

CONCEPTS AND SOLUTIONS FOR SOCIALLY OPTIMISED MOBILITY SYSTEMS

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Author(s):

Bax Innovation	J Bohlen, N Corti, L Axinte
Fit Consulting	M Meta, F Mauro
Panteia	C Ramos, T v d Sande, A Vasilenka

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Author(s)	Jasper Bohlen [**Bax**], Niccolò Corti [**Bax**] Carolina Ramos [**Panteia**], Anna Vasilenka [**Panteia**], Thomas Van Der Sande [**Panteia**] Marisa Meta [**Fit**], Filippo Mauro [**Fit**]				
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About GOLIA

GOLIA is a project focused on Governing, Optimising and Leveraging Innovation in cities through data-driven and social-optimum led approach. It aims to ensure an adaptive, accessible and just mobility system planned and governed with the help of digital assets, but also with the inclusive and co-creational policy making processes. Through the integration of STEM and SSH expertise and approaches, GOLIA will revolutionize spatial and mobility planning by co-developing and testing vision-led Social Optimum Mobility Index, a metric to assess urban mobility systems based not only on economic variables but also on indicators such as social support, healthy life quality or freedom to make life choices. The index will be location and time dependent to enable dynamic management of transport offer and spaces.

The project will analyse the policy making processes, citizen engagement practices and digital assets of the three Partner cities and with the gained knowledge, it will create an integrated, interdisciplinary and Adaptive Mobility Smart Governance Model. GOLIA aims at understanding to which extent and under which conditions, data generated by Smart Cities supported by AI-based tools novel communication and consultation channels and methodologies to engage citizens and stakeholders might foster the establishment of a new inclusive and adaptive mobility governance. GOLIA's goal is to identify governance models able to deliver policies resilient to political instability, extreme weather events, pandemics or any other more or less disruptive event, as they are co-developed, co-designed, and co-monitored by and for citizens and firms.

Deliverable detailed information

KEY WORDS

Transport personas, mobility map, governance models

GOLIA OUTPUTS MAPPING TO GA COMMITMENTS

Mapping D1.1 Outputs to the GA Deliverable Description
Extract of the Deliverable Description from the GA *"D1.1 Concepts and solutions for socially optimised mobility systems. Summary of promising concepts and solutions to fulfil user needs, contributing to more sustainable transport systems. Includes set of behavioural indicators and findings from mobility surveys"*
Chapters addressing the Deliverable Description *Chapter 3 and Chapter 4*
Justification *Chapter 4 Contains a comprehensive summary of promising mobility solutions and practices, their impacts and other considerations. Chapter 3 Contains the behavioural analysis conducted in T1.1 and the elaboration of the results coming from a survey focused on transport behaviours filled in by ICB members and their associate. Chapter 5 is about governance in mobility, multi-level governance and political considerations on the management of mobility solutions and practices.*
Mapping D1.1 Outputs to the GA Task Description
Extract of ST1.1.1 Description from the GA *"Mapping and evaluating City users' attitudes (Decode the genome). This subtask aims to quantify behavioural indicators related to emerging mobility practices, solutions and governance models, examining their interaction with social networks, psychological variables, spatial heterogeneity, and time dependence. For this, PAN will lead the segmentation of individuals and groups of city users, based on factors such as gender, age, location, education, income, historical heritage, cultural background, etc. - for citizens, and factors such as specific supply chain requirements, type of product and/or activity, location, dedicated spaces for sales/warehousing, replenishment needs, etc. - for firms. Building upon the social tipping theory, the analysis will identify user preferences, as well as effective nudges and incentives, which will feed into SOMI (T1.4). Additionally, T1.1 aims to consolidate the different applications of Agent-Based Modelling (ABM) in transportation research, providing a unified framework for the application of ABM in modelling the social optimum in task 1.4 and 2.5. This subtask will rely on synergies with the ICB which will deploy questionnaires and interviews with their members."*
Chapters addressing the Deliverable Description *Chapter 2, Chapter 3*

Justification

Chapter 2 presents the methodology followed, while Chapter 3, presents the behavioural dimension of the GOLIA framework through the development of user personas for the pilot cities of Antwerp, Florence, and Pilsen. The chapter explains the methodology used to identify different mobility users, their behavioural characteristics, barriers, enablers, and responses to mobility policies and innovations. Building on literature review, behavioural theory, and Social Tipping Theory, the analysis explores how factors such as accessibility, infrastructure, daily routines, and social influence shape mobility behaviour. The chapter also describes the process used to define and validate the personas, including the identification of nudges and incentives linked to different transport modes.

Extract of ST1.1.2 Description from the GA

"Mapping and evaluating new practices and solutions. This task will build on current knowledge bases and observatories to map and assess existing and emerging transport and mobility practices and solutions and how these relates to usage of public spaces in terms of: 1) Contribution to local/regional/national objectives (e.g., CO2 reduction, increase in accessibility, public health, cohesion, safety, security, environmental awareness, etc.); 2) Potential to foster inclusivity and equity, e.g., against the current MaaR definitions and in connection with T1.3; 3) Overall acceptance/popularity amongst both users and politicians; 4) Financial viability/implications for both users and providers (e.g., costs of physical and digital infrastructures, tariffs for the end users, etc). The mapping includes: i) Practices: superblocks, school streets, 15' cities, transit-oriented development, mixed land use, community mobility, commoning, UVARs and curbside management; ii) Solutions: shared mobility solutions, MaaS, mobility hubs, logistics micro-hubs, on-demand services, driverless vehicles etc. Together with the ICB, BAX will also highlight drivers with potential to enhance the social cohesion that enable certain mobility concepts and solutions (e.g. tactical urbanism, mobility festivals, neighbourhood shared workspaces)."

