mobile application - Real-time tracking and notifications - Customer support for booking assistance - Feedback mechanisms for service improvement - Trust-building through safety protocols and transparency **Channels** -Mobile app and website for bookings -Social media and online marketing -Partnerships with schools and extracurricular activity centers -Community outreach programs	- **Students**: Primary users for after-school activities mobility - **Parents**: Book service and monitor children's routes - **Tourists and City Employees**: Use service for general mobility needs in Limassol - **Extracurricular Schools**: Indirect beneficiaries through increased student attendance

Cost Structure	Revenue Streams
-Vehicle acquisition and maintenance - Fuel/energy costs - Driver and operational staff salaries - Platform development and maintenance - Marketing and promotional campaigns - Municipal coordination activities - Insurance and compliance costs	-Direct user payments through the platform -Advertising and sponsorship opportunities - Subscription models for regular users

Figure 24: LI-UC01 - Business Model

3.8. Shared e-bikes (LI-UC02)

3.8.1. Metadesigned Use Case

First Stage of Why – What – How Framework

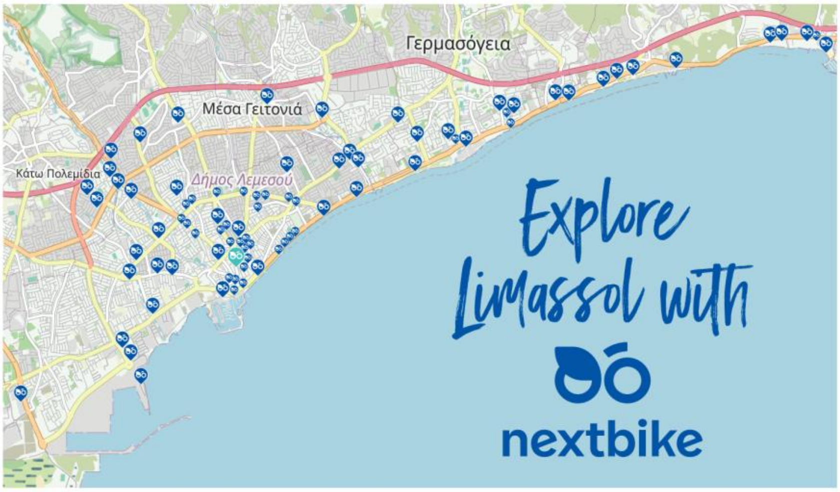
Why: Challenges and Objectives

Questions	Considerations

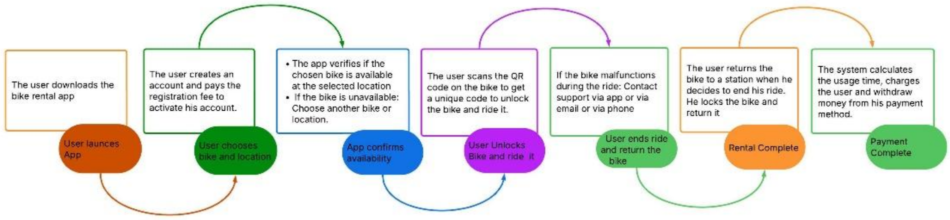
❗ What specific challenges faced by the city will this Use Case address?	The city aims at decreasing the dependency of car use to achieve the climate neutrality goals by using the shared e-bike service
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case?	1. Decrease of car usage 2. Reduction of air pollution 3. Promotion of healthier way of living 4. Promotion of sustainable urban mobility 5. Make citizens more active 6. Improve real-time data sharing to optimise the service 7. Reduce car traffic in central areas 8. Integrate cycling with public transportation 9. Incorporate smart technologies in sustainable transportation strategies

What: The Concept and Its Definition

Use Case Code	LI-UC02
Use Case Title	Shared e-bikes
❗ Use Case Concept Definition	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. Shared e-bikes. This concept is unique for the city of Limassol, because this service was not available in Limassol until now. Only conventional bikes are available, and hilly terrain is difficult to navigate with them.
❗ Location (and its influence area)	The shared e-bike service will be available in the metropolitan area of Limassol area with several stations placed in strategic places to be easily accessible to all Limassol residents. On the following map, all the docking stations where NextBike currently has conventional bikes are shown. E-bikes will be integrated at these stations as well. They cannot be separated because users can park e-bikes wherever they want.

	
❗ Which (physical and digital) infrastructure is needed?	**Digital infrastructures:** There is no need to develop a new app, since Nextbike has its own app **Physical infrastructure:** 50 e-bikes will be deployed E-bike charging-docking stations
❗ Who will be responsible for developing and managing this new infrastructure?	Nextbike will be responsible for developing and managing the shared e-bike service and Limassol municipality will decide the locations of the e-bike stations within the municipal limits.
❗ What (physical & digital) infrastructure needs to be modified	Docking stations of e-bikes
❗ Who will be responsible for these infrastructure modifications?	Nextbike will be responsible for the installation of the e-bike docking-charging stations and the Limassol city municipalities are responsible of giving access and electricity for the docking stations.
❗ Which metaInnovation technology (WP2) is being tested linked to this UC?	None. The NextBike application, which is already in use for conventional bikes installed in the city, will be integrated into the platform of UC 001. However, no meta-innovation will be applied to UC 002. Furthermore, the second Use Case for Limassol will be integrated in the Digital Twin Platform for Optimization

How: Operation and Management

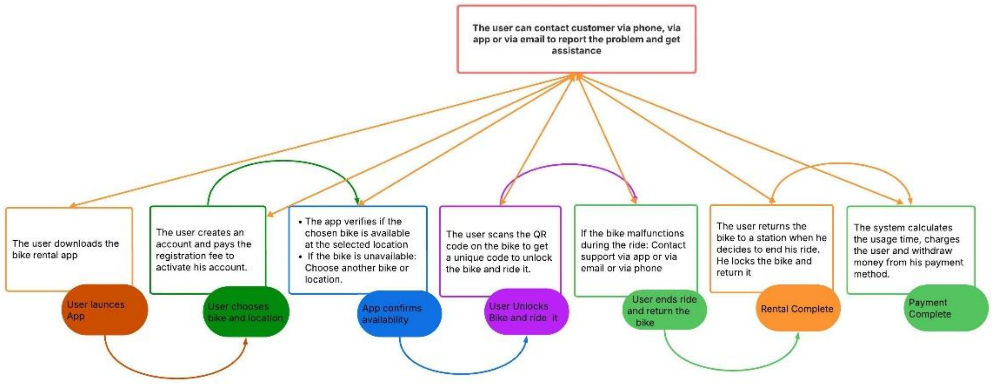
<table>
<tr><td>❗ How the Service will function (under normal conditions - operation on a daily basis)</td><td>
</td></tr>
<tr><td>❗ Please review the Prototype stakeholder map and make changes</td><td>The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.</td></tr>
</table>

Second Stage of Why – What – How Framework

What: Foreseen Internal Risks and Mitigation Actions

<table>
<tr><td colspan="4">Internal Risk (Technical issues, operability, service reliability):</td></tr>
<tr><td></td><td>Severity</td><td>Likelihood</td><td>Mitigation action</td></tr>
<tr><td>Real-time data (e.g., bike location or availability) is not updated correctly</td><td>High</td><td>Low</td><td>Use reliable cloud hosting services with high uptime guarantees.
Set up redundant servers and automatic failover system
The app is already ongoing and all of these have been integrated</td></tr>
<tr><td>Bikes are shown as available in the app but are physically not present or already rented.</td><td>High</td><td>Low</td><td>Implement real-time inventory tracking and notify users of nearby alternatives.</td></tr>
</table>

❗ How the Service will function (under the anomalous scenario)	



In case of anomalous scenario.

Step 1. The user creates an account and pays the registration fee to activate his account.

In case anything goes wrong, the user can contact customer support via phone, via app or via email to report the problem and get assistance.

Step 2. The app verifies if the chosen bike is available at the selected location.

If the bike is unavailable: Choose another bike or location. In case anything goes wrong, the user can contact customer support via phone, via app or via email to report the problem and get assistance.

Step 3. The user scans the QR code on the bike to get a unique code to unlock the bike and ride it.

In case anything goes wrong, the user can contact customer support via phone, via app or via email to report the problem and get assistance.

Step 4. If the bike malfunctions during the ride: the user can contact customer support via phone, via app or via email to report the problem and get assistance.

Step 5. The user returns the bike to a station when he decides to end his ride. He locks the bike and returns it.

In case anything goes wrong, the user can contact customer support via phone, via app or via email to report the problem and get assistance.

Step 6. The system calculates the usage time, charges the user and withdraw money from his payment method.

In case anything goes wrong, the user can contact customer support via phone, via app or via email to report the problem and get assistance.

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severity	Likelihood	Mitigation action
Theft or Vandalism	High	Medium	Insurance Policies: NextBike can cooperate with insurance providers to cover liabilities like accidents or theft
Weather conditions	Low	Low	• Inform users applications of weather updates and recommend caution during adverse conditions. • Provide waterproof covers for bikes or design them to handle mild rain.
Other external risks (Legislation, competitors (others))			
	Severity	Likelihood	Mitigation action
Competitors	Low	Low	There is not any other shared service with e-bikes within the city.

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated? •	The initial investment for shared e-bikes includes: • the e-bikes, • the docking stations, • and the installation of the docking stations. These investments are funded by the MetaCCAZe project, specifically through the NextBike partner. The project provides e-bikes, docking stations, and funding for the implementation. The management of this Use Case will be handled by NextBike. No software development will be required, as NextBike already has an app for conventional bikes, into which the e-bikes will be integrated. **During the pilot phase, NextBike will cover the costs of supply.** Software will not be developed as, NextBike provides already an application with conventional bikes where the e-bikes will be integrated as well.
What is included in this budget? (technology-based, consider running the service) •	• Marketing campaign – involved in the project • e-bikes – involved in the project • Docking stations- involved in the project • Testing phase – involved in the project • Monitoring and evaluation phase- involved in the project • Electricity – it is not involved in the project • Technical support, will be funded by the metaCCAZE project for its duration • Stakeholder engagement - involved in the project • Integrate the e-bikes into NextBike's application. - it is not involved in the project • Online tutorials – involved in the project • Physical workshops –involved in the project

How was the project funded? Under which funding schemas and co-financing?	The metaCCAZE project is co-funded by the European Union under the Horizon Europe Framework Programme, specifically The Horizon Europe Mission on Climate-Neutral and Smart Cities.
Do you need any human resources? If yes, what type of human resources are needed?	There will be employees directly involved in the project, responsible for all necessary actions related to its implementation. They will also oversee the test phase and manage the e-bike service. Additionally, employees will handle the app that citizens and tourists will use to rent e-bikes. All these human resources are included in the metaCCAZE project budget.
Please specify any additional costs not outlined above	An additional cost for the shared e-bikes is the electricity bill for charging them. NextBike will be responsible for charging the e-bikes.
Was the pricing of the proposed service defined? If yes, what is the pricing of the proposed service (for the user)	The pricing for the proposed service has been defined by the metaCCAZE partner NextBike, which will be responsible for the e-bikes. Renting an e-bike will cost €2.50 for 30 minutes and €32 for the entire day. Therefore, there will be a daily subscription.
Are there any incentives planned? If yes, would they motivate users to prefer this mobility solution more frequently? Why?	There are no incentives planned for the service; only some events will be organized to promote the use of the shared e-bikes. For example, once the e-bikes are installed at the docking stations, an event offering free e-bike rides will be held. Representatives from the Ministry of Transport and the Municipality of Limassol will be invited. Through this event, the risk of user acceptance is going to be mitigated. Finally, by using the shared e-bikes, users will save money by utilizing one of the cheapest modes of transportation.

3.8.2. Metadesigned BIGM

SECTION	DESCRIPTION
Summary of the BIGM	The updated Business Innovation and Governance Model (BIGM) for LI-UC02 Shared E-Bikes in Limassol enhances urban mobility through a subscription-based and pay-per-use model with dockless e-bike network integrated with public transit, using IoT sensors for fleet management. Municipality of Limassol benefits from reducing air pollutant emissions in order to achieve the goals of the Climate City Contract.
Governance Model	Operator-led daily operations with municipal oversight on parking compliance and enforcement (Figure 25).
Business Innovation Model	The business model centres on subscription-based and pay-per-minute pricing, with revenue from user fees, NextBike operates the service, leveraging its existing app to minimize development costs (Figure 26).
Changes from Prototype BIGM	**Governance Model**:

SECTION	DESCRIPTION
	• Remove the role of electricity provider since the bikes will be dockless. • Streamlined stakeholder roles **Business Model**: • Added 50 e-bikes (previously unspecified quantity). • Explicit use of NextBike's existing app (replaces plans for a new app). • Additional activity for on-demand e-bike charging and battery management

Table 17: LI-UC02 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Service Provider	Bike-Sharing Operator	NextBike	Manage daily operations, bike redistribution, on-demand charging, and app updates.	✅ Confirmed
Key Partner	Municipality	Municipalities of Limassol	Approve e-bikes locations, enforce safety regulations, promote the service. Benefits from reducing air pollutant emissions in order to achieve the goals of the Climate City Contract.	✅ Confirmed
Key Partner	Technology provider	NextBike	Develop and maintain digital platforms and IoT systems, including real-time data platforms and AI tools.	✅ Confirmed
Customer	Users	Users	Uses the service	⏳ Future Engagement

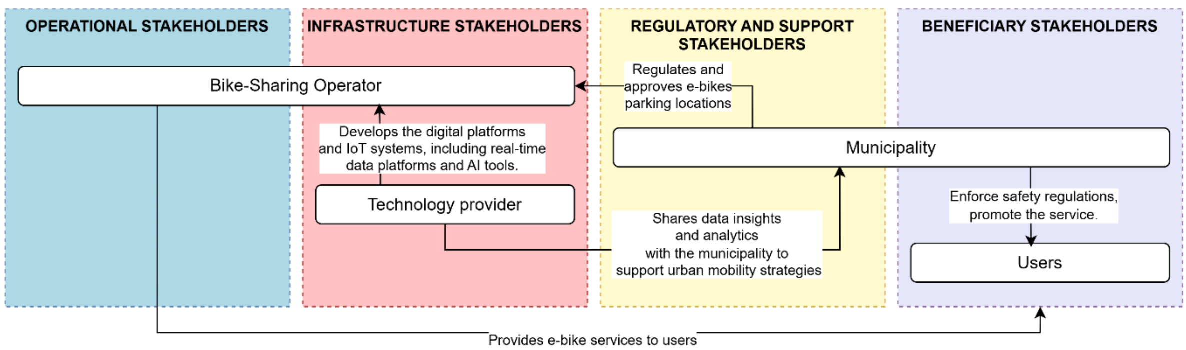


Figure 25: LI-UC02 - Governance Model

<table>
<tr>
<td rowspan="2">Key Partners
-Municipalities (Provides regulatory approval for station locations, enforces safety regulations, and supports service promotion)
-Technology provider (Develop Digital platform)</td>
<td>Key Activities
-Daily operations management and bike fleet maintenance
- Strategic bike redistribution to ensure availability
- On-demand e-bike charging and battery management
- App development and regular software updates
- Development and maintenance of IoT systems and real-time data platforms</td>
<td rowspan="2">Value Propositions
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.</td>
<td>Customer Relationships
- Self-service digital interface
- Automated system for bike access and returns
- Customer support through app and service centres
- User accounts with riding history and preferences
- Feedback mechanisms for service improvement</td>
<td rowspan="2">Customer Segments
-Local residents for daily commuting
- Tourists and visitors
- Students and young professionals
- Environmentally conscious citizens
- Occasional users for recreational purposes</td>
</tr>
<tr>
<td>Key Resources
-E-Bike Fleet
-Docking Stations
-Digital platforms (mobile app and backend systems)
-IoT infrastructure for real-time tracking and monitoring
-Operational staff for maintenance and redistribution
- Charging infrastructure
- AI and data analytics tools</td>
<td>Channels
-Mobile application
- Physical docking stations across Limassol
- Website platform
- Municipal information channels
- Tourism information points</td>
</tr>
<tr>
<td colspan="2">Cost Structure
-Capital expenditure for e-bikes
- Maintenance and repair of bicycle fleet
- Digital infrastructure development and maintenance
- IoT systems operation costs
- Staff wages (operations, maintenance, customer support)
- Electricity for e-bike charging
- Marketing and user acquisition</td>
<td colspan="3">Revenue Streams
-Pay-per-use riding fees
-Subscription models (daily, weekly, monthly)
- Advertising revenues</td>
</tr>
</table>

Figure 26: LI-UC02 - Business Model

3.9. Multimodal passenger hub (LI-UC03)

3.9.1. Metadesigned Use Case

First Stage of Why – What – How Framework

Why: Challenges and Objectives

Questions	Considerations
❗ What specific challenges faced by the city will this Use Case address?	The city aims at decreasing the dependency of car use and increasing the use of public transportation to achieve the climate neutrality goals. Furthermore, the use case serves the goals of the SUMP and the Climate City Contract, which aims to enhance mobility and the overall quality of life for residents and visitors alike.
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case?	• **Reducing Traffic Congestion:** Promote the use of public transport and micromobility solutions to reduce congestion. • **Accessibility:** Ensure all transportation options are accessible to a diverse range of users. • **Environmental Sustainability:** Lower carbon emissions through sustainable transport choices. Reduce noise and pollution, cutting environmental and social costs. • **Improved Quality of Life:** Enhance livability through sustainable urban mobility strategies.

	• **Smooth Integration:** Foster seamless integration between various transportation modes. • **Micromobility Enhancement:** Develop strategies to increase the micro-mobility modal split. Boost the number of shared e-bikes. • **Smart Technologies:** Incorporate innovative technologies into sustainable transportation strategies. • **E-Vehicle Support:** Expand the number of electric vehicle charging stations. • **Mode Shift:** Encourage a shift from individual motorization to safer, more efficient, and environmentally friendly transport modes. Improve interconnectivity between public transport, walking, and cycling.

What: The Concept and Its Definition

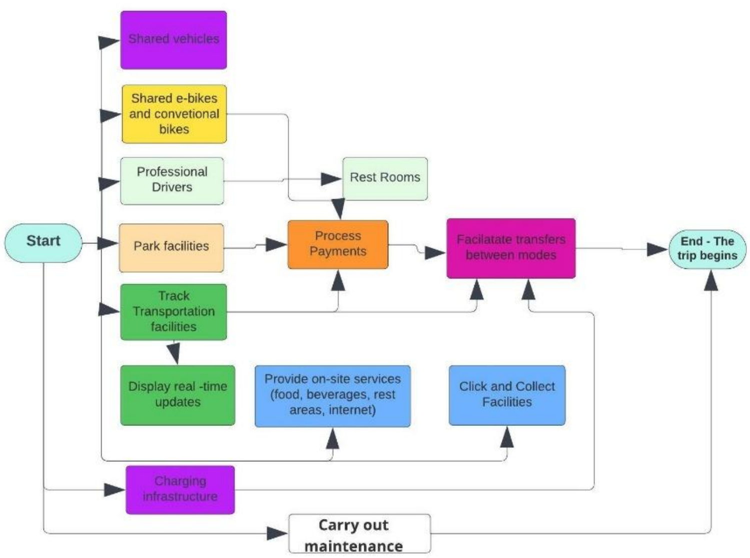
Use Case Code	LI- UC03
Use Case Title	Multimodal passenger hub
❗ Use Case Concept Definition	Limassol's third UC will establish a Mobility Hub in Limassol to centralize various transportation modes and ensure seamless connectivity for travellers. The hub will facilitate transfers between buses, bicycle 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. It integrates multiple transportation modes into a single, user-friendly location, promoting connectivity, sustainable practices and convenience. In the city there is any multimodal passenger hub. There is any multimodal passenger hub in the city of Limassol.
❗ Location (and its influence area)	The location which is decided is the Tsireio stadium. It is located close to highway, and it is close to a central entrance of the city. There is sufficient space to create a parking station, electric urban bus station and to create space for canteens, parcel collection and public toilets. This space has direct access to the bus lanes and cycle paths proposed in the Sustainable Urban Mobility Plan. This area can serve as a starting station for bus lines serving different directions (east, west and south) within the city centre.