Chapters addressing the Deliverable Description

Chapter 2, Chapter 4

Justification

Chapter 2 presents the methodology followed, while Chapter 4 presents the results. Bax conducted extensive desk research to first map, cluster and then evaluate the most promising solutions. Chapter 4 presents all the solutions reviewed and evaluated. Chapter 4 also reports the ICB remarks on the social cohesion impacts of certain solutions and practices.

Extract of ST1.1.3 Description from the GA

"ST1.1.3 Mapping and evaluating Regulatory frameworks and innovative governance. This subtask will i) map and evaluate readiness and compliance of regulatory frameworks, governance approaches (including public-private collaboration schemes), policies and incentives - further elaborating and updating the Compliance Map developed in GECKO and CREATE projects, also by considering effective experiences from other fields (e.g. energy, healthcare, tourism, education); ii) evaluate with a sustainable perspective the competition of different mobility service providers on different mobility markets and formulate approaches enabling cities, regions and countries to benefit from it. iii) analyse the influence of politicians on transport policies, paying particular attention to controversies among

different governance levels, structures and entities; identify requirements for policy making processes resilient to political instability and to develop horizontally and vertically harmonised governance frameworks. The work will involve the ICB to gather best practices, share barriers and drivers, and validate results."
Chapters addressing the Deliverable Description *Chapter 2, Chapter 5*
Justification *Chapter 2 introduces the Methodology.* *Chapter 5 presents the assessment of governance approaches, regulatory frameworks, market dynamics, political dimensions and funding schemes affecting the implementation of mobility solutions. Building on literature review and previous European projects such as GECKO and CREATE, the chapter examines how governance arrangements can support the implementation of mobility solutions, with attention to advantages and challenges, regulatory requirements and coordination between institutional levels and public-private cooperation. The chapter also integrates inputs from the Impact Creation Board to validate findings and identify barriers, best practices and transferability conditions across different mobility domains.*

Table 1: Deliverable Adherence to Grant Agreement deliverable and work description

Executive summary

This deliverable presents the primary findings of Task 1.1, which serves as the foundational knowledge base for the GOLIA project. The work reported here establishes the Three-Dimensional Mobility Ecosystem Map, which is an updated compilation of personas, solutions, practices, and governance models designed to help public authorities and mobility providers navigate the interplay between human behaviour, technological innovation, and regulatory structures. Although the framework was developed with a focus on the partner cities of Antwerp, Florence, and Pilsen, the findings are intended to be useful in general. The methodology and results can be adapted to other contexts, including the project follower cities and the broader European urban landscape.

The analysis is structured around three integrated pillars that form the three-dimensional map. The first pillar, behavioural decoding, identifies the mobility genome of city users by segmenting them into distinct user personas. Utilising socio-economic and psychological profiling, this section identifies the specific nudges and incentives required to support the transition towards sustainable mobility. The second pillar, practices and solutions, evaluates the impact of emerging urban concepts such as 15-minute cities alongside technical innovations like Mobility as a Service. The third pillar, governance and regulation, maps the readiness of regulatory frameworks and evaluates public and private collaboration schemes to ensure that mobility policies remain resilient against political instability.

While this deliverable exists as a formal manuscript, its potential is best expressed through an interactive website currently under development. This digital tool, which will be deployed in the coming months and disseminated through the GOLIA website, will allow users to cross-reference the three dimensions dynamically. By using this tool, stakeholders can determine the most effective strategies to achieve specific goals in varied contexts. The results presented in this document are the outcome of extensive desk research, validated through a co-creational process involving consortium partners and the project Impact Creation Board.

This deliverable provides the initial qualitative framework for the subsequent modelling and digital development within the GOLIA project. The behavioural indicators and solution impacts identified serve as the primary inputs for the Social Optimum Mobility Index and the agent-based modelling simulations. Ultimately, this document confirms that a socially optimised mobility system is achieved through an adaptive governance model that prioritises social welfare and equitable access as highly as technical efficiency.

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List of abbreviations and acronyms

Acronym	Meaning
3D	Three-Dimensional
ABM	Agent-Based Modelling
AFIR	Alternative Fuels Infrastructure Regulation
AV / AVs	Autonomous Vehicle(s)
B2C	Business-to-Consumer
B2G	Business-to-Government
BCR	Benefit-Cost Ratio
CCAM	Connected Cooperative Automated Mobility
CFD / CFDs	Car-free day(s)
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
DRT	Demand Responsive Transit
EC	European Commission
EGTC / EGTCs	European Grouping(s) of Territorial Cooperation
ETS 2	Emissions Trading System 2
FUA / FUAs	Functional Urban Area(s)
GA	Grant Agreement
GHG	Greenhouse Gas
ICB	Impact Creation Board
ITDP	Institute for Transportation and Development Policy
KPI / KPIs	Key Performance Indicator(s)
LEZ	Low Emission Zone

LSP / LSPs	Logistics Service Provider(s)
LTN / LTNs	Low Traffic Neighbourhood(s)
MaaR	Mobility as a Right
MaaS	Mobility as a Service
MCA	Micro-hubs Catchment Area
MLG	Multilevel Governance
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
NSSPs	National SUMP Supporting Frameworks
OECD	Organisation for Economic Co-operation and Development
PDE	Plan de Déplacement d'Entreprise (Company Travel Plan)
PM10 / PM2.5	Particulate Matter (10 or 2.5 microns)
PMDP	Plzeňské městské dopravní podniky (Municipal Transport Company)
PMS	Sustainable Mobility Plan (*Plan de Mobilité Scolaire / Spatiale*)
PSO	Public Service Obligation
PT	Public Transport
ROI	Return on Investment
SO / SOs	Specific Objective(s)
SOMI	Social Optimum Mobility Index
SUMP	Sustainable Urban Mobility Plan
ToD	Transit-Oriented Development
TOS	Terminal Operating System
ULEZ	Ultra Low Emission Zone
UMIs	Urban Mobility Indicators

UVAR	Urban Vehicle Access Regulations
V2X	Vehicle-to-Everything
VKT	Vehicle Kilometres Travelled
WP	Work Package
ZEZ	Zero Emission Zone

1 Introduction

This deliverable presents the comprehensive findings of T1.1, which serves as the knowledge cornerstone of the GOLIA project. As urban environments face increasing pressure from climate change, demographic shifts, and technological disruption, there is a critical need for a governance model that is not only data-driven but also socially inclusive.

The work conducted in T1.1 and reported in D1.1 establishes the Three-Dimensional (3D) Mobility Ecosystem Map, an updated compilation of personas, solutions, practices, and governance models that can help public authorities and mobility providers navigate the complex interplay between human behaviour, technological and non-technological innovations, and regulatory structures.

1.1 The three pillars of the Three-Dimensional Mobility Ecosystem Map

The analysis is structured around three integrated sub-pillars that together form the "3D Map":

- **Behavioural Decoding (The Human Dimension):** PANTEIA identified the mobility "genome" of city users by segmenting them into distinct User Personas. Utilising socio-economic, spatial, and psychological profiling, and applying Social Tipping Theory, PANTEIA identified the specific nudges and incentives required to support the transition towards more sustainable mobility behaviours. The approach focused on understanding behavioural patterns, barriers, motivations, and social dynamics rather than on quantitative analysis. This pillar also provides the Agent-Based Modelling (ABM) framework necessary for the simulations in Task 1.4.
- **Practices and Solutions (The Technical/Spatial Dimension):** BAX evaluated the impact of emerging urban concepts (such as 15-minute cities or superblocks) alongside technical innovations (including Mobility as a Service (MaaS) or autonomous transport). Solutions were assessed based on their financial viability, contribution to sustainability, and potential to enhance social cohesion.
- **Governance and Regulation (The Institutional Dimension):** FIT mapped the readiness of existing regulatory frameworks and evaluated public-private collaboration schemes. The goal was to identify governance strategies that remain resilient against political instability or disruptive events, ensuring that mobility policies are harmonised across different administrative levels.



Figure 1: The Three Pillars of the 3D Mobility Ecosystem Map

1.2 Purpose and value proposition

Beyond serving as the knowledge foundation for GOLIA, this ecosystem map acts as a decision-support tool. By cross-referencing the three dimensions, stakeholders can determine the most effective strategies to achieve certain goals in specific contexts. For instance, the map illustrates why a specific mobility solution (e.g., an e-scooter sharing scheme) might require a different governance structure, and a different incentive approach for "Persona A" compared to "Persona B."

The findings presented here are the result of extensive desk research, validated through a co-creational process involving consortium partners (cities, NGOs, and industry experts) and the project's Impact Creation Board (ICB). In the GOLIA project, the ICB consist of NGOs, industry experts and research partners who will provide authoritative feedback on the consortium's work. It consists of ALICE, EPA, MPACT, PAVE, POLIS, TTS ITALIA and UITP. Not only the ICB will provide directly feedback to the consortium work in different stages, but their members will also be occasionally involved for specific and punctual input. The results may be further updated in WP3 based on the stakeholder consultations with the cities. This is because the ICB, for instance, did not target tourism or older citizens as they are not their core expertise. Further input will be obtained from cities outside of the consortium through the engagement of follower cities and the Community of Practice.

1.3 Attainment of the objectives and explanation of deviations

The objectives related to this deliverable have been achieved in full and as scheduled.

1.4 Intended audience

This deliverable is public. The target audience includes practitioners in the field of mobility, logistics and urban planning; public transport (PT) operators; other public authorities concerned with mobility and logistics planning; mobility and logistics experts.