	
❗ Which (physical and digital) infrastructure is needed?	**Physical infrastructure** ○ Parking spaces for private cars, buses, bikes and scooters. ○ Parking spaces for shared vehicles and TAXIS. ○ EV charging stations for e-vehicles ○ Bike sharing docking stations for e-bikes and conventional ○ Covered waiting areas ○ Restrooms for professional drivers ○ WC ○ ATM ○ Space for food trucks or mobile coffee and food vendors ○ Click & collect boxes. ○ Bus stations – covered ○ Green spaces, seating areas, lighting , outdoor drinking water taps. ○ Advertising signs. ○ Real time information system providing live updates on schedules, routes and availability of parking spaces, smart parking sensors. ○ Security cameras. In the hub one docking station for e-bikes is going to be installed and another for conventional bikes. **Digital Infrastructure:** • WeeDrive Platform (UC 001) • Application NextBike • Energy and Transport Platform • Digital Twin Platform
❗ Who will be responsible for developing and managing this new infrastructure?	The Municipality of Limassol will be responsible for developing the new infrastructure within the framework of the project and the allocated budget. Private companies, such as NextBike, will be responsible for the bikes and e-bikes, while the Public Transport Operator will manage the bus stations and screens with real-time information.
❗ What (physical & digital) infrastructure needs to be modified	**Physical Infrastructure:** Parking facilities will be equipped with sensors providing real-time information. Ramps will be installed to ensure accessibility.

	Digital Infrastructure: The NextBikes application will integrate docking stations for both e-bikes and conventional bikes, providing real-time information. The platform from the first use case will integrate the hub's facilities. The Energy and Transport platform, developed in the fourth use case, will integrate e-vehicle charging stations. The Digital Twin platform will integrate some of the hub's facilities.
❗ Who will be responsible for these infrastructure modifications?	• Municipality of Limassol: Responsible for installing physical infrastructure which has to deal with the designing of the hub. • NextBike: Responsible for docking stations for e-bikes and conventional bikes. • Public Transport Operator: Responsible for bus stations, real-time information screens and restrooms • Individual Professional Drivers: Responsible for managing taxi stations. • Private companies providing shared cars • Private companies providing advertising signs • Private companies
❗ Which metaInnovation technology (WP2) is being tested linked to this UC?	• WeeDrive (Use Case 01) • Application NextBike • Energy and Transport Platform (Use Case 04) • Digital Twin Platform • Supply-demand matching platform for on-demand shared zero-emission services

How: Operation and Management Stakeholder Interaction

<table>
<tr>
<td>❗ How the Service will function (under normal conditions - operation on a daily basis)</td>
<td>

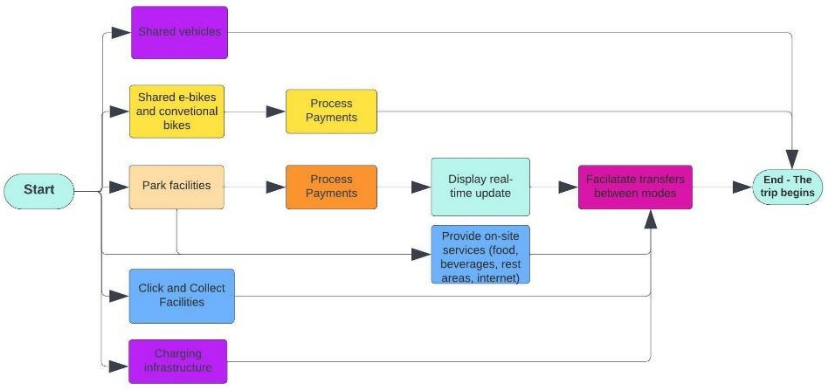


Daily Operations Begin (24/7)

Track Transportation Schedules

Display real-time updates (screens, mobile apps, kiosks)
Regulate Traffic and transport movement ??

</td>
</tr>
</table>

	Users enter hub Facilitate transfers between modes Process payments Carry out maintenance (such as cleaning) Provide on-site services (food, beverages, rest areas, internet) Ensure user safety and assistance (staff, emergency protocols) Users Depart
❗ How the User will interact (under normal conditions - operation on a daily basis)	 Users arrive at Mobility Hub Navigate to desired transport mode (bus, bike, shared vehicle etc) Check real-time information (Digital displays – Applications) Choose transport mode Pay for travel via different payment methods such as unified ticket, smart card or mobile apps) Use amenities (food, rest areas, Wi-Fi etc) Travel to next destination. Check notifications (delays, routes updates etc)
❗ Please review the Prototype stakeholder map and make changes	The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.

Second Stage of Why – What – How Framework

What: Foreseen Internal Risks and Mitigation Actions

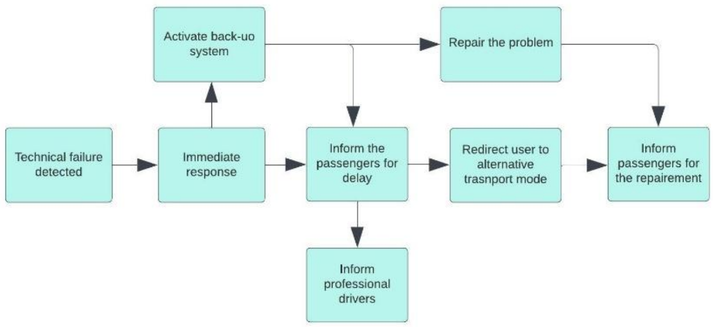
Internal Risk (Technical issues, operability, service reliability):			
	Severity	Likelihood	Mitigation action
The agreement between the Ministry of Transport and the land owner has not yet been finalized	Low	Low	There are internal discussions suggesting that the construction of some Park-and-Ride locations will create pressure to expedite the

			construction of the multimodal passenger hub.
The use of digital infrastructure by users	Low	Low	Online tutorials about the use of digital infrastructure and workshops

<table>
<tr><td>❗ How the Service will function (under the anomalous scenario)
•</td><td>Types of anomalous scenarios

Inconvenience in time schedules.

(Risk 2) How the service will function:



Technical failure detected
Alert hub operations team (via monitoring system or manual detection)
Immediate response (investigation & identify the issue)
Inform the users about delay or reduced services
Activate back-up systems
Redirect users to alternative transport
Repair the problem and restore normal operation
Inform users</td></tr>
<tr><td>❗ How the User will interact (under the anomalous scenario)</td><td>Users must be alerted to the issue through information displayed on digital screens, sent via an application, or conveyed by staff. If the journey is affected, users must be guided to new travel routes. During the disruption, users should be provided with comfort and amenities to minimize inconvenience.</td></tr>
</table>

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severity	Likelihood	Mitigation action
Citizen' s aceptante	Low	Low	Applying a successful marketing campaign The parking facilities can be free for a certain timeline

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated?	The budget available from the MetaCCAZE project will be used for the entire design and construction of the hub and the marketing campaign for the Use Case

	The Ministry of Transport will install some physical infrastructure like ramps for the entrance in the parking facilities. The monthly expenses (running costs) of the place will be identified by an internal agreement among the municipality and the land owner. To ensure that the mobility hub will be maintained, there should be a source of income that will be utilised for this purpose. As such, in this design phase, we have identified that the mobility hub will have spaces for food trucks/food canteens/cafe, spaces for parcels collection boxes and advertising boards in order these to be rent out to the private sector and the income to be utilised for the maintenance. The maintenance expenses will be covered by a third party, subcontracted by the landowner.
What is included in this budget? (technology-based, consider running the service)	a. Bus stops - kiosks b. Screens with real time information c. Taxi station d. Docking stations for e-bikes and conventional bikes e. Cafe f. Green areas g. Benches h. Spaces lighting i. Water refresher machine j. WC k. Billboards l. Electrical installations m. Hydrological facilities n. Parking facilities o. Parkings sensors p. Cycling paths in the hub q. Testing phase r. Monitoring s. Shared e-bikes Marketing campaign
Do you need any human resources? If yes, what type of human resources are needed?	Human resources will not be directly involved in the use case. The professional drivers and café owners are considered external human resources and are not directly engaged with the use case. Security for the site will be managed through technological devices, while the ramps to be implemented will be managed by the municipality and the Ministry.
Was the pricing of the proposed service defined? If yes, what is the pricing of the proposed service (for the user)	The pricing for the third use case has not yet been identified. However, there may be options for monthly or weekly subscriptions for parking facilities. The transport modes provided through the hub will be priced by the respective stakeholders and public transport operators supplying the buses. Furthermore, private companies will determine the pricing for shared cars and taxis.
Are there any incentives planned? If yes, would they motivate users to prefer this mobility solution more frequently? Why?	There are considerations to provide incentives, though not directly financial. The idea is to use something like credits. A concern has been raised about introducing a card system that can store credits whenever the hub is used, offering an incentive for the multimodal passeger hub. Furthermore, the parking facilities can be used for free during the initial phase of the multimodal passenger hub.

3.9.2. Metadesigned BIGM

SECTION	DESCRIPTION
Summary of the BIGM	A centralised hub integrating buses, e-bikes, and car-sharing to streamline connectivity and reduce car dependency. This initiative combines a collaborative governance structure, featuring multi-stakeholder oversight and service level agreements (SLAs), with a service-dominant business model that generates revenue from fees, advertisements, and subsidies.
Governance Model	The governance model of LI-UC03 is a multi-stakeholder framework that coordinates operational, infrastructure, regulatory, and beneficiary stakeholders to manage and optimise a mobility hub. Each group has defined roles, with the municipality and ministries providing oversight, infrastructure stakeholders managing assets, operational stakeholders delivering services, and users benefiting from integrated mobility and related services (Figure 25).
Business Innovation Model	SDBM/R with revenue from user fees and advertising. Costs include charging infrastructure and tech maintenance (Table 19).
SDBM/R Co-Created Value in use	Last mile zero-emissions delivery through logistics hubs
Changes from Prototype BIGM	**Business Model**: • Additional revenue streams from rent to food and beverage vendors, Banks and from advertisements **Governance Model**: • Expanded partnerships with food/beverage vendors for added amenities

Table 18: LI-UC02 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Focal	Mobility Hub Operator	*To be confirmed - Multiple options being explored currently.*	Manages daily operations (cleaning, maintenance, security).	⏱ In Discussion
Core Partners	Municipality	Municipality of Limassol	Grants permits, ensures policy alignment, funds infrastructure, and oversees hub construction.	✅ Confirmed
	Landowner	GSO	Provides land for the mobility hub.	✅ Confirmed

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
	Public Transport Operator	EMEL	Integrates bus schedules and ticketing systems.	✅ Confirmed
	Technology Providers	MaaSLab	Develop/maintain digital platforms and IoT systems.	✅ Confirmed
	Ministry of Transport	Cyprus Ministry of Transport Communications and Works	Regulatory oversight and funding support.	✅ Confirmed
	Electricity Authority	Electricity Authority of Cyprus	Supplies energy.	✅ Confirmed
	Bike-Sharing Operators	NextBike	Manage e-bike docking/charging stations.	✅ Confirmed
	Charging Stations Provider	Charging Stations Provider	Maintains EV charging infrastructure.	✅ Confirmed
	Taxi Companies	Taxi Companies	Offer taxi services in dedicated zones.	⏳ Future Engagement
	Parking Manager	Parking Manager	Manages parking facilities with real-time availability monitoring.	📪 To Be Contacted
	Carsharing Companies	Carsharing Companies	Offer on-demand vehicle rentals.	✅ Confirmed
	Ministry of Finance	Cyprus Ministry of Finance	Grants permits for financing hub construction.	✅ Confirmed
Enriching Partners	Educational Institutes	MaaSLab	Conduct user-behaviour research for service optimization	✅ Confirmed

Co-funded by the European Union

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
	Food and beverages companies	Food and beverages companies	Renting canteens in the hub or space dedicated for food trucks	✅ Confirmed
	Post Companies	Post services	Renting areas for operating and manage click and collect parcels	✅ Confirmed
	Banks	Banks	Offer ATM services at the hub	✅ Confirmed
Customer	Users (Commuters, Tourists)	Users (Commuters, Tourists)	Provide feedback via surveys and app interactions	✅ Confirmed
Other	Local Businesses	Local Businesses	Using advertising signs	⏳ Future Engagement

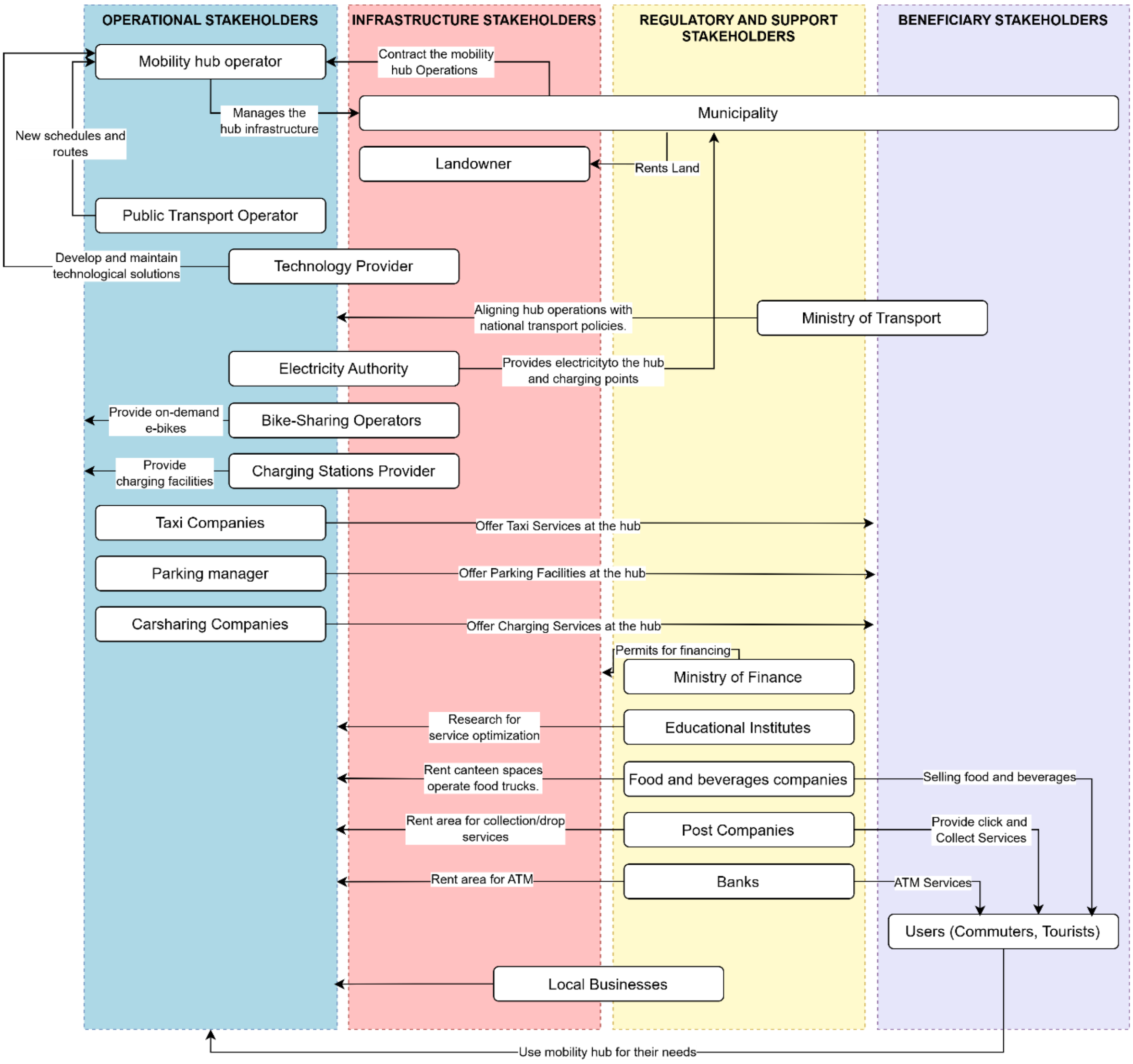


Figure 27: LI-UC03 - Governance Model

Note for the LI-UC03 Business Model: Service-Dominant Business Model Radar (SDBM/R) – shown as a table for ease of reading.

Table 19: LI-UC03 Business Model

STAKEHOLDER TYPE	COST – / BENEFIT (+)	CO-PRODUCTION ACTIVITY	VALUE PROPOSITION
Mobility Hub Operator	– Staffing and operational costs. + Reliable service delivery and user satisfaction.	Coordinating with service providers and resolving technical issues.	Seamless hub functionality and user safety.

STAKEHOLDER TYPE	COST − / BENEFIT (+)	CO-PRODUCTION ACTIVITY	VALUE PROPOSITION
Municipality	− Administrative costs for permits and infrastructure funding. + Progress towards climate neutrality and enhanced public transport adoption.	Policy development, funding allocation, and stakeholder coordination.	Reduced car dependency, alignment with SUMP and CCC goals.
Landowner	− Opportunity cost of land use. + Increased property value and contribution to urban sustainability.	Leasing land and collaborating on hub design.	Centralized location for seamless multimodal connectivity.
Public Transport Operator	− Operational costs for schedule integration and staff training. + Higher ridership and streamlined operations.	Updating schedules, integrating ticketing, and managing bus services.	Improved transit efficiency and real-time data sharing.
Technology Providers	− Software development and maintenance costs. + Enhanced user experience and operational efficiency.	Deploying digital twin platforms and optimizing hub operations.	Real-time passenger information and AI-driven demand prediction.
Ministry of Transport	− Policy enforcement costs. + Strengthened national mobility strategies.	Aligning hub operations with national transport policies.	Compliance with EU emissions targets and SUMP integration.
Electricity Authority	− Grid upgrade and maintenance costs. + Increased adoption of EVs and grid stability.	Installing and maintaining charging infrastructure.	Reliable energy supply for charging stations.
Bike-Sharing Operators	− Bike maintenance and charging costs. + Expanded user base and reduced car trips.	Operating docking stations and redistributing bikes.	Last-mile connectivity via shared bikes.

STAKEHOLDER TYPE	COST (−) / BENEFIT (+)	CO-PRODUCTION ACTIVITY	VALUE PROPOSITION
Charging Stations Provider	− Equipment procurement and maintenance costs. + Enhanced EV adoption and reduced emissions.	Installing, operating, and repairing charging stations.	Reliable charging solutions for electric vehicles.
Taxi Companies	− Vehicle operation and app integration costs. + Increased ridership and reduced idle time.	Booking taxis via hub apps and adhering to designated pickup areas.	Seamless connectivity for first/last-mile trips.
Parking Manager	− Sensor installation and system maintenance costs. + Efficient parking management and reduced traffic delays.	Installing sensors, updating occupancy data, and enforcing parking rules.	Optimized parking utilization and reduced congestion.
Carsharing Companies	− Vehicle acquisition and maintenance costs. + Additional revenue streams and reduced private car ownership.	Integrating carsharing platforms with hub services.	Flexible mobility options for hub users.
Ministry of Finance	− Administrative costs for financial oversight. + Secure funding for sustainable urban development.	Approving funding allocations and monitoring budget compliance.	Ensures financial feasibility for hub infrastructure.
Educational Institutes	− Research and data analysis costs. + Improved service alignment with user needs.	Conducting surveys, analysing travel patterns, and refining service design.	Data-driven insights for optimizing hub services.
Food and Beverage Companies	− Rental fees and operational costs. + Increased customer foot traffic and sales.	Managing food outlets and collaborating on hub amenities.	Enhanced traveller convenience and revenue opportunities.

STAKEHOLDER TYPE	COST − / BENEFIT (+)	CO-PRODUCTION ACTIVITY	VALUE PROPOSITION
Post Companies	− Infrastructure setup and maintenance costs. + Streamlined logistics and reduced delivery congestion.	Operating parcel lockers and coordinating logistics.	Convenient click-and-collect services for hub users.
Banks	− ATM installation and transaction fees. + Improved customer satisfaction and accessibility.	Installing and maintaining ATMs.	Financial convenience for travellers.
Users	− No direct costs (service fees absorbed by operators). + Reduced travel time and improved accessibility.	Providing feedback via surveys and app interactions.	Convenient, sustainable travel options with real-time information.
Local Businesses	− Rental fees for advertising space. + Enhanced brand exposure and sales.	Leasing advertising spaces and promoting local offerings.	Increased visibility and customer reach.

3.10. Transport and Energy Platform (LI-UC04)

3.10.1. Metadesigned Use Case

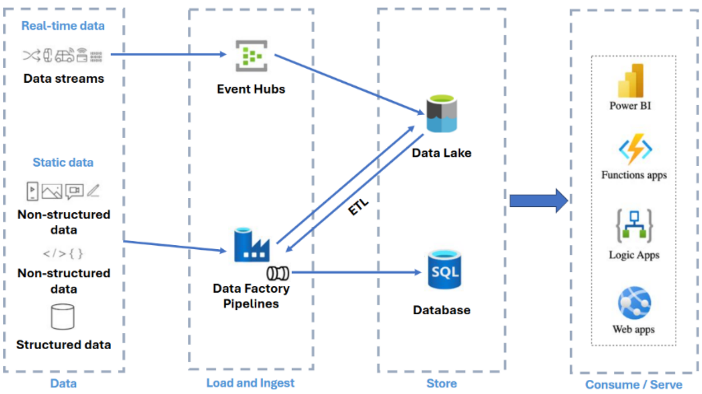
First Stage of Why – What – How Framework

Why: Challenges and Objectives

Questions	Considerations
❗ What specific challenges faced by the city will this Use Case address?	Increasing vehicle numbers lead to congestion, delays, and inefficient travel. Peaks in energy demand from EV charging stations can stress the city's energy grid. High operational costs for transport providers and energy suppliers. Lack of public engagement in sustainable energy and transport practices. High levels of noise from conventional vehicles in urban areas.
❗ Which (at least 5) objectives does the city aim to achieve	• Reduce air pollution • Optimize charging grid increasing use during non-peak grid hours or when renewable energy sources power the grid.

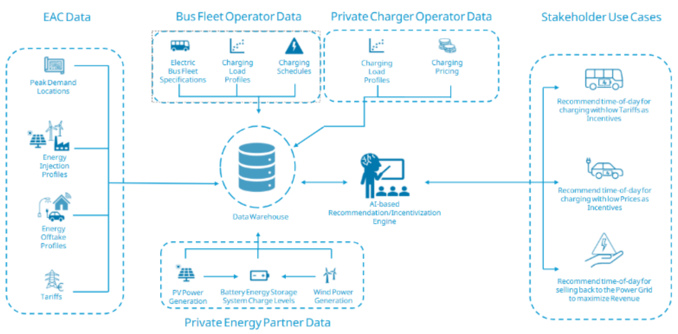
through this Use Case?	• Decrease the high car modal share (91.8%) by enhancing public transport appeal. • Incorporate smart technologies in sustainable transportation strategies • Reduce noise pollution

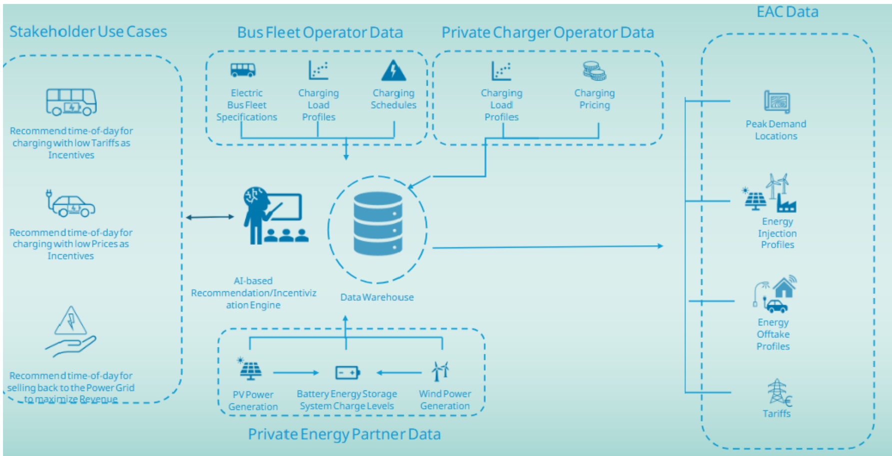
What: The Concept and Its Definition

Use Case Code	LI-UC04
Use Case Title	Transport and Energy Platform
❗ Use Case Concept Definition	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.
❗ Location (and its influence area)	The metropolitan area of Limassol
❗ Which (physical and digital) infrastructure is needed?	Digital Infrastructure  The Data Warehouse architecture comprises of the Data, Load and Ingest, Store and Consume/Serve components. Microsoft Azure Ecosystem selected for use in the Load and Ingest (Event Hubs, Azure Data Factory), Store (Azure Blob Storage) and Consume/Serve (Power BI, Azure Functions, Azure Logic & Web apps)
❗ Who will be responsible for developing and managing this new infrastructure?	Developing infrastructure: MaaSlab Managing infrastructure: MaaSLab

❗ What (physical & digital) infrastructure needs to be modified	Non- physical infrastructure will be used Digital infrastructure: Compatible endpoints with the API and connectors of the warehouse.
❗ Who will be responsible for these infrastructure modifications?	Responsible for modifications: MaaSLab
❗ Which metaInnovation technology (WP2) is being tested linked to this UC?	• Decentralised AI optimisation for grid-fleet-demand (NTUA) • AI recommendation and incentivitation engine • AI data models and warehouse • APIs and Connectors • Electric Vehicle Scheduling (NTUA) • Integrate and Plan: Digital Twin Platform for Optimization

How: Operation and Management

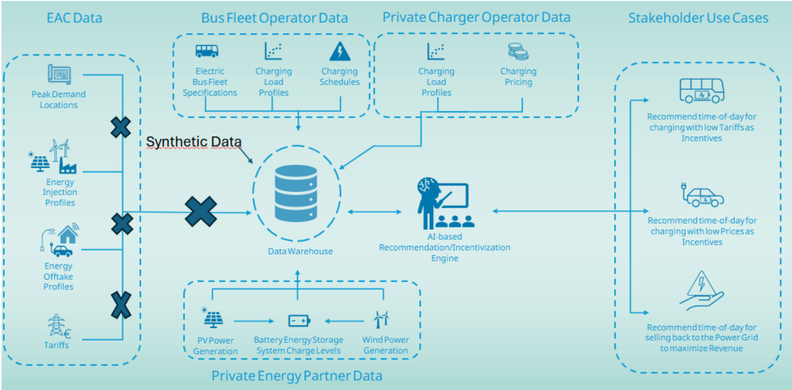
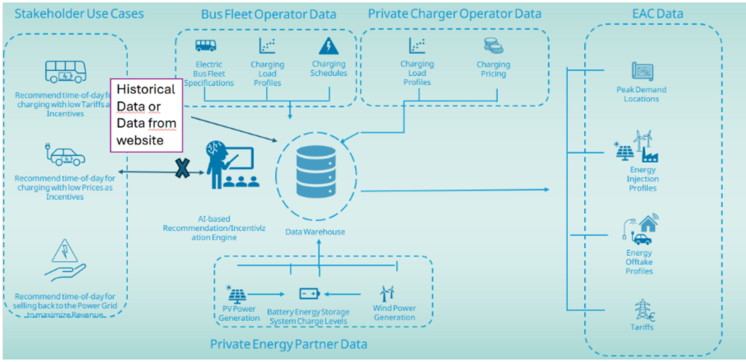
❗ How the Service will function (under normal conditions - operation on a daily basis)	 The conceptual framework architecture describes the use of Peak Demand Locations, Energy Injection Profiles, Energy Offtake Profiles and Tariffs data from the EAC, as well as Bus Fleet & Private Chargers Operators and Private Energy Partners Data to train the AI-based Recommendation Engine Models for the use cases of time-of-day recommendation for bus fleet operators and private EV vehicles charging as well as time-of-day for selling energy back to the grid

❗ How the User will interact (under normal conditions - operation on a daily basis)	 The user (private user, bus fleet operator) will be receiving recommendations on the WeePlatform regarding time-of-day for charging their vehicles, based on a set of criteria (sustainable electricity mix, impact on grid, cost savings). The user (private energy partner will receive recommendations regarding time-of-day for selling power back to the grid with the goal of maximizing revenue.
❗ Please review the Prototype stakeholder map and make changes	The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.

Second Stage of Why – What – How Framework

What: Foreseen Internal Risks and Mitigation Actions

Internal Risk (Technical issues, operability, service reliability):			
	Severity	Likelihood	Mitigation action
Unavailable Data	M	M	Perform testing of Data Warehouse and AI- based recommendation engine using synthetic data sets
Real time Data unavailable due to sensor fault	M	M	Implement statistical approaches for Data Imputation

❗ How the Service will function (under the anomalous scenario)	 In case of anomalous scenarios during data ingestion, resilience of the AI-based Recommendation Engine can be achieved through the use of synthetic data derived from historical data corresponding to the same day and times as the anomaly occurrence
❗ How the User will interact (under the anomalous scenario)	 In case of anomalous scenarios during recommendation provision, resilience of the AI-based Recommendation Engine can be achieved through the use of historical data from past recommendations at the same day and time as the anomaly occurrence

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severity	Likelihood	Mitigation action
User Acceptance	Medium	Low	Reduced charging costs, will be given to users (EV owners) Lower Energy Costs: Both utilities and fleet operators can achieve substantial cost savings. Reduced Operational Costs: Lower operational costs for fleet operators.
Other external risks (Legislation, competitors (others))			

	Severity	Likelihood	Mitigation action
[define risk]	[L. M, H]	[L. M, H]	

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated?	• The development of software (Transport and Energy Platform) • Training phase for professional drivers and Public Transport Operator (online tutorials and hands-on workshops) • Internet connection • Technical support • Marketing campaign – stakeholder engagement • Testing phase • Monitoring
What is included in this budget? (technology-based, consider running the service)	• The development of the software (Transport and Energy Platform) includes software licenses that are necessary for the development of the service • Training phase for professional drivers and Public Transport Operator • Marketing campaign – stakeholder engagement • Testing phase • Monitoring
How was the project funded? Under which funding schemas and co-financing?	The metaCCAZE project is co-funded by the European Union under the Horizon Europe Framework Programme, specifically The Horizon Europe Mission on Climate-Neutral and Smart Cities.
What is the cost per unit?	There is no cost per unit; the cost for this Use Case is associated with the development of the Energy and Transport Platform. The partner responsible for the development and management of the platform is MaaSlab.
Do you need any human resources? If yes, what type of human resources are needed?	Hiring costs and employee salaries will be charged to the metaCCAZE project through MaaSlab, the institute responsible for developing the platform. During the implementation, human resources will not be directly allocated to this Use Case, except for professional drivers and employees from the public transport operator who will use the platform.
Are there any incentives planned? If yes, would they motivate users to prefer this mobility solution more frequently? Why?	• Incentives, likely financial ones such as reduced charging costs, will be given to users (EV owners). • Lower Energy Costs: By taking advantage of off-peak rates and demand response programs, both utilities and fleet operators can achieve substantial cost savings. • Reduced Operational Costs: Improved efficiency in fleet management and maintenance translates to lower operational costs for fleet operators.

3.10.2. Metadesigned BIGM

SECTION	DESCRIPTION
Summary of the BIGM	The BIGM for LI-UC04 highlight a collaborative approach to urban mobility and sustainability. The governance model features a multi-stakeholder structure with operational leadership from MaaSLab and the Electricity Authority, regulatory oversight from the municipality and ministry, academic validation of algorithms, and IoT infrastructure support. Meanwhile, the business innovation model focuses on optimising charging schedules for EV owners and fleet operators, while contributing to the city's climate goals.
Governance Model	A multi-stakeholder governance structure where MaaSLab and the Electricity Authority lead operations, with municipality and ministry providing regulatory oversight, whilst academic institutions validate algorithms, and IoT providers support infrastructure implementation (Figure 28).
Business Innovation Model	MaaSLab, as the service provider, creating value through optimised charging schedules for private EV owners and fleet operators, generating revenue indirectly revenue from third-party usage whilst contributing to grid stability and climate goals. MaaSLab will exploit anonymized data to generate revenue to support this service (Figure 29).
Changes from Prototype BIGM	**Governance Model**: • Added formal validation process with MaaSLab to ensure algorithm effectiveness and security • Implemented clearer regulatory compliance framework with the Ministry of Transport **Business Model**: • Added incentives for EV owners and Bus fleets • Expanded revenue streams to include consulting services based on platform data • Enhanced value proposition

Table 20: : LI-UC04 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Service Provider	Technology Provider	MaaSLab	Develop the WeePlatform, maintain AI algorithms and platform security.	✅ Confirmed
Key Partner	Municipality	Municipality of Limassol	Enforce compliance with urban sustainability policies, provide mobility data, and promote the service. Reduce air pollutant emissions to meet Climate City Contract goals.	✅ Confirmed

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
	Electricity Authority	Electricity Authority of Cyprus	Manage grid stability and renewable integration.	✅ Confirmed
	Ministry of Transport	Cyprus Ministry of Transport Communications and Works	Provide regulatory oversight and mobility data.	✅ Confirmed
	Research Institutions and Universities	MaaSLab	Validate energy-saving algorithms and user behaviour models.	✅ Confirmed
	Internet of Things provider	Internet of Things provider	Provide and install sensors.	📪 To Be Contacted
	EV Charging Infrastructure Providers	EV Charging Infrastructure Providers	Provide and install EV Charging points. Exchange data with technology provider.	⏱ In Discussion
Customer	Private EV Owners (Users)	Private EV Owners (Users)	Adopt optimised charging schedules via the platform.	✅ Confirmed
	Public Transport Operators	EMEL	Integrate fleet charging with grid capacity.	✅ Confirmed

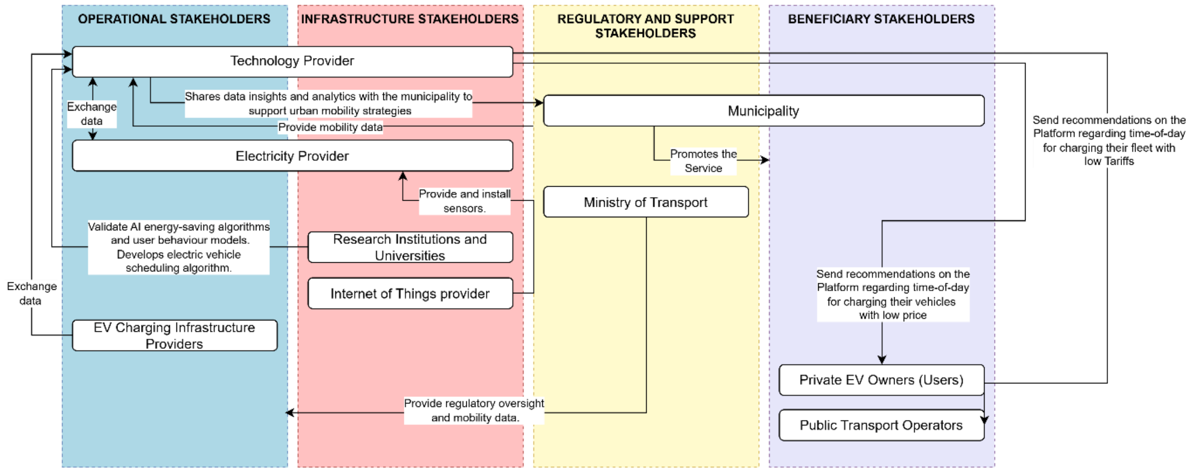


Figure 28: LI-UC04 - Governance Model

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
-Electricity Authority -Public Transport Operator. -Technology Providers -EV Charging Infrastructure Providers -Research Institutions and Universities - Municipality - Ministry of Transport	-Data Collection and Analysis -Platform Development and Maintenance -Algorithm Development - Real-time monitoring of energy usage via IoT sensors. - Validation of algorithms and user behaviour models by Research Insitutions/Universities -Stakeholder Engagement -User Support and Education **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.	**Users (EV Owners & PT Operators)** - Cost Savings / Improved route planning - Reduction of Environmental Impact - Incentives and Rewards: Access to demand response programs **- Electricity Provider (Grid Operator)** - Grid Stability / Optimize energy distribution and avoid peak load stress. - Low-carbon energy system. **Municipality** - Reduced Traffic Congestion/ Improved Air Quality	- Self-service through the Platform for scheduling and monitoring charging sessions. - Personalized Recommendations to users - Customer support for technical assistance via the platform - Regular updates on platform developments, policy changes, and incentives. **Channels** - Online Platform - Website platform for information and dissemination. - Municipal communication channels to promote the service to residents	- **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. - **Electricity Provider (Grid Operator)**: Entities responsible for managing the power grid and ensuring energy supply. - **Municipality**: Authorities interested in promoting sustainable transportation and energy policies.