1.5 Structure of the deliverable and links with other work packages/deliverables

To provide a clear path from data to actionable insights, the deliverable is organised as follows:

- **Chapter 2: Overall methodology**: Presents how the T1.1 partners defined the scope, ensured relevance for partner cities, and carried out the three analyses within a common approach
- **Chapter 3: The GOLIA User Personas**: A mapping of city users' attitudes, defining the "genomes" of different personas and the specific nudges required for behavioural change.
- **Chapter 4: The Mobility Solutions and Practices**: A detailed analysis of the clusters identified during desk research, evaluated against the project's sustainability and social cohesion objectives.
- **Chapter 5: Regulatory Frameworks and Innovative Governance**: An overview of multilevel governance models and best practices from both within and outside the mobility sector.
- **Chapter 6: Synthesis and Conclusions**: A recap of the integrated 3D Ecosystem, identifying gaps and outlining future work, including the development of the GOLIA digital assets.
- **Annex A**: Complete list of personas for the city of Florence, Pilsen, and Antwerp
- **Annex B**: ICB validation of the user personas
- **Annex C**: ICB contribution to (social cohesion) impacts of mobility solutions and practices
- **Annex D**: Full analysis of the governance models for the different groups of mobility practices and solutions
- **Annex E**: ICB's contribution to the governance of mobility solutions

2 3D mobility ecosystem: How did we do it?

The development of the 3D Mobility Ecosystem Map followed a "City Vision-Led" analytical framework. This approach ensures that the knowledge base is not merely a theoretical exercise but is grounded in the operational realities and long-term strategic ambitions of the GOLIA partner cities: **Antwerp, Florence, and Pilsen**.

2.1 Scope of the analysis

This analysis focuses on the intersection of three distinct but interdependent layers of the urban mobility ecosystem:

- **The Human Layer:** Deciphering the transport user behaviour and tipping points to achieve higher uptake of sustainable mobility solutions.
- **The Spatial/Technical Layer:** Compiling new and emerging mobility solutions and concepts and assessing their impacts.
- **The Institutional Layer:** Mapping regulatory readiness and multi-level governance models.

The analysis covers the geographic and functional urban areas (FUA) of the partner cities, while maintaining a European-wide perspective. The findings concerning Mobility (ST1.1.2) and Governance (ST1.1.3) constitute a general knowledge base, while Personas (ST1.1.1) reflect the reality of the three GOLIA cities. To ensure the transferability of findings to "Follower Cities" (Riga, Glasgow, and Metropole Aix-Marseille-Provence) and to the broader European landscape, the personas methodology has been explained in detail in Chapter 3. Replications activities will commence with T6.1 and the engagement of the Follower Cities and will be further expanded in T6.2: Knowledge sharing and Community of Practice.

2.2 The "Vision-to-Requirement" workflow

To ensure high relevance for the cities involved in the project, but also for a broader audience of cities interested in achieving more sustainable mobility planning, the methodology followed a structured four-stage deconstruction process:

2.2.1 Stage 1: Contextual immersion (The Rome Kick-off Meeting)

The process began during the GOLIA Kick-off Meeting in Rome (June 2025), where representatives from Antwerp, Florence and Pilsen presented their current mobility landscapes. This included:

- An explanation of current challenges (e.g., linked to car dependency, decreased road safety, complex last-mile logistics).
- A presentation of existing digital assets and stakeholder consultation maturity.
- The articulation of each city's "Vision" for a climate-neutral and socially just mobility system.

2.2.2 Stage 2: Vision deconstruction

Following the Kick-off, the T1.1 leadership distilled these high-level visions into a hierarchy of objectives:

- **Strategic Visions:** Broad qualitative statements (e.g., "Optimise the use of public space, achieving sustainable, safe, digital and socially optimal mobility").

- **Core Objectives:** Main objectives which together concur to the realisation of the vision (e.g., "Promote Innovative Logistics Policies and Strategies for the UNESCO area of the City Centre").
- **Specific, Actionable Objectives:** Sub-objectives that served as the "search parameters" for the compilation of the different solutions realising such objectives ("Optimise the use of public space, including road space re-allocation, greening and dynamic solutions for sustainable urban logistics")

2.2.3 Stage 3: Pillar-specific research

Once the specific objectives (SOs) were validated by the cities, research was initiated across the three sub-pillars:

- **First Pillar: Behavioural Decoding:** City users were segmented into "Personas" based on socio-economic, spatial, and psychological factors. Research focused on identifying "Social Tipping Points" (the specific conditions under which these personas would tolerate or embrace a shift in mobility habits). The analysis also explored the nudges and incentives that could support more sustainable mobility behaviours and feed into the ABM framework.
- **Second Pillar: Practices and Solutions:** Desk research identified emerging mobility practices (e.g., Superblocks, School Streets) and technical solutions (e.g., MaaS, CCAM). Each solution was evaluated against the question: *"To what extent does this solution help achieve the SOs identified in Stage 2?"*
- **Third Pillar: Governance and Regulation:** Research on the governance conditions required to make GOLIA mobility solutions operational, legitimate and scalable. Building on the ongoing discussion on multilevel governance, the section shifts from the general institutional framework to a more practical analysis of how governance affects the implementation of different types of mobility measures.

2.2.4 Stage 4: Synthesis and delivery

This deliverable represents the knowledge core of the work conducted. The reader will find the methodology, the findings and reflections on each of the dimension. However, the final stage of the work would be to cross-reference the three pillars. By linking a **Solution** (e.g., Mobility Hubs) to a **Persona** (e.g., young urban family) and a **Governance Model** (e.g., Public-Private Partnership), the project established the 3D map that guides cities and other practitioners navigating mobility knowledge, contributing to a truly inclusive mobility planning.