Cost Structure	Revenue Streams
- 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	- Data exploitation for consulting services

Figure 29: LI-UC04 - Business Model

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

3.11.1. Metadesigned Use Case

First Stage of Why – What – How Framework

Why: Challenges and Objectives

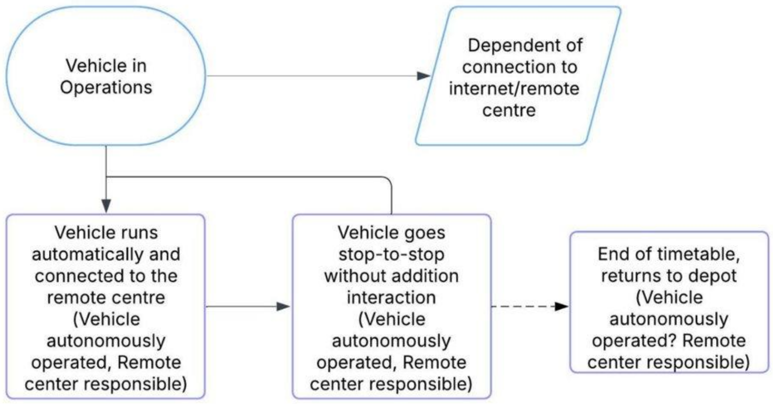
Questions	Considerations
❗ What specific challenges faced by the city will this Use Case address?	The city of Tampere is aiming towards reaching the sustainability and emissions reduction goals. Key tasks of metaCCAZE focusing on this are linked to lowering car use and car dependency, while increasing the modal share of public transport through the new piloted technologies. **Improved Accessibility -** Autonomous shuttles are designed to provide seamless connectivity to disconnected areas, addressing gaps in the public transportation network. **Operational Efficiency in Public Transport -** Real-time monitoring and automation reduce the need for human intervention in shuttle operations. This reduces costs, improves reliability, minimizes delays, and enhances the overall user experience.
❗ Which (at least 5) objectives does the city aim to achieve through this Use Case?	• To increase public transport / tram passenger usage in pilot areas. • To reduce car dependency of travel in pilot areas • To ensure actual and perceived safety of the piloted system • To evaluate cost-effectiveness of providing the pilot solutions • To ensure the working functionality of the autonomous charging and remote operation center supporting the pilots

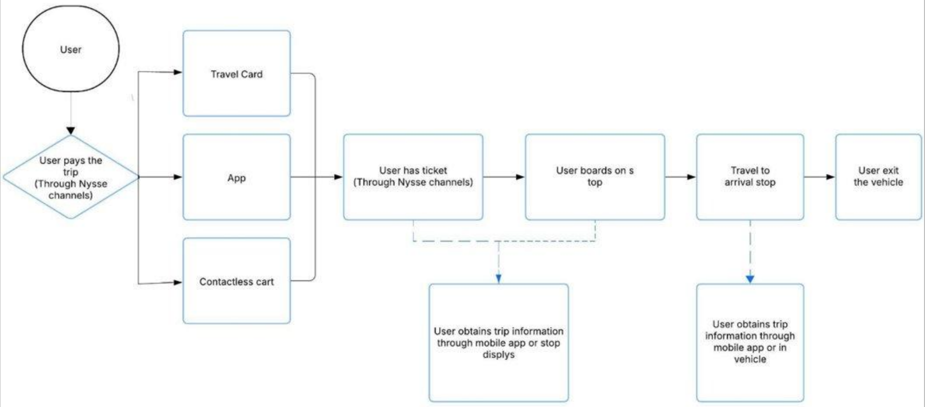
What: The Concept and Its Definition

Use Case Code	TA-UC01
Use Case Title	Autonomous e-shuttles with advanced remote control centre and inductive changing
❗ Use Case Concept Definition	This use case involves transitioning the role of the safety operator within an autonomous vehicle to a remote operations center. By doing so, Vehicles operate independently without the need for an onboard human operator, relying on advanced sensors, AI, and connectivity for navigation, safety, and decision-making. By relocating safety operators to a centralized facility, the system improves efficiency, reduces the need for on-site personnel, and allows monitoring multiple vehicles simultaneously while reducing the operational cost.
❗ Location (and its influence area)	Most likely, Hervanta, Tampere. Hervanta is chosen as it would be a good size with large demand of different user groups. Our plan is to have all pilot cases around Hervanta, thus the charging solutions and depot for vehicles could be shared between use cases.
❗ Which (physical and digital) infrastructure is needed? ○	Charging will need electricity grid access for the needed power, while remote operation centre would need stable connections. For street infrastructure, some minor modifications may be needed, such as bus stop, parking limitations etc. that will be specified when the route is fixed. Vehicle-wise, we aim 4 in total, 2 per use case, which will be obtained by the operating partner Remoted. Both the charger and vehicles also host a set of sensors (location, power, speed…) providing data that are collected through the pilots.

❗ Who will be responsible for developing and managing this new infrastructure?	Infrastructure in general is managed by the city (in case of bus stop or curb changes), Remoted (operating partner) will be responsible of remote operation and charging solutions development, but some solutions (such as charging system or parts of it) can be purchased from an existing provider.
❗ What (physical & digital) infrastructure needs to be modified	Bus stops and possible parking limitations etc. to allow the buses to operate. We aim to operate on existing infrastructure as-is, but some adaptations might be needed.
❗ Who will be responsible for these infrastructure modifications?	City of Tampere will be the one responsible of the action, Remoted will be cooperating on defining the needed changes
❗ Which metaInnovation technology (WP2) is being tested linked to this UC?	Both the remote operation center and inductive charging. In WP2, Remoted is highly included in this (as well as TAU in researching these areas). Remoted will also be operating the buses, creating a direct link.

How: Operation and Management

❗ How the Service will function (under normal conditions - operation on a daily basis)	 The flow chart shows the daily operational workflow of the autonomous vehicle service under normal conditions. It starts with the vehicle entering operation, during which it remains connected to the internet and the remote-control centre, which oversees its functionality. The vehicle operates autonomously, traveling from stop to stop without requiring additional manual interaction. The remote operation centre remains responsible for monitoring and intervening only if necessary. At the end of the timetable, the vehicle automatically returns to the depot, concluding its operational cycle.
❗ How the User will interact (under normal conditions - operation on a daily basis)	

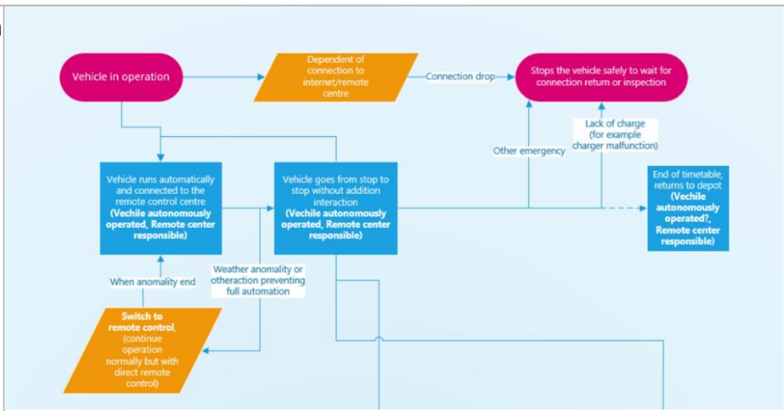
<table>
<tr><td></td><td>

The flow chart shows how users interact with the autonomous vehicle service during normal daily operations. The process begins when the user pays for their trip using one of the Nysse payment channels, such as a travel card, mobile app, or contactless card. Once the user has their ticket, they wait at a designated stop. User can access trip information through the mobile app or display screens available at the stop. After boarding user can see the trip information inside the vehicle itself. During the journey, the vehicle autonomously travels to the chosen arrival stop, where the user exits the vehicle</td></tr>
<tr><td>❗ Please review the Prototype stakeholder map and make changes</td><td>The detailed stakeholder map is presented in the following section, titled 'Meta designed BIGM,' and is accompanied by the Governance and Business Innovation Model.</td></tr>
</table>

Second Stage of Why – What – How Framework

What: Foreseen Internal Risks and Mitigation Actions

Internal Risk (Technical issues, operability, service reliability):			
	Severity	Likelihood	Mitigation action
Vehicles not suitable for metaInnovation tests	High	Low	***More cooperation with the vehicle manufacturers***
Weather problems	Low to High	Med to High	Remote control operations + redesign of affected parts

<table>
<tr><td>❗ How the Service will function (under the anomalous scenario)</td><td>

The flow chart shows how the autonomous vehicle service operates during anomalous scenarios (unexpected situations). Under normal conditions,</td></tr>
</table>

	the vehicle runs autonomously while connected to the remote-control center, traveling from stop to stop without interruptions. However, if an issue arises, such as a connection drop, lack of charge (e.g., charger malfunction), or another emergency, the vehicle safely stops and waits for the connection to return or for an inspection. In cases where weather anomalies or other factors prevent full automation, the system switches to remote control mode, allowing the remote center to directly operate the vehicle. Once the anomaly ends, the vehicle resumes normal autonomous operation.
❗ How the User will interact (under the anomalous scenario)	The above anomality's should not affect user experience as long as the bus can run in remote operation, users however may be informed through the bus that the vehicle is remote operated.

What: Foreseen External and Other Risks and Mitigation Actions

External Risk (user acceptance: complex interface, trust,):			
	Severity	Likelihood	Mitigation action
Lack of users to test pilots	High	Low	***More information/marketing***
Other external risks (Legislation, competitors (others))			
	Severity	Likelihood	Mitigation action
Not suitable test areas	Low	Low	***Continuous conversation with the PT office***

How: Investment, Costs, and Pricing

What kind of initial investment might be anticipated?	Initial budget is needed to obtain vehicles and required technical solutions (remote operation centre + charging solutions), which are upfront expenses, through Remoted's budget. For running the pilots in a viable business case -manner, some additional funding is required, such as funding/subvention/ticket revenue through PT office. This would also allow the operation to continue after the project. These are calculated through Remoted's budget. Some minor infrastructure revisions might go through city budget, supporting task (such as research and development) through university.
What is included in this budget? (technology-based, consider running the service)	- Automated vehicles and related licenses - Remote Operation Center - Automated Charging Technologies - Personnel costs for Remote Operators
How was the project funded? Under which funding schemas and co-financing?	- MetaCCAZE project funding - Companys own funding

What is the cost per unit?	This cannot be defined at the current state as final costs of vehicles, technologies and required personnel costs are not well known
Do you need any human resources? If yes, what type of human resources are needed?	Yes, remote operators and other staff members are needed for running the operation
Was the pricing of the proposed service defined? If yes, what is the pricing of the proposed service (for the user)	- The service is aimed to be integrated into the existing public transport services, and the end user will pay for it as part of the standard ticket price
Are there any incentives planned? If yes, would they motivate users to prefer this mobility solution more frequently? Why?	- The incentive for the end user to use the service is convenient compared to the existing services.

3.11.2. Metadesigned BIGM

SECTION	DESCRIPTION
Summary of the BIGM	The metadesigned BIGM for TA-UC01 provides enhanced stakeholder roles for seamless integration into Tampere's public transport network, with emphasis on regulatory compliance, user safety, and energy efficiency.
Governance Model	Collaborative framework led by Remoted (operator), with coordination between Nysse (public transport authority), City of Tampere (permits/funding), Traficom (regulatory oversight), and technology providers (Figure 30).
Business Innovation Model	The Business Model is focusing on ticket revenue integrated into public transport systems, subsidies, and partnerships for inductive charging infrastructure (Figure 31).
Changes from Prototype BIGM	**Governance Model**: • Enhanced focus on regulatory compliance through collaboration with Traficom. • Increased stakeholder involvement in managing infrastructure modifications and operational oversight. **Business Model**: • Inclusion of inductive charging technology as a core component. • Greater emphasis on partnerships with technology providers for operational efficiency

Table 21: TA-UC01 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Service Provider	Public Transport Authority	Nysse	Integrates service with existing transport, app, and ticketing systems; sets vehicle requirements.	✅ Confirmed
Key Partner	Municipality	City of Tampere	Issues permits, supports infrastructure updates, and provides funding.	✅ Confirmed
	Vehicle Manufacturers	Vehicle Manufacturers	Develops autonomous shuttles, control centres, and inductive charging.	⏳ Future Engagement
	Transport and Communications Agency	Traficom	Sets regulations for autonomous vehicles.	✅ Confirmed
	Autonomous Fleet Management Entity	Remoted	Operates e-shuttles and manages remote-control centre.	✅ Confirmed
	Inductive charging Provider	Remoted & existing provider	Maintains charging infrastructure.	✅ Confirmed
	Electricity Provider	Electricity Provider	Supplies energy for charging.	⏳ Future Engagement
	Telecommunication Provider	Telecommunication Provider	Provides 5G connectivity.	⏳ Future Engagement
	Consultants	Consultants	Offers public transport planning and user experience expertise.	⏳ Future Engagement
	Standardization bodies	SAE, PAS, EU	Ensures technical and safety compliance.	✅ Confirmed

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Customer	End Users/Passengers	Users	Use the autonomous shuttle service.	⌛ Future Engagement

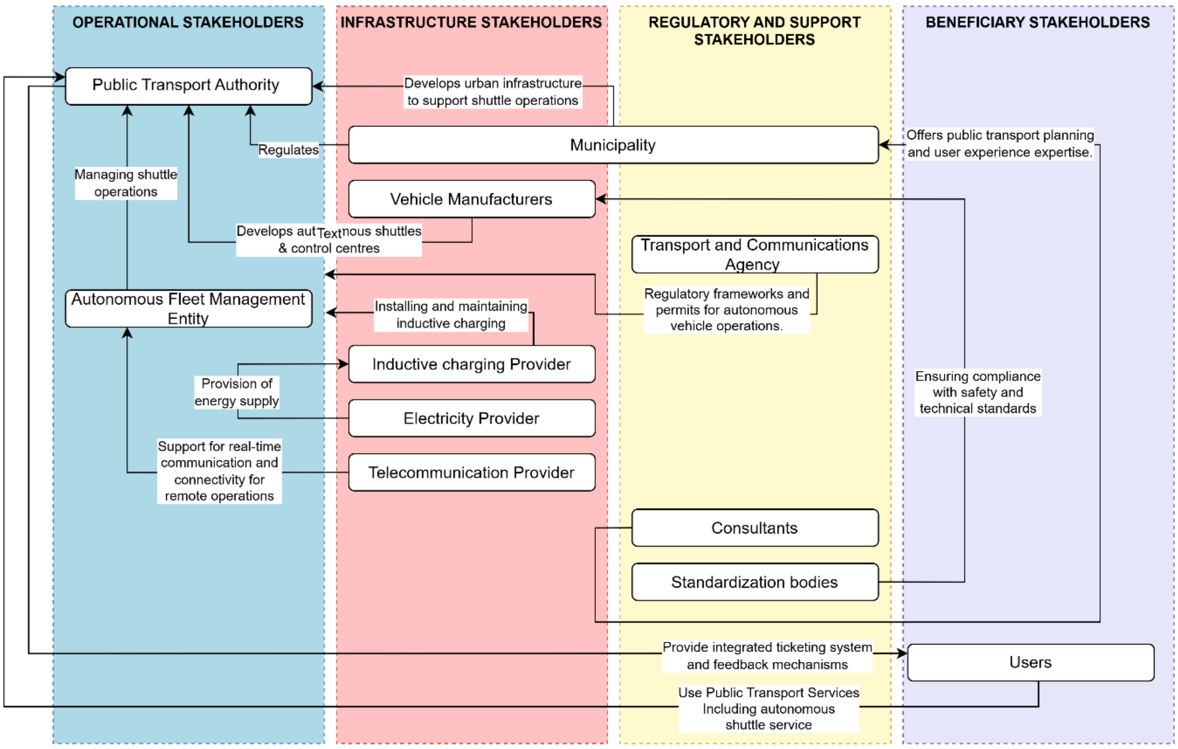


Figure 30: TA-UC01 - Governance Model

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
- Municipality - Vehicle Manufacturers - Transport and - Communications Agency - Autonomous Fleet Management Entity - Inductive charging Provider - Electricity Provider - Telecommunication Provider - Consultants - Standardization bodies	- Operating autonomous e-shuttles - Managing the remote control centre with trained operators - Ensuring regulatory compliance and safety standards - Integrating with existing public transport ticketing systems - Conducting real-time monitoring of vehicle operations **Key Resources** - Autonomous e-shuttles - Advanced remote control centre technology and infrastructure - Inductive charging technology and equipment - 5G connectivity infrastructure - Specially trained remote operators	**Users** - Zero-emission transportation option supporting climate neutrality goals - Enhanced accessibility to public transport - Safe, reliable autonomous service with remote oversight - IIntegration with existing ticketing system (no additional cost to users)	-Service integrated within existing public transport relationship - Self-service through public transport ticketing platforms - Real-time information and updates through transport information channels - Support through existing customer service infrastructure **Channels** - Existing public transport ticketing system and mobile app - Public transport information displays at stops and on vehicles - Dedicated shuttle stops - Marketing campaigns by Nysse promoting the integrated service - City of Tampere's communication channels for public awareness	**Users** - Tram passengers requiring first/last mile connectivity - Students and university community - Local residents within the service area - Visitors and tourists to Tamper

Cost Structure	Revenue Streams
- Initial investment: Autonomous vehicles and equipment - Remote operation centre setup and maintenance - Inductive charging infrastructure installation and maintenance - Operational costs: Electricity, remote operators' salaries, maintenance - Technology licenses and software updates - 5G connectivity services - Insurance and regulatory compliance - Marketing and communication costs	-Integration with Nysse's standard public transport ticketing (no premium pricing) - City of Tampere funding support for climate-neutral mobility initiatives - Public transport authority (Nysse) subsidies and operational funding

Figure 31: TA-UC01 - Business Model

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

3.12.1. Metadesigned Use Case

First Stage of Why – What – How Framework

The two use cases are highly similar to each other, only with different types of pilot areas. The answers for the previous use case (TA-UC01) in this section is applicable as well in TA-UC02.

3.12.2. Metadesigned Use BIGM

SECTION	DESCRIPTION
Summary of the BIGM	Optimized governance for tram-shuttle synchronization, energy-efficient operations, and user-centric service to enhance first/last-mile connectivity.
Governance Model	Collaborative framework led by Remoted (operator), with coordination between Nysse (public transport authority), Tampere Tramway Ltd, City of Tampere (permits/funding), Traficom (regulatory oversight), and technology providers (Figure 32).
Business Innovation Model	Business Model Canvas prioritizing fare harmonization with trams and increasing the use of Tram using the tram-feeder service (Figure 33).