Since the written format is not the ideal format to visualise the intricate connections among these three dimensions, the T1.1 partners agreed on creating an online interactive tool instead. During the first period of the project, the website will be made available online through the GOLIA website and made accessible to as many users as possible.

2.3 Co-creation and validation

The methodology relied on iterative co-creation and validation cycles:

City Validation: Each stage of the objective deconstruction was reviewed by the partner cities to ensure alignment with local Sustainable Urban Mobility Plans (SUMPs).

Expert Review: The draft findings were presented to the **ICB** to ensure the scientific robustness and market relevance of the mapped solutions, personas and governance models here reported. PANTEIA, BAX and FIT involved the ICB in their respective chapters following different approaches, ultimately matching the scope of the different sections. A more detailed description of the different processes is reported in each chapter. The ICB comprises the following partners: **MPACT, TTS, UITP, PAVE, ALICE, EPA,** and **POLIS**

This collaborative approach guarantees that the 3D Mobility Ecosystem Map serves as a resilient foundation for the subsequent modelling (Task 1.4) and digital module development (WP2) within the GOLIA project.

3 City users' attitudes (GOLIA user personas)

3.1 Methodology

The methodology used in this subtask aimed to identify and structure behavioural aspects related to new mobility practices, solutions, and governance models. The main goal was to understand how mobility behaviour was influenced by social characteristics, spatial conditions, personal attitudes, and daily routines. These insights were then used to build a set of user personas that could support both policy development and modelling activities within GOLIA.

The approach followed several steps, combining **desk research, theoretical input, persona development, and behavioural analysis**. This ensured that the results were both evidence-based and useful for later tasks, including ABM.

3.1.1 Sources and basis of the analysis

The development of the GOLIA user personas was based on a structured desk-research process. This process aimed to understand how mobility behaviour was influenced by urban form, transport systems, social conditions, and governance frameworks.

A wide range of sources was used. Instead of relying only on academic studies, the analysis also included European research projects, policy documents, case studies, and practical reports. This approach was important because the task was not only to describe mobility users in theory, but also to identify real user types, behavioural barriers, and possible nudges that are relevant for cities such as Antwerp, Florence, and Pilsen. As a result, the sources provided both strong analytical insights and practical examples. **T**he following sections present the main themes identified across the sources

3.1.1.1 Built environment and street design

A first identified group of sources showed the importance of the built environment and street design in shaping mobility choices. The URBACT *Thriving Streets* report, for example, explained that mobility should be seen as a way to access services and activities, rather than as a goal in itself. It also showed that reducing car use requires a mix of actions, including political support, citizen involvement, temporary measures, placemaking, and positive communication (URBACT, 2023). In addition, it linked changes in streets to improvements in health, inclusion, local economic activity, and social life (proGireg, 2023). These findings were important for persona development, as they showed that mobility choices are not only personal decisions, but are also influenced by the quality, safety, and meaning of public space (URBACT, 2023) (OECD, 2022). Research also shows that street design, layout, visual cues, and signalling influence how users understand and navigate public space, shaping behaviours such as route choice, speed, and interactions with other road users (Theeuwes, 2021).

3.1.1.2 Behavioural change and mobility management

These sources focused on behaviour change and mobility management. The European Commission (EC)'s *Promoting Mobility Behaviour Change* framework was particularly useful because it explained that behaviour change takes time and does not happen all at once. It also suggested looking at questions such as who is most likely to change behaviour, who influences them, what benefits they get from their current behaviour, and what barriers they face (European Commission, 2018). This approach matched well with

the GOLIA persona exercise, as it helped identify user groups not only based on socio-demographic characteristics, but also on motivations, perceived benefits, and obstacles to change (Götschi, et al., 2017). The CIVITAS SWITCH toolbox further supported this by providing examples of personalised travel planning and campaigns aimed at reducing car use, especially during key life changes (CIVITAS, 2016). In addition, the CIVITAS SUNRISE project showed how these approaches can be applied in practice through co-creation with local communities and targeted behaviour change measures, helping cities design more effective and user-focused interventions (CIVITAS SUNRISE, 2021).

3.1.1.3 Accessibility, equity and inclusion

This group of sources helped explain challenges related to accessibility, equity, and inclusion. Mobility depends not only on transport systems but also on land use and access to services (OECD, 2022). The SUMP guide further supports this by emphasising that mobility planning should focus on accessibility for all users, taking into account differences in location, income, and travel needs, particularly in wider metropolitan areas (Rupprecht Consult, 2019).

This helped move beyond a simple focus on transport modes and supported the idea that personas should also reflect where people live and how easily they can reach daily activities. Projects such as DIGNITY showed that digital transport systems can improve mobility but may also create barriers for some users if they do not have the skills or access needed (DIGNITY project, 2022). The COMMUTE case study also highlighted the importance of improving accessibility for vulnerable users, including people with disabilities, and supported a solidarity fare system for people with reduced mobility, such as seniors, low-income individuals, and others with disabilities, allowing for reduced or free travel (UIA - COMMUTE, 2021).

Recent research also highlights the importance of considering gender and age when analysing mobility behaviour and accessibility. Mobility patterns are not gender-neutral, as women often undertake more complex and multimodal trip chains linked to caregiving responsibilities, household-related activities, and access to services. Women are also often more affected by actual and perceived safety concerns, including inadequate street lighting, poor visibility, limited passive surveillance ("eyes on the street"), and insufficient public amenities, which can directly influence travel choices and accessibility (EIT Urban Mobility, 2025).