SECTION	DESCRIPTION
Changes from Prototype BIGM	**Governance Model**: • Enhanced focus on regulatory compliance through collaboration with Traficom. • Increased stakeholder involvement in managing infrastructure modifications and operational oversight. **Business Model**: • Inclusion of inductive charging technology as a core component. • Greater emphasis on partnerships with technology providers for operational efficiency

Table 22: TA-UC02 - List of stakeholders and roles

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
Service Provider	Public Transport Authority	Nysse	Integrates service with existing transport, app, and ticketing systems; sets vehicle requirements.	✅ Confirmed
Key Partner	Municipality	City of Tampere	Issues permits, supports infrastructure updates, and provides funding.	✅ Confirmed
	Vehicle Manufacturers	Vehicle Manufacturers	Develops autonomous shuttles, control centres, and inductive charging.	⏳ Future Engagement
	Transport and Communications Agency	Traficom	Sets regulations for autonomous vehicles.	✅ Confirmed
	Autonomous Fleet Management Entity	Remoted	Operates e-shuttles and manages remote-control centre. Synchronize schedule with tram schedule.	✅ Confirmed
	Inductive charging Provider	Remoted & existing provider	Maintains charging infrastructure.	✅ Confirmed
	Electricity Provider	Electricity Provider	Supplies energy for charging.	⏳ Future Engagement
	Telecommunication Provider	Telecommunication Provider	Provides 5G connectivity.	⏳ Future Engagement

	STAKEHOLDER TYPE	IDENTIFIED STAKEHOLDER	ROLE	STATUS
	Consultants	Consultants	Offers public transport planning and user experience expertise.	⏳ Future Engagement
	Standardization bodies	SAE, PAS, EU	Ensures technical and safety compliance.	✅ Confirmed
	Tram Operator	Tampere Tramway Ltd	Operating the tram	✅ Confirmed
Customer	Users	Users	Use the autonomous shuttle service to reach the tram stops.	⏳ Future Engagement

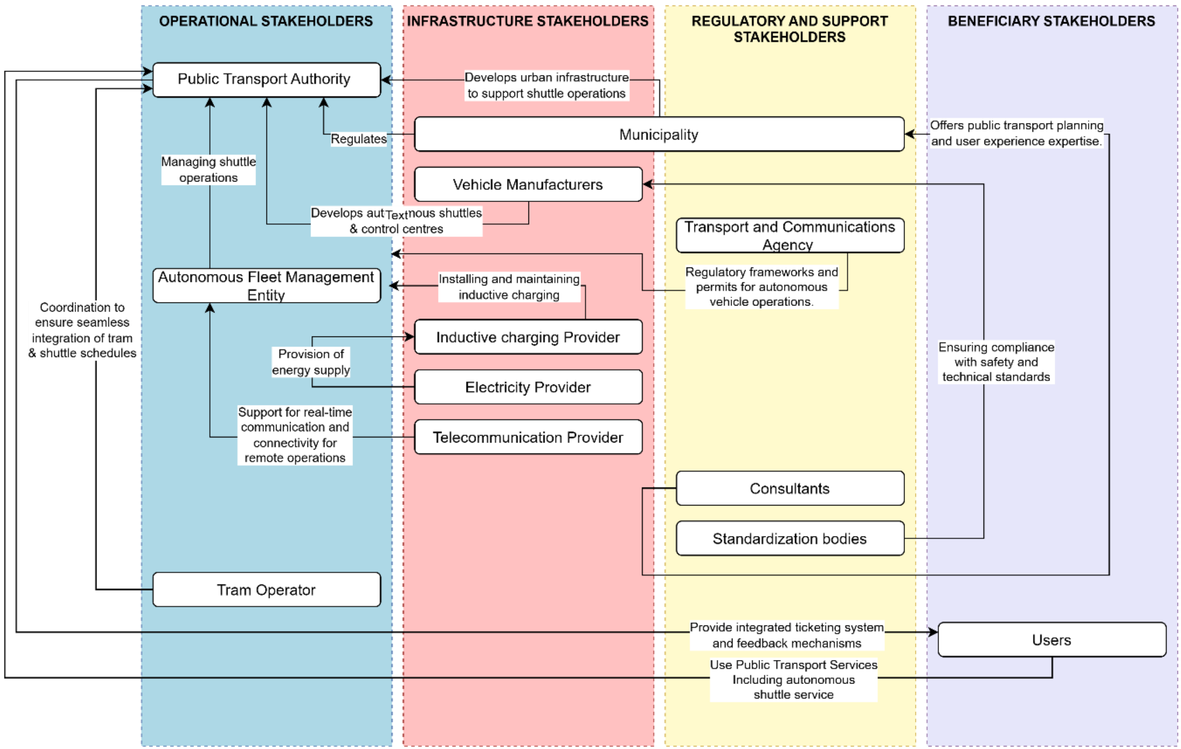


Figure 32: TA-UC02 - Governance Model

Key Partners

- Municipality
- Vehicle Manufacturers
- Transport and
- Communications Agency
- Autonomous Fleet Management Entity
- Inductive charging Provider
- Electricity Provider
- Telecommunication Provider
- Consultants
- Standardization bodies
- Tram Operator

Key Activities

- Operating autonomous e-shuttles as tram-feeder services
- Managing the remote control centre with trained operators
- Ensuring regulatory compliance and safety standards
- Integrating with existing public transport ticketing systems
- Conducting real-time monitoring of vehicle operations
- Synchronizing shuttle schedules with tram timetables

Key Resources

- Autonomous e-shuttles
- Advanced remote control centre technology and infrastructure
- Inductive charging technology and equipment
- 5G connectivity infrastructure
- Specially trained remote operators

Value Propositions

Users

- Seamless first/last mile connectivity to tram services
- Synchronized timetables for minimal waiting between shuttle and tram
- Zero-emission transportation option supporting climate neutrality goals
- Enhanced accessibility to public transport in areas without direct tram access
- Safe, reliable autonomous service with remote oversight
- lIntegration with existing ticketing system (no additional cost to users)

Customer Relationships

-Service integrated within existing public transport relationship
- Self-service through public transport ticketing platforms
- Real-time information and updates through transport information channels
- Support through existing customer service infrastructure

Channels

- Existing public transport ticketing system and mobile app
- Public transport information displays at stops and on vehicles
- Dedicated shuttle stops synced with tram stations
- Marketing campaigns by Nysse promoting the integrated service
- City of Tampere's communication channels for public awareness

Customer Segments

Users

- Tram passengers requiring first/last mile connectivity
- Commuters traveling to/from areas without direct tram access
- Students and university community
- Local residents within the service area
- Visitors and tourists to Tamper

Cost Structure

- Acquisition of the remote operation center, and inductive charging
- Technology Development and Maintenance of the ITS infrastructure
- Licenses renewal
- inductive charging technology installation and maintenance
- Data Management and Analysis
- User Support
- Administrative and Operational Costs

Revenue Streams

-Integration with Nysse's standard public transport ticketing (no premium pricing)
- City of Tampere funding support for climate-neutral mobility initiatives
- Public transport authority (Nysse) subsidies and operational funding

Figure 33: TA-UC02 - Business Model

4. Conclusions and next steps

This deliverable marks a key milestone in the metaCCAZE journey—transforming conceptual ideas and preliminary mappings into ready-for-deployment Use Cases, validated by stakeholder input and tailored to the real challenges of urban mobility transitions. The 12 Use Cases presented here represent scalable, practical, and forward-looking solutions for both passengers and freight, developed through a collaborative and iterative metadesign process. By integrating technical planning with governance models, impact evaluation, and behavioural readiness strategies, metaCCAZE has built a comprehensive foundation for the next phase of implementation.

The next foreseen related activities are described below:

- **Transfer to WP3**: The defined Use Cases and associated models will be handed over to WP3 for implementation and demonstration. Feedback loops will be established to ensure insights from real-life pilots can inform refinements to the methodology and templates.
    - As part of this process, both the Standardised Impact Evaluation Framework (SIEF) and the Social Embracement activities will be deployed after implementation. SIEF will enable the assessment of the actual impacts through predefined KPIs, allowing for a robust evaluation of what worked, what didn't, and why. In parallel, Social Embracement activities will revisit user readiness, behavioural incentives, and acceptance in real-life conditions, ensuring that the long-term adoption potential of the solutions is fully captured and understood.
- **Preparation of D1.5**: D1.4 serves as a foundational stepping stone for the upcoming Deliverable 1.5, which will focus on the adaptation of these Use Cases for the six Follower Cities. Insights and tools from this report will be instrumental in guiding that process.
- **Validation and final alignment with city partners**: All Use Cases and models will be reviewed by city partners to identify any last adjustments, especially concerning publicly shareable content. The Final validation will ensure readiness for both public dissemination and operational deployment.
- **Ongoing monitoring and cross-learning**: Partners will continue to use SIEF indicators and social acceptance tools to monitor progress, evaluate user feedback, and enable knowledge transfer between Trailblazer and Follower Cities.

Through this process, metaCCAZE is not only equipping cities with the tools to act but also fostering a learning ecosystem that supports long-term sustainability, innovation, and replication across Europe's urban mobility landscape.

5. Literature /References

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metaCCAZE (2024). D1.1. Status Quo Map, Prototype ZESM Use Cases for Passengers and Freight

metaCCAZE (2025). D1.3. Follower cities: status quo map and prototype ZESM use cases

6. Annex

The reader may find the following annexes to complete the deliverable

- Annex I - Available results from Social Embracement Survey
- Annex II – expected impacts and KPIs selected for each T-LL

6.1. Annex I - Available results from Social Embracement Survey Design

Dynamic Curbside Management (MU-UC01)

(MU-UC01) S1 - Stakeholders [draft version]		
Question in English	**Response type**	**Response options in English**
Introduction to the Survey & Acceptance of participation		
Introductory text		
I confirm I am above 18 years old.	Single Choice	[Yes, No]
I confirm I work for any of the following companies: * A delivery company operating in the district * A business located in the district * The parking enforcement agency of Munich (TBD)	Single Choice	[Yes, No]
I allow the researchers to process and collect my data in an anonymized way	Single Choice	[Yes, No]
Sociodemographic and work-related attributes		
How old are you? (Only numbers may be entered in this field. Your must be older than 18 to participate)	Numerical	
What nationality do you hold? If you hold several nationalities and one of them is German/EU-citizen, please, answer according to that one.	Single choice	[German, EU citizen, Non-EU citizen,Prefer not to answer]
What gender do you identify yourself with?	Single choice	[Woman,Man, Transgender, Non-binary/non-conforming, Prefer not to answer]
What of the following categories describe better your job type?	Single choice	[I am a driver of a parcel delivery company (UPS, Hermes, etc.), I work (not as a driver) for a parcel delivery company (UPS, Hermes, etc.), I am a driver for a B2B delivery company I work (not as a driver) for a B2B delivery company, Other (please, specify)]
What of the following vehicle types do you often use for your work? (You can select multiple options)	Multiple choice	[Normal service car,Small van (examples), Large van (example), Truck]
Considering the bellow map, how often do you deliver/park in zone **A**? *(Note, we might need to repeat this question if there are multiple DCM zones)*	Single choice	[Never, Rarely (<1 month), Sometimes (1-3 times per month), Weekly (4 times per month, Often (1-3 times per week), Daily (>3 times per week)]
Typically, how long do you need to stop/park in the district for your job purposes?	Single choice	[Very short stops (<1 min),Short stops (1-5 min), Mid stops (5-15 min), Long stops (15 min-1 h), Very long stops (>1 h)]
Parking behavior		
How difficult is it for you to find a suitable parking/stop location in the district?	Single choice	[Very difficult, Somewhat difficult, Neither difficult nor easy, Somewhat easy, Very easy]
Typically, how long do you need to find a parking spot in the district?	Single choice	[Less than 2 min,2 to 5 min, 5 to 10 min, Over 10 min]
How are you negatively affected by the double-parking of other delivery vehicles? *(Explanation of what double parking is)*	Single choice	[Not affected at all, Low affected, Moderately affected, Highly affected]
How often do you perform double-parking?	Single choice	[Never,Very Rarely, Rarely, Occasionally, Frequently, Very Frequently]
UC01 Questions		
Here we will briefly explain what UC01 is about and introduce the concept of Dynamic Curbside Management. Show a couple of picutres (app, DCM zones, etc.).		
Were you familiar with the concept of Dynamic Curbside Management (also with a different name)	Single choice	[Yes, No,Unsure]

(Only if we advertise the project beforehand). Are you aware of the upcoming pilot project to implement dynamic curbside management on your district?	Single choice	[Yes, No,Unsure]
According to the following map, near which of the following DCM zones do you usually park/stop for your deliveries? (you can select multiple options)	Multiple Choice	[Zone A, Zone B, ...]
How much do you think this pilot can contribute to reducing the time you need to find an available parking spot?	Single choice	[Not effect at all ,Slightly effective, Moderately effective, Very effective, Extremely effective]
How much do you think this pilot can contribute to reducing operational costs for your business?	Single choice	[Not effect at all ,Slightly effective, Moderately effective, Very effective, Extremely effective]
How much do you think this pilot can contribute to reducing traffic emissions and pollution the district?	Single choice	[Not effect at all ,Slightly effective, Moderately effective, Very effective, Extremely effective]
Contact Form		
If you want to receive a voucher for your participation in the survey, please, introduce your email address. The voucher will be sent to you between X and Y.	Open field	
We plan to conduct a similar survey in early 2026. Do you want us to contact you again? (You will be also offered a voucher for your participation)	Single choice	[Yes, No]
(MU-UC01) S2 – Citizens/Users [draft version]		
Question in English	**Response type**	**Response options in English**
Introduction to the survey		
Introductory text		
I confirm I am above 18 years old.	Single Choice	[Yes, No]
I confirm I live in the area shown in the map	Single Choice	[Yes, No]
I allow the researchers ... to process and collect my data (link to additional information) in an anonymized way.	Single Choice	[Yes, No]
Sociodemographic		
How old are you? (Only numbers may be entered in this field. Your must be older than 18 to participate)	Numerical	[18-99]
What nationality do you hold? If you hold several nationalities and one of them is German/EU-citizen, please, answer according to that one.	Single choice	[German, EU citizen, Non-EU citizen,Prefer not to answer]
What gender do you identify yourself with?	Single choice	[Woman,Man, Transgender, Non-binary/non-conforming, Prefer not to answer]
Do you have any physical mobility restriction?	Single choice	[No, Minor mobility restriction, Major mobility restriction]
What is your level of education? (Choose one of the following answers)	Single choice	[Basic education (lower than secondary), Secondary education or Professional Education, University (Bachelor and/or Master), PhD]
Are you currently registered as a student?	Single choice	[Yes, No]
How would you describe your job arrangement? (Choose one of the following answers)	Single choice	[Work and Study, Full time employment, Part time employment, Not working, Retired, Other]
How long have you been living in this district?	Single choice	[< 1 years, 1 to 5 years, > 5 years]
How many people (including you) live in your household?	Numeric	[1-99]
Do any children (under X years old) live in your household?	Single choice	[Yes, No]
In which range would you classify your household's total (bruto) annual income? (Choose one of the following answers)	Single Choice	[Under 20,000 Euros, 20,001 - 40,000 Euros, 40,001 - 60,000 Euros, 60,001 - 80,000 Euros]
According to the following map, which of the X zones shown is closer to your home? If multiple zones are approximately equally close, you can mark several of them	Multiple Choice	[Zone A, Zone B, ...]

Do you have a car driving license valid in Germany?	Single choice	[Yes, No]
Do you own or have access to a car in your household?	Single choice	[Yes, No]
Do you have a resident's parking permit?	Single choice	[Yes, No]
Do you own/rent/use a private parking (e.g., underground, off-street) to park your car near you house?	Single choice	[Yes, No]
Do you own or have access to a bike in your household?	Single choice	[Yes, No]
How often do you drive a car?	Single choice	[Daily, More than 3 times per week, Less than once a week]
How often do you commute by bicycle?	Single choice	[Daily, More than 3 times per week, Less than once a week]
How often do you commute by Public Transportation (U-bahn, S-bahn, Bus, Tram,...)?	Single choice	[Daily, More than 3 times per week, Less than once a week]
How commute by foot? (Walks longer than 10 min)	Single choice	[Daily, More than 3 times per week, Less than once a week]
Do you frequently use other transport modes to commute in the city? Which ones and how often?	Open field	
Which transport mode do you use most often to commute to work/education?	Single choice	[Car, Bike, PT, Walk, Other]
Which transport mode do you use most often for shopping purposes?	Single choice	[Car, Bike, PT, Walk, Other]
Which transport mode do you use most often participate in leisure activities (meet friends, go to sport activities, etc.)?	Single choice	[Car, Bike, PT, Walk, Other]
How often do you receive parcel deliveries at home (Amazon, food deliveries, etc.)?	Single choice	[At least once a week, At least once a month, Never]
Problem perception (Road Congestion + Double parking + Time searching for parking)		
Please, think about the neighborhood in which you live, not the general situation in Munich. What is your opinion about the following statements?		
I enjoy living in my neighborhood	Likert scale	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
Traffic congestion is an important problem in the XXX district.	Likert scale	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
It is very challenging for me to find available on-street parking to park my car	Likert scale	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
Typically, how long do you need to find a parking spot near your home?	Single choice	[Less than 2 min, 2 to 5 min, 5 to 10 min, Over 10 min]
Here we will briefly explain what double parking is and show a picture of a real DP situation in Munich.		
Have you seen double parking by delivery or service vehicles on your street?	Single choice	[Yes, No]
How often do you notice double parking by delivery or service vehicles on your street?	Single choice	[Never, Rarely, Sometimes, Often, Always]
How much do these activities disrupt traffic flow/Congestion on your street?	Single choice	[Not at all, Slightly, Moderately, Significantly, Extremely]
As a driver, how much does double parking affect you? [mention examples]	Single choice	[Not at all, Slightly, Moderately, Significantly, Extremely]
As a cyclist, how much does double parking affect you? [mention examples]	Single choice	[Not at all, Slightly, Moderately, Significantly, Extremely]
Do you think that double parking and logistic vehicle activities have a negative impact on the liveability of your street?	Single choice	[Yes, No,Unsure]
UC01 Questions		
Briefly explaination about the UC01		

Were you familiar with the concept of Dynamic Curbside Management (also with a different name)	Single choice	[Yes, No,Unsure]
(Only if we advertise the project beforehand). Are you aware of the upcoming pilot project to implement dynamic curbside management on your district?	Single choice	[Yes, No,Unsure]
How supportive are you of this pilot project?	Single choice	[Not supportive at all, Slightly supportive, Moderately supportive, Very supportive, Extremely supportive]
How much do you think this pilot can contribute to reducing congestion in your home district?	Single choice	[Not supportive at all, Slightly supportive, Moderately supportive, Very supportive, Extremely supportive]
How much do you think this pilot can contribute to reducing traffic emissions and pollution in your home district?	Single choice	[Not supportive at all, Slightly supportive, Moderately supportive, Very supportive, Extremely supportive]
How much do you think this pilot can contribute to improving safety for drivers, cyclists and pedestrians?	Single choice	[Not supportive at all, Slightly supportive, Moderately supportive, Very supportive, Extremely supportive]
How much do you think this pilot can contribute to improving livability in your home district?	Single choice	[Not supportive at all, Slightly supportive, Moderately supportive, Very supportive, Extremely supportive]
Do you have any concerns about the pilot project? If yes, please specify:	Open field	
Rickshaw		
Here we will briefly explain what purpose of the rickshaw is and show some photos/pictures		
What is your overall opinion of the proposed Rickshaw vehicle?	Single choice	[Very negative, Somewhat negative, Neither positive nor negative, Somewhat positive, Very positive]
How would you feel about sharing the street space (Driving/Walking/Cycling) next to the autonomous Rickshaw?	Single choice	[Very uncomfortable, Somewhat uncomfortable, Neither uncomfortable nor comfortable, Somewhat comfortable, Very comfortable]
How likely would you be to take a free rickshaw ride for short trips (less than 3 km) within the city center?	Single choice	[Very unlikely, Somewhat unlikely, Neither likely not unlikely, Somewhat likely, Very likely]
Contact Form		
If you want to receive a voucher for your participation in the survey, please, introduce your email address. The voucher will be sent to you between X and Y.	Open field	
We plan to conduct a similar survey in early 2026. Do you want us to contact you again? (You will be also offered a voucher for your participation)	Single choice	[Yes, No]

Multimodal Logistics Hubs (MU-UC02)

(MU-UC02) S3 - Stakeholders [draft version]		
Question in English	**Response type**	**Response options in English**
Introduction to the Survey & Acceptance of participation		
Introductory text		
I confirm I am above 18 years old.	Single Choice	[Yes, No]
I confirm I work for any of the following companies: * A delivery company operating in the X district * A business located in the X district * The parking enforcement agency of Munich (TBD)	Single Choice	[Yes, No]