Similarly, older adults may face specific barriers related to physical accessibility, wayfinding, digital ticketing systems, affordability, and age-friendly public space infrastructure. The Expert Group on Urban Mobility (EGUM) highlights the need for transport systems to incorporate accessibility features such as low-floor vehicles, ramps, priority seating, and accessible pick-up and drop-off locations. In addition, the group recommends improving pedestrian crossings, signalling systems, bus stops, and transport nodes to better accommodate ageing populations and people with reduced mobility (Expert Group for Urban Mobility, EGUM , 2022).

Together, these sources supported the inclusion of attributes such as digital skills, accessibility, affordability, safety perception, caregiving responsibilities, and age-related mobility needs within the persona framework.

3.1.1.4 Shared mobility services

Different types of bike and carsharing schemes were shown to have varying effects on car ownership and travel behaviour, depending on how they are designed and used. Some schemes can reduce the need for private car ownership, while others mainly provide additional flexibility without fully replacing car use

(H2020-STARS, 2022). Testing new mobility solutions, such as e-bikes or cargo bikes, was also found to help users try alternative modes and gradually change their habits. These types of pilot activities can lower barriers to entry and allow users to experience new options in practice (CIVITAS-ECCENTRIC, 2019). Overall, these insights helped identify personas that are more open to innovation and willing to experiment, as well as those who may require more incentives or support to move away from private car use.

3.1.1.5 Safety and user perception

Several studies highlighted the importance of safety perception in shaping mobility behaviour. Research shows that travel choices are influenced not only by actual safety conditions but also by how users perceive risks associated with different modes, routes, and environments. People may avoid certain streets, public spaces, or transport modes if they consider them unsafe, even when objective safety indicators suggest otherwise (VIVE, 2017). This is particularly relevant for vulnerable users such as pedestrians, cyclists, older adults, women, and people with reduced mobility, whose travel decisions are often more strongly influenced by perceived safety and comfort.

Behavioural research also demonstrates that users continuously adapt their actions in response to their surroundings. Visual cues, signalling, and the overall transport environment can influence how people navigate public spaces, assess risks, and interact with other users (Theeuwes, 2021). More broadly, the overall quality and attractiveness of the urban environment can also influence how people experience and use public space (Casparini et al., 2023). These findings supported the inclusion of psychological aspects in the persona framework, such as risk perception, confidence, and familiarity with the transport environment.

3.1.1.6 Urban logistics

In addition, several sources addressed the role of urban logistics and freight transport in shaping mobility patterns. While logistics actors do not represent individual user personas in the same way as citizens, they form an important sector that strongly influences urban mobility systems. Research shows that logistics operations are highly sensitive to time constraints, costs, and access regulations, particularly in dense urban areas. Projects such as NOVELLOG and case studies like the Paris logistics hotels demonstrate how solutions such as consolidation centres, micro-hubs, and low-emission delivery systems can improve efficiency while reducing environmental impacts (NOVELOG H2020, 2018) (Ellen MacArthur Foundation, 2022). More recent initiatives, such as the DISCO project, further highlight the growing importance of data sharing, digital platforms, and coordinated planning in urban logistics, supporting more efficient and integrated management of freight flows and urban space (DISCO, 2025). These insights are relevant for understanding how business actors respond to mobility policies and for defining firm-related user types within the GOLIA framework.

3.1.2 Social tipping and behaviour change dynamics

The development of the GOLIA personas was based on research on social tipping and behaviour change, especially the work of Otto et al. (2020). This helped explain how changes in mobility behaviour can spread between people and lead to wider changes over time.

Social tipping means that small changes can lead to much larger changes once a certain point is reached. Change does not always happen slowly and step by step. Instead, once enough people adopt a new

behaviour, it can spread more quickly. For example, when more people start using sustainable transport, this can encourage others to do the same, making these options more normal and accepted.

Recent research also showed that these changes are influenced by **connections between different factors**, such as social norms, policies, technology, and economic conditions. This means that a change in one area can affect others. For example, more people using sustainable transport can influence public opinion, policy decisions, and investments. These effects can reinforce each other and support faster change (Eker, et al., 2024).

At the same time, change is not always easy. Some factors can slow it down, such as strong habits, resistance to new solutions, or lack of trust. For this reason, social tipping was understood as a **process that develops over time**, rather than a single moment.

Another important point is that people are influenced by others. Behaviour often depends on what friends, colleagues, or other people in the community do. When sustainable mobility becomes more common, people are more likely to follow (Otto et al., 2020). This is especially important in mobility, where habits like car use are often shaped by daily routines.

Behaviour can also change during important moments in life, such as moving house, starting a new job, or changes in family situation. During these moments, people may be more open to trying new ways of travelling. This shows that targeted measures can often be more effective than general ones. Policies also play an important role. Measures such as incentives, regulations, better infrastructure, and information campaigns can support behaviour change. However, these measures work best when they are combined and support each other (European Commission , 2018).

Overall, mobility behaviour is influenced by a mix of individual choices, social influence, and wider system factors. Behaviour does not change in isolation, but depends on the interaction between people, infrastructure, policies, and social norms (Otto et al., 2020).