I allow the researchers to process and collect my data (link to additional information) in an anonymized way.	Single Choice	[Yes, No]
Sociodemographic and work-related attributes		
How old are you? (Only numbers may be entered in this field. You must be older than 18 to participate)	Numerical	[18-99]
What nationality do you hold? If you hold several nationalities and one of them is German/EU-citizen, please answer according to that one.	Single choice	[German, EU citizen, Non-EU citizen, Prefer not to answer]
What gender do you identify yourself with?	Single choice	[Woman, Man, Transgender, Non-binary/non-conforming, Prefer not to answer]
Which of the following categories describe better your job type?	Single choice	[I am a driver of a parcel delivery company (UPS, Hermes, etc.), I work (not as a driver) for a parcel delivery company (UPS, Hermes, etc.), I am a driver for a B2B delivery company I work (not as a driver) for a B2B delivery company, Other (please, specify)]
Which of the following vehicle types do you often use for your work? (You can select multiple options)	Multiple choice	[Normal service car,Small van (examples), Large van (example), Truck]
Considering the bellow map, how often do you deliver/park in zone **A**? (*Note, we might need to repeat this question if there are multiple DCM zones)*	Single choice	[Never, Rarely (<1 month), Sometimes (1-3 times per month), Weekly (4 times per month, Often (1-3 times per week), Daily (>3 times per week)]
Typically, how long do you need to stop/park in the district for your job purposes?	Single choice	[Very short stops (<1 min),Short stops (1-5 min), Mid stops (5-15 min), Long stops (15 min-1 h), Very long stops (>1 h)]
UC02 Questions		
Here we will briefly explain what UC02 is about and introduce the concept of Multimodal Logistic Hubs.		
Were you familiar with the concept of Multimodal Logistic Hubs?	Single choice	[Yes, No, Unsure]
(Only if we advertise the project beforehand). Are you aware of the upcoming implementation of a Multimodal Logistic Hub in the X district?	Single choice	[Yes, No, Unsure]
How much do you think this pilot can contribute to reducing operational costs for your business?	Single choice	[Not effective at all,…,Extremely effective]
How much do you think this pilot can contribute to reducing traffic emissions and pollution in the district?	Single choice	[Not effective at all,…,Extremely effective]
How much do you think this pilot can contribute to reducing traffic congestion in the district?	Single choice	[Not effective at all,…,Extremely effective]
How much do you think this pilot can contribute to decreasing traffic noise in the district?	Single choice	[Not effective at all,…,Extremely effective]
How much do you think this pilot can contribute to increasing road safety in the district?	Single choice	[Not effective at all,…,Extremely effective]
What is your overall impression of the Multimodal Logistic Hub concept?	Single choice	[Not effective at all,…,Extremely effective]
Contact form		
If you want to receive a voucher for your participation in the survey, please enter your email address. The voucher will be sent to you between X and Y.	Open field	
We plan to conduct a similar survey in early 2026. Do you want us to contact you again? (You will again be offered a voucher for your participation)	Single choice	[Yes, No]

(MU-UC02) S4 – Citizens/Users [draft version]		
Question in English	**Response type**	**Response options in English**
Introduction to the Survey & Acceptance of participation		
Introductory text		

I confirm I am above 18 years old.	Single Choice	[Yes, No]
I confirm I live in the area shown in the map	Single Choice	[Yes, No]
I allow the researchers ... to process and collect my data (link to additional information) in an anonymized way.	Single Choice	[Yes, No]
Sociodemographic		
How old are you? (Only numbers may be entered in this field. Your must be older than 18 to participate)	Numerical	
What nationality do you hold? If you hold several nationalities and one of them is German/EU-citizen, please, answer according to that one.	Single choice	[German, EU citizen, Non-EU citizen,Prefer not to answer]
What gender do you identify yourself with?	Single choice	[Woman,Man, Transgender, Non-binary/non-conforming, Prefer not to answer]
Do you have any physical mobility restriction?	Single choice	[No, Minor mobility restriction, Major mobility restriction]
What is your level of education? (Choose one of the following answers)	Single choice	[Basic education (lower than secondary), Secondary education or Professional Education, University (Bachelor and/or Master), PhD]
Are you currently registered as a student?	Single choice	[Yes, No]
How would you describe your job arrangement? (Choose one of the following answers)	Single choice	[Work and Study, Full time employment, Part time employment, Not working, Retired, Other]
How long have you been living in this district?	Single choice	[< 1 years, 1 to 5 years, > 5 years]
How many people (including you) live in your household?	Numeric	
Do any children (under X years old) live in your household?	Single choice	[Yes, No]
In which range would you classify your household's total (gross) annual income? (Choose one of the following answers)	Single Choice	[Under 20,000 Euros, 20,001 - 40,000 Euros, 40,001 - 60,000 Euros, 60,001 - 80,000 Euros]
According to the following map, in which zone is your home located?	Multiple Choice	[Zone A, Zone B, ...]
Do you have a car driver's license valid in Germany?	Single choice	[Yes, No]
Do you own or have access to a car in your household?	Single choice	[Yes, No]
Do you have a resident's parking permit?	Single choice	[Yes, No]
Do you own/rent/use a private parking (e.g., underground, off-street) to park your car near you house?	Single choice	[Yes, No]
Do you own or have access to a bike in your household?	Single choice	[Yes, No]
How often do you drive a car?	Single choice	[Daily, More than 3 times per week, Less than once a week]
How often do you ride a bicycle?	Single choice	[Daily, More than 3 times per week, Less than once a week]
How often do you travel by Public Transportation (U-bahn, S-bahn, Bus, Tram,...)?	Single choice	[Daily, More than 3 times per week, Less than once a week]
How often do you travel by foot? (Walks longer than 10 min)	Single choice	[Daily, More than 3 times per week, Less than once a week]
Do you frequently use other transport modes to travel in the city? Which ones and how often?	Open field	
Which transport mode do you use most often to commute to work/education?	Single choice	[Car, Bike, PT, Walk, Other]
Which transport mode do you use most often for shopping purposes?	Single choice	[Car, Bike, PT, Walk, Other]
Which transport mode do you use most often to participate in leisure activities (meet friends, go to sport activities, etc.)?	Single choice	[Car, Bike, PT, Walk, Other]

How often do you receive parcel deliveries at home (Amazon, food deliveries, etc.)?	Single choice	[Car, Bike, PT, Walk, Other]
Problem perception (Road Congestion + Double parking + Time searching for parking)		
My neighbourhood is a nice place to live in.	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
Traffic congestion is an important problem in the XXX district.	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
It is very challenging for me to find available on-street parking to park my car	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
Typically, how long do you need to find a parking spot near your home?	Single choice	[Less than 2 min, 2 to 5 min, 5 to 10 min, Over 10 min]
Have you seen double parking by delivery or service vehicles on your street?	Single choice	[Yes, No]
How often do you notice double parking by delivery or service vehicles on your street?	Single choice	[Never, Rarely, Sometimes, Often, Always]
How much do these activities disrupt traffic flow/congestion on your street?	Single choice	[Not at all, Slightly, Moderately, Significantly, Extremely]
As a driver, how much does double parking affect you? [mention examples]	Single choice	[Not at all, Slightly, Moderately, Significantly, Extremely]
As a cyclist, how much does double parking affect you? [mention examples]	Single choice	[Not at all, Slightly, Moderately, Significantly, Extremely]
Do you think that double parking and logistic vehicle activities have a negative impact on the quality of life in your street?	Single choice	[Not at all, Slightly, Moderately, Significantly, Extremely]
UC02 Questions		
Here we will briefly explain what UC02 is about and introduce the concept of Multimodal Logistic Hubs.		
Were you familiar with the concept of Multimodal Logistic Hubs?	Single choice	[Yes, No, Unsure]
(Only if we advertise the project beforehand). Are you aware of the upcoming pilot project to implement a multimodal logistic hub your district?	Single choice	[Yes, No, Unsure]
How supportive are you of this pilot project?	Single choice	[Not supportive at all, Slightly supportive, Moderately supportive, Very supportive, Extremely supportive]
How much do you think this pilot can contribute to reducing traffic congestion in your home district?	Single choice	[Not effective at all,…,Extremely effective]
How much do you think this pilot can contribute to reducing traffic emissions and pollution in your home district?	Single choice	[Not effective at all,…,Extremely effective]
How much do you think this pilot can contribute to decreasing traffic noise in the district?	Single choice	[Not effective at all,…,Extremely effective]
How much do you think this pilot can contribute to improving road safety in the district?	Single choice	[Not effective at all,…,Extremely effective]
How much do you think this pilot can contribute to improving quality of life in your home district?	Single choice	[Not effective at all,…,Extremely effective]
Do you have any concerns about the pilot project? If yes, please specify:	Open field	
Contact form		
If you want to receive a voucher for your participation in the survey, please enter your email address. The voucher will be sent to you between X and Y.	Open field	
We plan to conduct a similar survey in early 2026. Do you want us to contact you again? (You will again be offered a voucher for your participation)	Single choice	[Yes, No]

Autonomous Sailing (AM-UC01)

(MU-UC01) S2 – Citizens/Users [draft version]		
Question in English	**Response type/format**	**Response options in English**

Stakeholder Needs & Logistics Challenges		
How significant is the impact of urban freight congestion on your logistics performance?	Single Choice	[Very significant, Somewhat significant, Neutral, Somewhat insignificant, Not significant]
How important is it for your business to find alternative last-mile delivery solutions?	Single Choice	[Very significant, Somewhat significant, Neutral, Somewhat insignificant, Not significant]
To what extent would improved infrastructure make waterborne transport more attractive for your business?	Single Choice	[Very much, Somewhat, Neutral, Not much, Not at all]
How much influence do existing or future regulations and compliance requirements have on your logistics choices?	Single Choice	[A great deal, A moderate amount, Neutral, A little, Not at all]
Are you willing to collaborate with other businesses or the municipality to implement autonomous inland waterway logistics?	Single Choice	[Yes, definitely, Yes, possibly, Neutral, No, probably not, No, definitely not]
Perception of Autonomous Barges		
Do you consider autonomous barges a viable solution for your industry?	Single Choice	[Yes, No, Not sure]
Which factors would most influence your decision to use autonomous barges? (Select up to 2)	Multiple Choice	[Cost savings, Logistical efficiency, Safety, [Regulations & permits, Sustainability, Technological reliability]
How much do safety risks influence your willingness to use autonomous barges?	Single Choice	[A great deal, A moderate amount, Neutral, A little, Not at all]
Safety & Regulations		
Do you think existing maritime safety regulations are adequate for autonomous operations?	Single Choice	Yes, No, Not sure
To what extent would advanced safety technology (e.g., collision detection) increase your confidence in autonomous barges?	Single Choice	A great deal, A moderate amount, Neutral, A little, Not at all
How important is third-party certification for your trust in autonomous vessels?	Single Choice	Very important, Important, Neutral, Not important, Not important at all
What challenges do you foresee in integrating autonomous barges with manned vessels?	Open-ended	-
Sustainability & Environmental Impact		
How important is sustainability in your choice of logistics solutions?	Single Choice	[Very important, Important, Neutral, Not important, Not important at all]
To what extent do autonomous barges contribute to your company's sustainability goals?	Single Choice	[A great deal, A moderate amount, Neutral, A little, Not at all]
Which environmental factors are most relevant to your organization? (Select multiple options)	Multiple Choice	[CO2 reduction, Reduction of traffic congestion, Noise reduction, Reduction of air pollution]
Would your company be more likely to adopt autonomous barges if government incentives were available?	Single Choice	[Yes, No, Not sure]
Business Model & Willingness to Adopt		
How much do financial considerations influence your decision to use autonomous barges?	Single Choice	[A great deal, A moderate amount, Neutral, A little, Not at all]
What would be the most attractive way for your organization to use an autonomous barge?	Single Choice	[Pay-per-use model, Lease option, Full ownership, Partnership with other companies]
How likely is your company to consider a pilot project with autonomous barges?	Single Choice	[Very likely, Likely, Neutral, Unlikely, Very unlikely]
On what timeline would your organization be ready to adopt autonomous barges, provided the technology proves reliable?	Single Choice	[Within 2 years, Within 3 years, Within 4 years, Longer than 5 years]

Waste Logistics (AM-UC03)

(MU-UC03) S6 – Citizens/Users [draft version]

Question in English	Response type	Response options in English
How satisfied are you with the new waste collection system?	Single choice	[Very satisfied, ..., Very dissatisfied]
Do you agree that the new system has a positive impact on the neighborhood?	Single choice	"Strongly agree" to "Strongly disagree"

Mobility Credits (AM-UC04)

(MU-UC04) S7 – Stakeholders [draft version]		
Question in English	**Response type**	**Response options in English**
To what extent do you agree with the following statement:		
The system aligns well with the goals and values of my organization.	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
I would accept the implementation of the system as a way to manage commuting.	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
This system is feasible to implement in real life.	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
I think the way mobility credits were allocated was fair.	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
(MU-UC04) S8 – Citizens/Users [draft version]		
Question in English	**Response type**	**Response options in English**
To what extent do you agree with the following statement:		
I am aware of the different transportation options available to me for my daily trips.	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
The system has influenced me to change my travel habits.	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
Using the system increased my awareness of the environmental impacts of my travel behavior.	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
Using the system increased my awareness of the environmental impacts of my travel behavior.	Single choice	[Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]

On-Demand Mini-Buses (LI-UC01)

(LI-UC01) S2 - Questionnaire for parents		
Question in English	**Response type**	**Response options**
Introduction and contact detail		
Introductory text		
Please enter your personal email address. (It will be used to invite you to the Focus Group about the new service being developed for transporting teenagers to their activities.)	open ended (text)	
Please provide your personal mobile phone number, including the country code. (It will be used if we face difficulty contacting you via email for the Focus Group regarding the new service being developed for transporting teenagers to their activities.)	open ended (phone number)	
Family profile		
Which household member are you? (Choose one of the following answers)	Single choice	[Father, Mother, Other]

How old are you? (Only numbers may be entered in this field. Your answer must be at most 80)	open ended (numeric)	
What is your level of education? (Choose one of the following answers)	Single choice	Basic (secondary/higher), University, Postgraduate, PhD]
What is your occupation? (Enter text)	Open ended	
How would you describe your job arrangement? (Choose one of the following answers)	Single choice	[Full time employment with fixed working hours, Full time employment with flexible working hours, Remote working model with fixed working hours, Remote working model with flexible working hours, Hybrid working model with fixed working hours, Hybrid working model with flexible working hours, Part time employment with fixed working hours, Part time employment with flexible working hours, Not working, Retired, Other]
What is the occupation of the other parent of your child/children? (Enter text)	Open ended	
How would you describe of the job arrangement of the other parent of your child? (Choose one of the following answers)	Single choice	[Full time employment with fixed working hours, Full time employment with flexible working hours, Remote working model with fixed working hours, Remote working model with flexible working hours, Hybrid working model with fixed working hours, Hybrid working model with flexible working hours, Part time employment with fixed working hours, Part time employment with flexible working hours, Not working, Retired, Other]
In which range would you classify your household's total annual income? (Choose one of the following answers)	Single choice	[Under 20,000 Euros, 20,001 - 40,000 Euros, 40,001 - 60,000 Euros, 60,001 - 80,000 Euros, Over 80,001 Euros]
The house you live in is: (Choose one of the following answers)	Single choice	[Owned, Rented]
The house you live in is: (Choose one of the following answers)	Single choice	[House, Apartment/Flat]
In which neighborhood is your home located?	open ended (text)	
How many cars does your household own? (Choose one of the following answers)	numeric	
Where do you park your car/cars at home? (Select all that apply)	multiple choice	[Covered/Uncovered parking at my property space, On the road, In a parking space that we rent]
In which neighborhood is your work located?	open ended (text)	
Profiles of minor members of the family		
How many children do you have? (Your answer must be at least 1. Only an integer value may be entered in this field).	open ended (numeric)	
How many of your children are between 11 to 18 years old? (Only numbers may be entered in this field. Your answer must be between 1 and 6).	open ended (numeric)	[1-6]
What is the age of your child/children (between 11-18 years)?	open ended (numeric)	
Please indicate the gender(s) of your child/children (between 11 and 18).	single choice	[Male, Female, other]
Please provide the name of the school(s) your child/children (between 11 and 18) attend.	open ended (text)	
Who is responsible for escorting your child/children (between 11 and 18) to school? (Choose one of the following answers)	single choice	[Mainly me, Mainly the other parent, Both parents, Mainly grandparents, Both parents and grandparents]

Which transport mode does your child/children (between 11 and 18) use to go to school? (choose one of the following answers).	single choice	[Household car, A car that belongs to someone else (friend, grandparents, parents of classmates etc), Walking, Bicycle / Scooter, By public bus, By private school bus, By taxi or private driver]
Who is responsible for escorting your child/children (between 11 and 18) to their after-school activities? (Choose one of the following answers).	single choice	[Mainly me, Mainly the other parent, Both parents, Mainly grandparents, Both parents and grandparents]
Which transport mode do your child/children (between 11 and 18) use for the after-school activities? (Choose one of the following answers).	single choice	[A car that belongs to someone else (friend, grandparents, parents of classmates etc), Walking, Bicycle / Scooter, By public bus, By private school bus, By taxi or private driver]
What is the total amount you pay each month for your child/children's extracurricular activities? (Only numbers may be entered in these fields).	open ended (numeric)	
Please provide information for your first child (aged 11-18) regarding the type of activity, the name of the organization, the address, and the start and end times of the extracurricular activities they attend each day of the week. (This data will only be used to calculate the distances you travel for your daily activities and for no other purpose).	open ended (text)	
Opinions | Perceptions		
How important are the factors below for selecting your childrens's after-school activities?		
Cost	Single choice	[1=Not important at all, ... 5=Very important]
Distance	Single choice	[1=Not important at all, ... 5=Very important]
Time that after-schools activities take place	Single choice	[1=Not important at all, ... 5=Very important]
Reputation	Single choice	[1=Not important at all, ... 5=Very important]
Please indicate to what extent you agree or disagree with the following statemements.		
I spend a lot of time escorting my children to their activities	Single choice	[1=Not important at all, ... 5=Very important]
I wait outside until my child/ children finish their activities	Single choice	[1=Not important at all, ... 5=Very important]
I like escorting my children to their after-school activities	Single choice	[1=Not important at all, ... 5=Very important]
I feel i do not have free time for myself	Single choice	[1=Not important at all, ... 5=Very important]
I would prefer not to spend my afternoons escorting my children to their after-school activities	Single choice	[1=Not important at all, ... 5=Very important]
I would prefer not to spend my afternoons taking my children to their activities	Single choice	[1=Not important at all, ... 5=Very important]
SERVICE PRESENTATION		
What is your first reaction hearing about this service?	Single choice	[1=Completely negative, ... 5= Completely positive]
Would you use this service to take your children to their extracurricular activities? (Choose one of the following answers).	Single choice	[1=Yes, 2=No, 3=I do not know]
Would you like this service to be available for transporting your children from and to school? (Choose one of the following answers).	Single choice	[1=Yes, 2=No, 3=I do not know]
Would you like this service to also be available for the leisure and social activities of your children? (Choose one of the following answers).	Single choice	[1=Yes, 2=No, 3=I do not know]
To what extent do you agree or disagree with the below statements?		
I expect to be satisfied with this service	Single choice	[1= Completely Disagree, 2=Disagree, 3=Neither agree or disagree, 4=Agree, 5=Completely Agree]
| I do not feel safe for my kids to use such a service	Single choice	[1= Completely Disagree, 2=Disagree, 3=Neither agree or disagree, 4=Agree, 5=Completely Agree]
My quality of life will be improved by using this service	Single choice	[1= Completely Disagree, 2=Disagree, 3=Neither agree or disagree, 4=Agree, 5=Completely Agree]

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This service can contribute to traffic alleviation	Single choice	[1= Completely Disagree, 2=Disagree, 3=Neither agree or disagree, 4=Agree, 5=Completely Agree]
This service will have a positive environmental impact	Single choice	[1= Completely Disagree, 2=Disagree, 3=Neither agree or disagree, 4=Agree, 5=Completely Agree]
What is the maximum and minimum amount you would be willing to pay per week, per child, for your child to attend extracurricular activities using this service?	open ended	
What do you think will be the positive impact of such a service on your daily life? Mention up to 3 emotions you feel.	open ended	
What reasons would make you hesitate to use such a service? Mention up to 3 feelings you have.	open ended	
Availability		
Please select which days are you available for our in-person meeting.	multiple choice	
Please select what time(s) you are available for us to have our in-person meeting. -You can select more than one available option. (Select all that apply)	multiple choice	

Autonomous E-Shuttles & Tram-Feeder Services (TA-UC01 and TA-UC02)

(TA-UC01) and (TA-UC02) - Pre-Pilot Implementation Survey		
Question in English	**Response type**	**Response options in English**
Have you used the robot bus service operating in Lintuhytti?	Single choice	[Yes, No]
What is your overall opinion about the robot bus service?	Single choice	[Very Positive, Positive, Neutral, Negative, Very Negative]
If there is a disruption to the traffic provided by the robot bus service, how would you like to be informed?	Multiple Choice	[SMS, Email, App Notification, Voice Announcement, Other (please specify)]
Do the following factors affect your confidence in using the robot bus service? (Heavy rain,)	Single choice	[Strongly Affects, Somewhat Affects, No Effect, Not Sure]
How accessible do you find the robot bus service?	Single choice	[Very Accessible, Somewhat Accessible, Neutral, Somewhat Inaccessible, Very Inaccessible]
How do factors affecting accessibility impact your experience using the service, and how could they be improved?	Open-Ended	-
What information would you like to receive during the trip?	Open-Ended	-
What kind of ticket payment methods should be available for robot bus transport?	Multiple Choice	[Contactless Payment, Cash, Travel Card, Nysse App, Service Provider's App]
In what situations would you like to connect to the remote control center and how?	Open-Ended	-
How long would it take to get to the tram stop from Lintuhytti so that you would use the robot bus service?	Numeric	-
If you wish, you can write your general thoughts about robot bus traffic or wishes for the development of future routes here.	Open-Ended	-

6.2. Annex II – expected impacts and KPIs selected for each T-LL

T. D.* Thematic domain	
T	Transport System
Env	Environment
Ene	Energy
V	vehicle and automation
S	Social
E	Economy

H* (hierarchy)
PW: Project wide
SW: Solution wide
CS: context specific

Level:
FL: First Level
SL: Second Level

Scale:
Pilot area
Whole city

AM-UC01

						Data sources		Scale	
H*	T.D.	Expected impact	Level	Indicator	unit	Source 1	Alternative Source (if needed)	P	C
CS	T	Reducing motorised freight vehicles activity	SL	Amount of trucks that would replace the amount of freight carried by the vessel	n of vehicles / day	Operator		X	
PW	Env	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability (perception)	Weighted average	Task 1.5 - Survey		X	
PW	Env	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm or per unit time	Operator		X	
PW	Ene	Reducing transport energy demand	FL	Modelled energy demand (3 separated numbers on Gasoline, Diesel, Electricity)	litres (Gasoline, Diesel) and Kwh (elect.)	Operator		X	
PW	Ene	Reducing transport energy demand	FL	Energy supplied at fuelling/recharging	litres (Gasoline, Diesel) and Kwh (elect.)	Operator		X	
SW	V	Reduce frequency of system failures	FL	Frequency of system failures	Count per km driven and their description	On-field measurement		X	
SW	V	Reduce disengagement rate	FL	disengagement rate	Count per km driven	On-field measurement		X	
CS	S	Increase transport related safety	SL	Incident rates of Automated Electric Waterborne Vessels compared to conventional vessels.	On field	On-field measurement		X	
PW	S	Increase perceived safety of mobility in the experiment area	SL	Reported road safety (perception)	Weighted average	Task 1.5 - Survey		X	

PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	Task 1.5 - Survey		X	
SW	S	Acceptability of being next to the automated vehicle	FL	Share of respondents that would support: Driving/Walking/Cycling next to the AV	%	Task 1.5 - Survey		X	
CS	E	Reduce operational cost	FL	Average operational costs per parcel	€/parcel	Operator		X	
CS	E	Reduce operational cost	FL	Average Delivery time per parcel	minutes/parcel	On field measurement		X	
SW	E	Reduce operational cost	FL	Operational costs using (automated vehicles/electric mini-buses), compared to Operational costs using convensional vehicles	%	Operator		X	
SW	E	Reduce operational cost	FL	Monetarised value of travel time	€	Operator		X	
PW	E	Economic viability of the system	FL	Share of stakeholders that consider the system will be / is economicaly viable	%	Task 1.5 - Survey		X	

AM-UC02

						Data sources		Scale	
H*	**T.D.**	**Expected impact**	**Level**	**Indicator**	**unit**	**Source 1**	**Alternative Source (if needed)**	**P**	**C**
PW	Env	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability (perception)	Weighted average	Task 1.5 - Narrative Record	Prior narrative records conducted before commencement of metaCCAZE	X	
PW	S	Increase transport related safety	SL	Total number of traffic accidents per inhabitant in pilot/experiment area	n	Task 1.5 - Narrative Record	Prior narrative records conducted before commencement of metaCCAZE	X	
PW	S	Increase perceived safety of mobility in the experiment area	SL	Reported road safety (perception)	Weighted average	Task 1.5 - Narrative Record	Prior narrative records conducted before commencement of metaCCAZE	X	
PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Narrative Record	Prior narrative records conducted before commencement of metaCCAZE	X	
PW	S	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	Task 1.5 - Narrative Record	Prior narrative records conducted before commencement of metaCCAZE	X	
PW	S	Increase Customer satisfaction	FL	Level of satisfaction of the residents (or users) with the service	Weighted average	Task 1.5 - Narrative Record	Prior narrative records conducted before commencement of metaCCAZE	X	
CS	S	Respect of speed limits by relevant transport mode	FL	Share of bicycles/relevant transport mode exceeeding speed limits	%	Task 1.5 - Narrative Record	Prior narrative records conducted before commencement of metaCCAZE	X	

AM-UC03

						Data sources		Scale	
H*	T.D.	Expected impact	Level	Indicator	unit	Source 1	Alternative Source (if needed)	P	C
CS	T	Maximizing efficiency of waste collection	FL	Distance traveled per unit of waste collected	km/kg	operational data (city of Amsterdam)		X	
SW	T	Minimization of deadhead distances (freight)	FL	Average loading capacity (freight)	freight/km travelled	operational data (city of Amsterdam)		X	
CS	T	Maximizing efficiency of waste collection	FL	Amount of waste collected per unit time or amount of households served per unit time	households / hour (kg/hour)	operational data (city of Amsterdam)		X	
PW	Ene	Reducing transport energy demand	FL	Energy supplied at fuelling/recharging	litres (Gasoline, Diesel) and Kwh (elect.)	operational data (city of Amsterdam)		X	
PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey		X	
PW	S	Increase Customer satisfaction	FL	Level of satisfaction of the residents (or users) with the service	Weighted average	Task 1.5 - Survey		X	

AM-UC04

						Data sources		Scale	
H*	T.D.	Expected impact	Level	Indicator	unit	Source 1	Alternative Source (if needed)	P	C
PW	T	Decrease perceived car dependancy	FL	Share of a representative sample of inhabitants/users reporting to be fully or highly dependent on car for their daily urban mobility	%	Task 1.5 - Survey		X	
PW	T	Modal shift towards public transport for commuting trips	SL	Share of public transport on generated commuting trips in the pilot area	%	FYNCH data		X	
PW	T	Modal shift towards active modes for commuting trips	SL	Share of active modes on generated commuting trips in the pilot area	%	FYNCH data		X	
SW	T	Increasing use of shared mobility	FL	Number of usages of shared vehicles (cars, bikes, scooters, ...) per week per inhabitant	n of pax/share per population	FYNCH data		X	
PW	Env	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm or per unit time	FYNCH data		X	

PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	Task 1.5 - Survey		X	
CS	S	Increasing number of employees participating in the TMC scheme	FL	Number of employees participating in the TMC scheme over total of employees in the companies	n	Number of participants at the beginning and end of the pilot		X	
PW	S	Increasing propensity to adopt sustainable mobility behaviors (change mobility patterns)	FL	Share of respondents (stakeholders/citizens/students/employees/relevant group of people) ready to adopt sustainable mobility behaviours	%	Task 1.5 - Survey		X	
CS	S	Fainess of credit allocation across different demographics within the company	FL	Share of users/stakeholders that find the credit allocation fair	%	Task 1.5 - Survey		X	
PW	E	Economic viability of the system	FL	Share of stakeholders that consider the system will be / is economicaly viable	%	Task 1.5 - Survey		X	

MU-UC01

						Data sources		Scale	
H*	**T.D.**	**Expected impact**	**Level**	**Indicator**	**unit**	**Source 1**	**Alternative Source (if needed)**	**P**	**C**
PW	T	Reducing road congestion (Measured as "PW" indicator. No significant expected impact on this indicator).	SL	Number of motorised vehicles on a sample of roads (Traffic counts in peak time of a sample day)	n of vehicles / h	Traffic counts (on-site, manually collected)	Source 2: Loop detectors / Source 3: FCD from commercial providers	X	
CS	T	Reducing road congestion	SL	Average speed on samples of roads (district/streets where the system is implemented)	km/h	Traffic microsimulation model.	On-site measurements to calibrate model / Source 3: FCD from commercial providers	X	
CS	T	Reducing road congestion	SL	Average number of veh. (traffic) stops in the zone (district/streets where the system is implemented)	stops/time unit	Traffic microsimulation model.	On-site measurements to calibrate model / Source 3: FCD from commercial providers	X	
PW	T	Reducing Perceived Road congestion	SL	Congestion perception of residents	weighted average	Task 1.5 - Survey		X	
CS	T	Reduction of the time/distance searching for a parking spot (for delivery companies)	FL	Average time searching for a parking spot (for delivery vehicles)	minutes	Empirical data provided by logistics providers	Alternative: On-site measurements + Traffic simulation	X	

CS	T	Reduction of total km driven by the On Demand mobility fleet to transport the same amount of people	FL	Vehicle-Km-Travelled (VKT) of an On-Demand-Mobility Service to transport the same amount of people	Vkm	Transport model - Fleetpy simulations			X
CS	T	User perception of the time needed to find a parking spot	FL	Share of users perceiving a reduction on the time needed to find a parking spot	%	Task 1.5 - Survey		X	
CS	Env	Reduce illegal double-lane parking	FL	Frequency (events/h) of double parking in selected streets in the pilot area	events/h	On-field measurement		X	
PW	Env	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability (perception)	Weighted average	Task 1.5 - Survey		X	
PW	Env	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm or per unit time	Traffic microsimulation model.	On-site measurements to calibrate model / Source 3: Fleet composition Data from the vehicle registry	X	
PW	Env	Reducing Pollution impact	FL	Total pollutants emissions (produced by all vehicles circulating in the area) expressed in tonnes/year, for three pollutants: Particulate Matter (PM), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC).	tonnes/year	Traffic microsimulation model.	On-site measurements to calibrate model / Source 3: Fleet composition Data from the vehicle registry	X	
PW	Ene	Reducing transport energy demand	FL	Modelled energy demand (3 separated numbers on Gasoline, Diesel, Electricity)	litres (Gasoline, Diesel) and Kwh (elect.)	estimation on microsimulation model		X	
SW	V	Improving Speed of AV	FL	Observed travel time of AV between sample segments in sample periods in the experiment area	m/s	On-board sensors	External sensors (e.g., LiDAR, camera sensors, etc.)	X	
PW	S	Increase perceived safety of mobility in the experiment area	SL	Reported road safety (perception)	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	Task 1.5 - Survey		X	
SW	S	Acceptability of being next to the automated vehicle	FL	Share of respondents that would support: Driving/Walking/Cycling next to the AV	%	Task 1.5 - Survey		X	
SW	S	Acceptability to hop on an automated vehicle	FL	Share of respondents that would use an AV as passengers	%	Task 1.5 - Survey		X	
SW	E	Reduce operational cost	FL	Monetarised value of travel time	€	Traffic microsimulation model.	On-site measurements to calibrate model / Source 3: Estimates of the VTT for Munich/Germany	X	

PW	E	Economic viability of the system	FL	Share of stakeholders that consider the system will be / is economically viable	%	Task 1.5 - Survey		X	

MU-UC02

						Data sources		Scale	
H*	T.D.	Expected impact	Level	Indicator	unit	Source 1	Alternative Source (if needed)	P	C
CS	T	Reducing road congestion	SL	Average speed on samples of roads (district/streets where the system is implemented)	km/h	Traffic microsimulation model.	On-site measurements to calibrate model / Source 3 Optional: FCD from commercial providers	X	
PW	T	Reducing Perceived road congestion	SL	Congestion perception of residents	weighted average (scale from 1 to 5)	Task 1.5 - Survey		X	
SW	T	Reducing motorised freight vehicles activity	SL	Number of road freight vehicles on a sample of roads	n of vehicles / h	In-field measurement	Transport model	X	
PW	T	Modal shift towards lighter and electrified vehicles (cargo bikes and cargo ships) in freight (or waste collection)	FL	Modal shares on trips (deliveling goods or collecting waste) done by lighter and electrified vehicles (cargo bikes and cargo ships)	%	Information from logistics providers	On-site measurement	X	
SW	T	Minimization of deadhead distances (freight)	FL	Average loading capacity (freight)	freight/km travelled	Information from logistics providers		X	
CS	Env	Reduce standing time of motorized vehicles in the public space	SL	Observed standing time of vehicles at a complete stop (e.g. due to congestion or road blockages)	minutes	Microscopic traffic simulation		X	
PW	Env	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability (perception)	Weighted average	Task 1.5 - Survey		X	
PW	Env	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm or per unit time	Microscopic traffic simulation	On-site observations to calibrate model / Source 3: Fleet composition Data from the vehicle registry	X	
PW	Env	Reducing Pollution impact	FL	Total pollutants emissions (produced by all vehicles circulating in the area) expressed in tonnes/year, for three pollutants: Particulate Matter (PM), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC).	tonnes/year	Microscopic traffic simulation	On-site observations to calibrate model / Source 3: Fleet composition Data from the vehicle registry	X	
PW	Ene	Reducing transport energy demand	FL	Modelled energy demand (3 separated numbers on Gasoline, Diesel, Electricity)	litres (Gasoline, Diesel) and Kwh (elect.)	Microscopic traffic simulation		X	

PW	S	Increase perceived safety of mobility in the experiment area	SL	Reported road safety (perception)	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	Task 1.5 - Survey		X	
SW	S	Acceptability of being next to the automated vehicle	FL	Share of respondents that would support: Driving/Walking/Cycling next to the AV	%	Task 1.5 - Survey		X	
SW	S	Acceptability to hop on an automated vehicle	FL	Share of respondents that would use an AV as passengers	%	Task 1.5 - Survey		X	
CS	E	Reduce operational cost	FL	Average operational costs per parcel	€/parcel	Operator data		X	
CS	E	Reduce operational cost	FL	Average Delivery time per parcel	minutes/parcel	Operator data		X	
PW	E	Economic viability of the system	FL	Share of stakeholders that consider the system will be / is economicaly viable	%	Task 1.5 - Survey		X	

LI-UC01

						Data sources		Scale	
H*	T.D.	Expected impact	Level	Indicator	unit	Source 1	Alternative Source (if needed)	P	C
PW	T	Reducing road congestion	SL	Number of motorised vehicles on a sample of roads (Traffic counts in peak time of a sample day)	n of vehicles / h	Transport model	On-field measurement		X
PW	T	Reducing road congestion	SL	Average travel time by a vehicle (car/vessel) for a sample of OD pairs	minutes	Transport model			X
PW	T	Reducing Perceived road congestion	SL	Congestion perception of residents	weighted average (scale from 1 to 5)	Task 1.5 - Survey			X
PW	T	Decrease perceived car dependancy	FL	Share of a representative sample of inhabitants/users reporting to be fully or highly dependent on car for their daily urban mobility	%	Task 1.5 - Survey			X
SW	T	Increasing Speed of public transport (Reduction of travel times with public transport)	FL	Observed travel time of PT between sample stops in sample periods in the experiment area for each involved route	minutes	PT operator	On-field measurement	X	
SW	T	Improving reliability of public transport	SL	Share of services arriving at a sample stops more than 20% of headway delayed	%	PT operator	On-field measurement	X	

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SW	T	Increasing perceived accessibility to public transport	FL	Share of users perceving an increase in the accessibility to public transport	%	Task 1.5 - Survey			X
SW	T	Increase number of passengers in public trasport	FL	Number of bus (or mini-bus) passengers in specific stops	n of pax	On-field measurement	PT operator	X	
CS	T	minimizing the passengers' waiting time at each pickup point.	FL	average waiting time at each pickup point	minutes	PT operator		X	
PW	T	Modal shift towards public transport for commuting trips	SL	Share of public transport on generated commuting trips in the pilot area	%	Task 1.5 - Survey		X	
CS	T	Reduction of total km driven by the On Demand mobility fleet to transport the same amont of people	FL	Vehicle-Km-Travelled (VKT) of an On-Demand-Mobility Service to transport the same amount of people	Vkm	Transport model		X	
SW	T	Minimization of deadhead distances (passangers)	FL	Kms run by PT with less than 15% passenger load capacity/Passengers traveling by PT by time of day	km/pax	Transport model			X
PW	Env	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability (perception)	Weighted average	Task 1.5 - Survey			X
PW	Env	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm or per unit time	Transport model			X
PW	Env	Reducing Pollution impact	FL	Total pollutants emissions (produced by all vehicles circulating in the area) expressed in tonnes/year, for three pollutants: Particulate Matter (PM), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC).	tonnes/year	Ministry	Municipality		X
PW	Ene	Reducing transport energy demand	FL	Modelled energy demand (3 separated numbers on Gasoline, Diesel, Electricity)	litres (Gasoline, Diesel) and Kwh (elect.)	Transport model			X
PW	S	Increase transport related safety	SL	Total number of traffic accidents per inhabitant in pilot/experiment area	n	Traffic Police - Ministry of Transport			X
PW	S	Increase perceived safety of mobility in the experiment area	SL	Reported road safety (perception)	Weighted average	Task 1.5 - Survey			X
PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey			X
PW	S	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	Task 1.5 - Survey			X
PW	S	Increase Customer satisfaction	FL	Level of satisfaction of the residents (or users) with the service	Weighted average	Task 1.5 - Survey		X	
CS	S	Increasing awareness of service and time-schedules	FL	Share of Students that aware of service and time-schedules	%	Task 1.5 - Survey		X	
PW	S	Increasing propensity to adopt sustainable mobility behaviors (change mobility patterns)	FL	Share of respondents (stakeholders/citizens/students/employees/relevant	%	Task 1.5 - Survey			X

				group of people) ready to adopt sustainable mobility behaviours					
SW	S	Increasing perceived accessibility of vulnerable groups	FL	Perceived level of accessibility by vulnerable groups	Weighted average	Task 1.5 - Survey			X
SW	E	Reduce operational cost	FL	Operational costs using (automated vehicles/electric mini-buses), compared to Operational costs using convensional vehicles	%	PT operator		X	
SW	E	Reduce operational cost	FL	Monetarised value of travel time	€	PT operator		X	
PW	E	Economic viability of the system	FL	Share of stakeholders that consider the system will be / is economicaly viable	%	Task 1.5 - Survey		X	
CS	E	Willingness to pay	FL	Share of users that are willing to pay for the service	%	Task 1.5 - Survey		X	