Based on this, the theory also helped identify which factors should be included in the persona framework. These included:

- Openness to change
- Influence from others
- Strength of existing habits
- Perceived barriers
- Sensitivity to incentives and social norms

This approach supported the use of personas in GOLIA. Personas helped describe different types of users but also helped understand how they might react to changes, what barriers they face, and how likely they are to change their behaviour.

3.1.3 Persona development, mapping of nudges, incentives and barriers

The identification of personas built directly on the evidence base described in Section 3.1.1. The key themes identified in the literature, such as behavioural barriers, drivers of change, and the role of policy measures, were used as a starting point for the desk research and persona development process. The process also reflected the perspective introduced in Section 3.1.2, which showed that behaviour differs across user groups and depends on factors such as habits, social influence, and openness to change. This supported the need to define different types of users rather than assuming a single average user.

Step 1: Starting from city objectives. The process started from the specific objectives defined by each pilot city (Antwerp, Florence, and Pilsen). These objectives reflected local mobility challenges, such as

improving liveability, supporting sustainable logistics, increasing cycling, improving safety, and enhancing data-driven mobility systems. Starting from these objectives ensured that personas were directly linked to real policy needs. This approach is consistent with mobility planning guidance, which highlights that user segmentation should be connected to specific policy goals rather than being purely descriptive.

Step 2: Identification of primary personas. For each objective, a **primary persona** was defined based on the literature reviewed in Section 3.1.1, as well as expert judgement. These personas represent typical users facing specific mobility situations. The literature shows that different user groups experience mobility in different ways depending on their daily routines, constraints, and access to services. In addition, several European project (i.e. CIVITAS SUNRISE, UPPER project, and HARMONY) emphasise the importance of understanding user needs and behaviours when designing mobility solutions. This perspective supported the development of personas that reflect realistic user situations and mobility challenges. Based on this, personas were defined in a concrete and relatable way.

The resulting persona framework reflects a broad range of mobility users across the three pilot cities. The personas include a combination of residents, commuters, vulnerable users, logistics and business actors, as well as visitors and students, capturing different mobility needs, behaviours, and barriers. In total, the framework identified **7 personas for Antwerp, 9 personas for Florence, and 7 personas for Pilsen**. The final personas can be found in Annex A. While some personas appeared across multiple cities, others reflected specific local conditions and mobility challenges. The Figure below presents an overview of the final personas identified for each city.

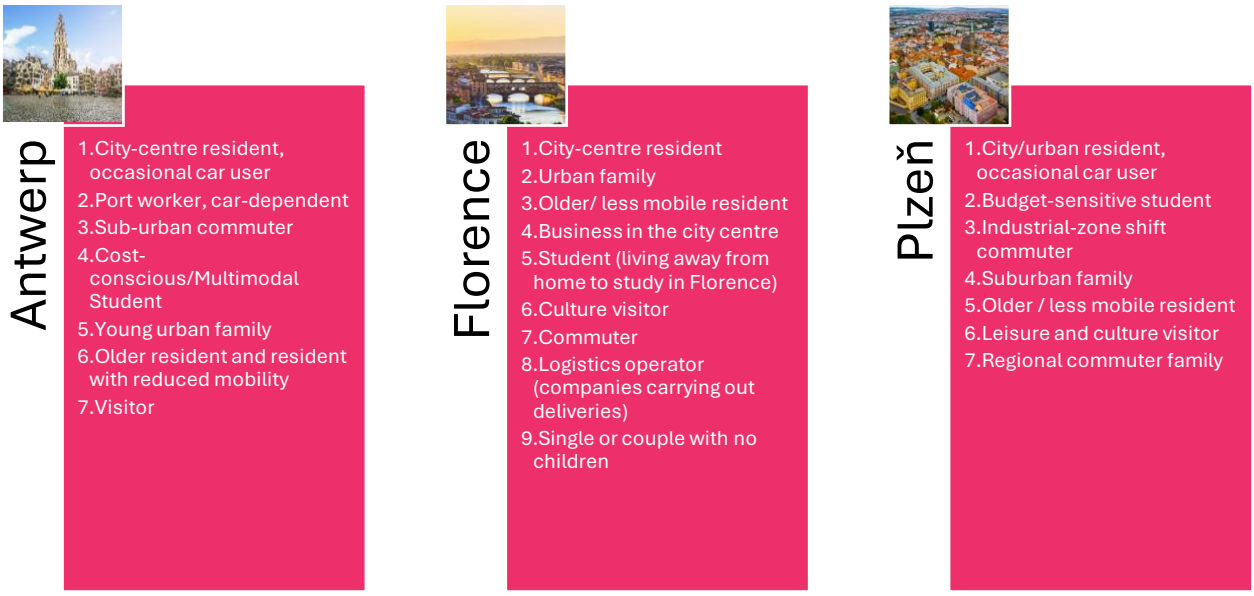


Figure 2: Final personas per city

Step 3: Definition of key attributes. For each persona, a set of **key attributes** was defined to describe behaviour, needs, and context. These attributes were based on recurring patterns identified in the literature on travel behaviour and decision-making, which show that mobility choices are influenced by daily routines, preferences, and constraints. The attributes included (among others):

- Daily mobility needs and constraints (e.g. time pressure, cost sensitivity)
- Preferences (e.g. flexibility, speed, comfort, safety)

- Level of digital skills and access to information
- Reliance on existing systems (e.g. car dependency, public transport)
- Social context and influence
- Openness to change

Different user groups may place varying importance on factors such as reliability, travel time, affordability, accessibility, safety, or flexibility depending on their daily routines and mobility needs. For example, logistics operators are often highly sensitive to time constraints and depend on predictable rules and access conditions, while other users may place greater emphasis on accessibility, affordability, or comfort (Gerike et al., 2016; DISCO, 2025).