LI-UC02

						Data sources		Scale	
H*	**T.D.**	**Expected impact**	**Level**	**Indicator**	**unit**	**Source 1**	**Alternative Source (if needed)**	**P**	**C**
PW	T	Reducing road congestion	SL	Number of motorised vehicles on a sample of roads (Traffic counts in peak time of a sample day)	n of vehicles / h	Transport Model			X
PW	T	Reducing road congestion	SL	Average travel time by a vehicle (car/vessel) for a sample of OD pairs	minutes	Transport Model			X
PW	T	Reducing Perceived road congestion	SL	Congestion perception of residents	weighted average (scale from 1 to 5)	Task 1.5 - Survey			X
PW	T	Decrease perceived car dependancy	FL	Share of a representative sample of inhabitants/users reporting to be fully or highly dependent on car for their daily urban mobility	%	Task 1.5 - Survey			X
CS	T	improve physical integration between transport modes	FL	Number of sharing stations in the city that can be reached from PT stop/stations in the experiment area in a 5 min walk	n	Bike sharing operator			X
PW	T	Modal shift towards active modes for commuting trips	SL	Share of active modes on generated commuting trips in the pilot area	%	Bike sharing operator	Task 1.5 - Survey		X
CS	T	Improving accessibility to city functions (schools) throught bike sharing facilities	FL	Number of bike sharing stations that can be reached within 10, minutes starting from schools in the pilot area	n	Bike sharing operator			X
SW	T	Increasing use of shared mobility	FL	Number of usages of shared vehicles (cars, bikes, scooters, ...) per week per inhabitant	n of pax/share per population	Bike sharing operator			X
PW	Env	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability (perception)	Weighted average	Task 1.5 - Survey			X

PW	Env	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm or per unit time	Transport Model			X
PW	Env	Reducing Pollution impact	FL	Total pollutants emissions (produced by all vehicles circulating in the area) expressed in tonnes/year, for three pollutants: Particulate Matter (PM), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC).	tonnes/year	Ministry	Municipality		X
PW	Ene	Reducing transport energy demand	FL	Modelled energy demand (3 separated numbers on Gasoline, Diesel, Electricity)	litres (Gasoline, Diesel) and Kwh (elect.)	Transport Model			X
PW	S	Increase transport related safety	SL	Total number of traffic accidents per inhabitant in pilot/experiment area	n	Traffic Police - Ministry of Transport			X
PW	S	Increase perceived safety of mobility in the experiment area	SL	Reported road safety (perception)	Weighted average	Task 1.5 - Survey			X
PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey			X
PW	S	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	Task 1.5 - Survey			X
PW	S	Increase Customer satisfaction	FL	Level of satisfaction of the residents (or users) with the service	Weighted average	Task 1.5 - Survey			X
PW	S	Increasing propensity to adopt sustainable mobility behaviors (change mobility patterns)	FL	Share of respondents (stakeholders/citizens/students/employees/relevant group of people) ready to adopt sustainable mobility behaviours	%	Task 1.5 - Survey			X
SW	S	Increasing perceived accessibility of vulnerable groups	FL	Perceived level of accessibility by vulnerable groups	Weighted average	Task 1.5 - Survey			X
PW	E	Economic viability of the system	FL	Share of stakeholders that consider the system will be / is economicaly viable	%	Task 1.5 - Survey			X

LI-UC03

						Data sources		Scale	
H*	**T.D.**	**Expected impact**	**Level**	**Indicator**	**unit**	**Source 1**	**Alternative Source (if needed)**	**P**	**C**
PW	T	Reducing road congestion	SL	Number of motorised vehicles on a sample of roads (Traffic counts in peak time of a sample day)	n of vehicles / h	Transport model	On-field measurement		X
PW	T	Reducing Perceived road congestion	SL	Congestion perception of residents	weighted average (scale from 1 to 5)	Task 1.5 - Survey			X

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PW	T	Decrease perceived car dependancy	FL	Share of a representative sample of inhabitants/users reporting to be fully or highly dependent on car for their daily urban mobility	%	Task 1.5 - Survey			X
SW	T	Improving reliability of public transport	SL	Share of services arriving at a sample stops more than 20% of headway delayed	%	PT operator	On-field measurement	X	
SW	T	Increasing perceived accessibility to public transport	FL	Share of users perceving an increase in the accessibility to public transport	%	Task 1.5 - Survey			X
SW	T	Increase number of passengers in public trasport	FL	Number of bus (or mini-bus) passengers in specific stops	n of pax	On-field measurement	PT operator	X	
CS	T	improve physical integration between transport modes	FL	Ratio between the number of passengers interchanging at multimodal hubs and population	n/share per population	Task 1.5 - Survey	On-field measurement	X	
PW	T	Modal shift towards public transport for commuting trips	SL	Share of public transport on generated commuting trips in the pilot area	%	Task 1.5 - Survey			X
PW	T	Modal shift towards active modes for commuting trips	SL	Share of active modes on generated commuting trips in the pilot area	%	Task 1.5 - Survey			X
SW	T	Increasing use of shared mobility	FL	Number of usages of shared vehicles (cars, bikes, scooters, ...) per week per inhabitant	n of pax/share per population	Sharing mobility operators			X
CS	T	Improving Real-time information about disruptions	FL	Share of transport operators whose services are covered by a multimodal trips planning application considering real time disruptions	n	PT operator			X
PW	Env	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability (perception)	Weighted average	Task 1.5 - Survey			X
PW	Env	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm or per unit time	Transport model			X
PW	Env	Reducing Pollution impact	FL	Total pollutants emissions (produced by all vehicles circulating in the area) expressed in tonnes/year, for three pollutants: Particulate Matter (PM), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC).	tonnes/year	Ministry	Municipality / Source 3: Cyprus Institute		X
PW	Ene	Reducing transport energy demand	FL	Modelled energy demand (3 separated numbers on Gasoline, Diesel, Electricity)	litres (Gasoline, Diesel) and Kwh (elect.)	Transport model			X
PW	S	Increase transport related safety	SL	Total number of traffic accidents per inhabitant in pilot/experiment area	n	Traffic Police - Ministry of Transport			X
PW	S	Increase perceived safety of mobility in the experiment area	SL	Reported road safety (perception)	Weighted average	Task 1.5 - Survey			X
PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey			X
PW	S	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	Task 1.5 - Survey			X

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PW	S	Increase Customer satisfaction	FL	Level of satisfaction of the residents (or users) with the service	Weighted average	Task 1.5 - Survey			X
PW	S	Increasing propensity to adopt sustainable mobility behaviors (change mobility patterns)	FL	Share of respondents (stakeholders/citizens/students/employees/relevant group of people) ready to adopt sustainable mobility behaviours	%	Task 1.5 - Survey			X

LI-UC04

						Data sources		**Scale**	
H*	**T.D.**	**Expected impact**	**Level**	**Indicator**	**unit**	**Source 1**	**Alternative Source (if needed)**	**P**	**C**
PW	T	Reducing road congestion	SL	Number of motorised vehicles on a sample of roads (Traffic counts in peak time of a sample day)	n of vehicles / h	Transport model	On-field measurement		X
SW	T	Minimization of deadhead distances (passangers)	FL	Kms run by PT with less than 15% passenger load capacity/Passengers traveling by PT by time of day	km/pax	PT operator			X
CS	T	Optimize charging grid increasing use during non-peak hours	FL	Time charging on peak hours over time charging on non-peak hours	minutes/ratio	Transport model			X
PW	Env	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability (perception)	Weighted average	Task 1.5 - Survey			X
PW	Env	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm or per unit time	Transport model			X
PW	Env	Reducing Pollution impact	FL	Total pollutants emissions (produced by all vehicles circulating in the area) expressed in tonnes/year, for three pollutants: Particulate Matter (PM), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC).	tonnes/year	Ministry	Municipality / Source 3: Cyprus Institute		X
PW	Ene	Reducing transport energy demand	FL	Modelled energy demand (3 separated numbers on Gasoline, Diesel, Electricity)	litres (Gasoline, Diesel) and Kwh (elect.)	Transport model			X
PW	S	Increase transport related safety	SL	Total number of traffic accidents per inhabitant in pilot/experiment area	n	Traffic Police - Ministry of Transport			X
PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey			X

TA-UC01

						Data sources		**Scale**	

H*	T.D.	Expected impact	Level	Indicator	unit	Source 1	Alternative Source (if needed)	P	C
PW	T	Decrease perceived car dependancy	FL	Share of a representative sample of inhabitants/users reporting to be fully or highly dependent on car for their daily urban mobility	%	Task 1.5 - Survey		X	
SW	T	Increasing Speed of public transport (Reduction of travel times with public transport)	FL	Observed travel time of PT between sample stops in sample periods in the experiment area for each involved route	minutes	Automated Bus Operator Data		X	
SW	T	Improving speed of driverless bus service compared to conventional bus service	FL	Ratio of between Travel time between sample stops in sample periods in the experiment area for each involved route of driverless bus compared to conventional bus services	Ratio	Automated Bus Operator Data		X	
SW	T	Improving reliability of public transport	SL	Share of services arriving at a sample stops more than 20% of headway delayed	%	Task 1.5 - Survey	alternative: bus operator data	X	
SW	T	Increasing perceived accessibility to public transport	FL	Share of users perceving an increase in the accessibility to public transport	%	Task 1.5 - Survey		X	
CS	T	minimizing the passengers' waiting time at each pickup point.	FL	average waiting time at each pickup point	minutes	Task 1.5 - Survey	alternative: bus operator data	X	
PW	T	Modal shift towards public transport for commuting trips	SL	Share of public transport on generated commuting trips in the pilot area	%	Task 1.5 - Survey		X	
SW	T	Minimization of deadhead distances (passangers)	FL	Kms run by PT with less than 15% passenger load capacity/Passengers traveling by PT by time of day	km/pax	Automated Bus Operator Data		X	
PW	Env	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability (perception)	Weighted average	Task 1.5 - Survey		X	
PW	Env	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm or per unit time	Automated Bus Operator Data	Finland Car Registry	X	
PW	Env	Reducing Pollution impact	FL	Total pollutants emissions (produced by all vehicles circulating in the area) expressed in tonnes/year, for three pollutants: Particulate Matter (PM), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC).	tonnes/year	Automated Bus Operator Data	Finland Car Registry	X	
PW	Ene	Reducing transport energy demand	FL	Energy supplied at fuelling/recharging	litres (Gasoline, Diesel) and Kwh (elect.)	Automated Bus Operator Data		X	
CS	Ene	Reducing transport energy demand	FL	Stations using inductive changing with respect to manual charging	kWh, %, Ratio	Automated Bus Operator Data		X	
SW	V	Reduce frequency of system failures	FL	Frequency of system failures	Count per km driven and their description	Automated Bus Operator Data		X	
SW	V	Reduce disengagement rate	FL	disengagement rate	Count per km driven	Automated Bus Operator Data		X	

SW	V	Acceleration sum	FL	Sum of positive accelerations per 100 km, in free driving and in car following	m/s2	Automated Bus Operator Data		X	
SW	V	Harsh braking events	FL	Number of ego vehicle decelerations over X m/s² for at least Y s, per distance driven	Number/km or number/h	Automated Bus Operator Data		X	
PW	S	Increase transport related safety	SL	Total number of traffic accidents per inhabitant in pilot/experiment area	n	Automated Bus Operator Data		X	
PW	S	Increase perceived safety of mobility in the experiment area	SL	Reported road safety (perception)	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	Task 1.5 - Survey		X	
SW	S	Acceptability of being next to the automated vehicle	FL	Share of respondents that would support: Driving/Walking/Cycling next to the AV	%	Task 1.5 - Survey		X	
SW	S	Acceptability to hop on an automated vehicle	FL	Share of respondents that would use an AV as passengers	%	Task 1.5 - Survey		X	
PW	S	Increase Customer satisfaction	FL	Level of satisfaction of the residents (or users) with the service	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing propensity to adopt sustainable mobility behaviors (change mobility patterns)	FL	Share of respondents (stakeholders/citizens/students/employees/relevant group of people) ready to adopt sustainable mobility behaviours	%	Task 1.5 - Survey		X	
SW	S	Increasing perceived accessibility of vulnerable groups	FL	Perceived level of accessibility by vulnerable groups	Weighted average	Task 1.5 - Survey		X	
SW	E	Reduce operational cost	FL	Operational costs using (automated vehicles/electric mini-buses), compared to Operational costs using convensional vehicles	%	Automated Bus Operator Data		X	
SW	E	Reduce operational cost	FL	Monetarised value of travel time	€	Task 1.5 - Survey		X	
PW	E	Economic viability of the system	FL	Share of stakeholders that consider the system will be / is economicaly viable	%	Task 1.5 - Survey		X	

TA-UC02

						Data sources		**Scale**	
H*	**T.D.**	**Expected impact**	**Level**	**Indicator**	**unit**	**Source 1**	**Alternative Source (if needed)**	**P**	**C**

PW	T	Decrease perceived car dependancy	FL	Share of a representative sample of inhabitants/users reporting to be fully or highly dependent on car for their daily urban mobility	%	Task 1.5 - Survey		X	
SW	T	Increasing Speed of public transport (Reduction of travel times with public transport)	FL	Observed travel time of PT between sample stops in sample periods in the experiment area for each involved route	minutes	Automated Bus Operator Data		X	
SW	T	Improving speed of driverless bus service compared to conventional bus service	FL	Ratio of between Travel time between sample stops in sample periods in the experiment area for each involved route of driverless bus compared to conventional bus services	Ratio	Automated Bus Operator Data		X	
SW	T	Improving reliability of public transport	SL	Share of services arriving at a sample stops more than 20% of headway delayed	%	Task 1.5 - Survey	alternative: bus operator data	X	
SW	T	Increasing perceived accessibility to public transport	FL	Share of users perceving an increase in the accessibility to public transport	%	Task 1.5 - Survey		X	
SW	T	Increase number of passengers in public trasport	FL	Number of bus (or mini-bus) passengers in specific stops	n of pax	Task 1.5 - Survey		X	
CS	T	minimizing the passengers' waiting time at the station (after drop-off for intermodal trips)	FL	average waiting time at the station/stop (after drop-off for intermodal trips)	minutes	Task 1.5 - Survey	alternative: bus operator data	X	
CS	T	improve physical integration between transport modes	FL	Ratio between the number of passengers interchanging at tram stop (with the autonomous service) and population of the experiment area	n/share per population	Task 1.5 - Survey		X	
PW	T	Modal shift towards public transport for commuting trips	SL	Share of public transport on generated commuting trips in the pilot area	%	Task 1.5 - Survey		X	
SW	T	Minimization of deadhead distances (passangers)	FL	Kms run by PT with less than 15% passenger load capacity/Passengers traveling by PT by time of day	km/pax	Automated Bus Operator Data		X	
PW	Env	Improving urban environmental liveability perception of selected target groups	FL	Reported environmental liveability (perception)	Weighted average	Task 1.5 - Survey		X	
PW	Env	Reducing Climate impact	FL	Average CO2 emission per vkm of road vehicles in the fleet	kg CO2-eq / vkm or per unit time	Automated Bus Operator Data	Finland Car Registry	X	
PW	Env	Reducing Pollution impact	FL	Total pollutants emissions (produced by all vehicles circulating in the area) expressed in tonnes/year, for three pollutants: Particulate Matter (PM), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC).	tonnes/year	Automated Bus Operator Data	Finland Car Registry	X	
PW	Ene	Reducing transport energy demand	FL	Energy supplied at fuelling/recharging	litres (Gasoline, Diesel) and Kwh (elect.)	Automated Bus Operator Data		X	
CS	Ene	Reducing transport energy demand	FL	Stations using inductive changing with respect to manual charging	kWh, %, Ratio	Automated Bus Operator Data		X	
SW	V	Reduce frequency of system failures	FL	Frequency of system failures	Count per km driven and their description	Automated Bus Operator Data		X	

SW	V	Reduce disengagement rate	FL	disengagement rate	Count per km driven	Automated Bus Operator Data		X	
SW	V	Acceleration sum	FL	Sum of positive accelerations per 100 km, in free driving and in car following	m/s2	Automated Bus Operator Data		X	
SW	V	Harsh braking events	FL	Number of ego vehicle decelerations over X m/s² for at least Y s, per distance driven	Number/km or number/h	Automated Bus Operator Data		X	
PW	S	Increase transport related safety	SL	Total number of traffic accidents per inhabitant in pilot/experiment area	n	Automated Bus Operator Data		X	
PW	S	Increase perceived safety of mobility in the experiment area	SL	Reported road safety (perception)	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing perception of positive impact (or benefit) on day to day life	FL	Reported perception of positive impact (or a benefit) on day to day life by selected group	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing acceptance of implemented measures	FL	Reported score of respondents considering acceptable the implemented measures	Weighted average	Task 1.5 - Survey		X	
SW	S	Acceptability of being next to the automated vehicle	FL	Share of respondents that would support: Driving/Walking/Cycling next to the AV	%	Task 1.5 - Survey		X	
SW	S	Acceptability to hop on an automated vehicle	FL	Share of respondents that would use an AV as passengers	%	Task 1.5 - Survey		X	
PW	S	Increase Customer satisfaction	FL	Level of satisfaction of the residents (or users) with the service	Weighted average	Task 1.5 - Survey		X	
PW	S	Increasing propensity to adopt sustainable mobility behaviors (change mobility patterns)	FL	Share of respondents (stakeholders/citizens/students/employees/relevant group of people) ready to adopt sustainable mobility behaviours	%	Task 1.5 - Survey		X	
SW	S	Increasing perceived accessibility of vulnerable groups	FL	Perceived level of accessibility by vulnerable groups	Weighted average	Task 1.5 - Survey		X	
SW	E	Reduce operational cost	FL	Operational costs using (automated vehicles/electric mini-buses), compared to Operational costs using convensional vehicles	%	Automated Bus Operator Data		X	
SW	E	Reduce operational cost	FL	Monetarised value of travel time	€	Automated Bus Operator Data		X	
PW	E	Economic viability of the system	FL	Share of stakeholders that consider the system will be / is economicaly viable	%	Task 1.5 - Survey		X	

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