Defining these attributes helped move beyond simple demographic descriptions and allowed personas to reflect behavioural and psychological aspects. It should be noted that the personas were not intended to represent statistically defined population segments based on detailed socio-demographic characteristics. Instead, they were developed as qualitative and policy-oriented user profiles linked to the mobility objectives and challenges identified by the pilot cities. As a result, some characteristics, such as age, mobility needs, commuting patterns, family status, or accessibility requirements, are more explicitly reflected in the persona framework than others. While factors such as gender, income, and household composition were considered during the literature review and analysis, they were generally reflected through the specific barriers, needs, behaviours, nudges, and incentives associated with each persona rather than being used as primary segmentation criteria. A more detailed socio-demographic segmentation would require additional quantitative data and behavioural analysis, which falls outside the scope of this task. These aspects can be further explored and refined in subsequent project activities, particularly through the quantitative analyses, modelling activities, and validation processes foreseen in WP2 and WP3.

Step 4: Identification of nudges. For each persona, possible **nudges** were identified. Nudges are soft measures that influence behaviour without restricting choice, often by changing how options are presented or perceived. The literature review showed that behaviour can be influenced through communication, social norms, and the design of the environment (CIVITAS, 2016) (URBACT, 2023). In addition, pilot actions and co-creation processes can help build trust and encourage users to try new solutions (CIVITAS SUNRISE, 2021) (UIA - COMMUTE, 2021). Based on this, different types of nudges were considered, including:

- Communication and awareness measures (e.g. campaigns, personalised messages)
- Visibility of benefits (e.g. time savings, cost savings, environmental impact)
- Social influence (e.g. testimonials, peer examples, community initiatives)
- Physical and spatial interventions (e.g. safer streets, better signage, improved design)
- Digital tools (e.g. apps, dashboards, real-time information)

For example, demonstration projects and test actions, such as pilot fleets of e-bikes or cargo bikes, have been shown to reduce uncertainty and support behavioural change. Similarly, visible street transformations can influence behaviour by making sustainable mobility options more attractive and easier to understand (URBACT, 2023).

Step 5: Identification of incentives. In addition to nudges, **incentives** were identified for each persona. Incentives are stronger measures that provide direct benefits or rewards and can help overcome barriers to change. The literature highlights that financial and structural incentives (UIA - COMMUTE, 2021) are

often needed alongside behavioural measures to support long-term change (OECD, 2023). The incentives identified included:

- Financial incentives (e.g. discounts, subsidies, tax benefits)
- Mobility credits and loyalty programmes
- Improved access or priority (e.g. permits, dedicated infrastructure)
- Funding opportunities (for public authorities or businesses)
- Recognition and visibility (e.g. labels, certifications, public campaigns)

For example, subsidies and reduced fees can support the adoption of low-emission logistics solutions (H2020-STARS, 2022) (NOVELOG H2020, 2018), while integrated ticketing and mobility services can encourage multimodal travel by making it easier to plan, combine, and pay for different transport modes within a single system (MOBIDATALAB H2020, 2024).

Step 6: Linking personas, attributes, nudges and incentives. This step consisted of linking all elements together. For each objective, a clear connection was established between:

- The persona (who the user is)
- The attributes (how the user behaves and what they need)
- The nudges (how behaviour can be influenced)
- The incentives (what can support or accelerate change)

This structured approach ensured that proposed measures were tailored to specific user types and aligned with the behavioural patterns identified in the literature. This is consistent with behaviour-change frameworks, which emphasise the importance of matching interventions to user characteristics and contexts.

Step 7: Consolidation and grouping of personas

As an intermediate result, the initial desk research led to the identification of a relatively large number of personas across the different objectives (step 1 to 6). While this allowed for a detailed understanding of user diversity, it also made the analysis more complex and difficult to operationalise.

To address this and in agreement with the WP1 members, a final step was carried out to **consolidate and group similar personas**. Personas that shared similar characteristics, behaviours, and needs were clustered together into broader user types. This helped reduce complexity while maintaining the key behavioural differences identified in the earlier steps.

In parallel, the analysis moved from individual personas to a more structured understanding of **mobility patterns across different transport modes**, including walking, cycling, public transport, and car use. For each mode, the main **enablers** and **barriers** influencing user behaviour were identified.

These included:

- **Enablers**, such as:
    - Availability of safe and well-designed infrastructure
    - Reliable and accessible public transport services
    - Clear and real-time information
    - Affordability and financial support
    - Integration between different transport modes

- **Barriers**, such as:
    - Lack of safety or perceived risk
    - Limited accessibility or poor connectivity
    - High costs or unclear pricing
    - Strong habits related to car use
    - Complexity of systems or lack of information

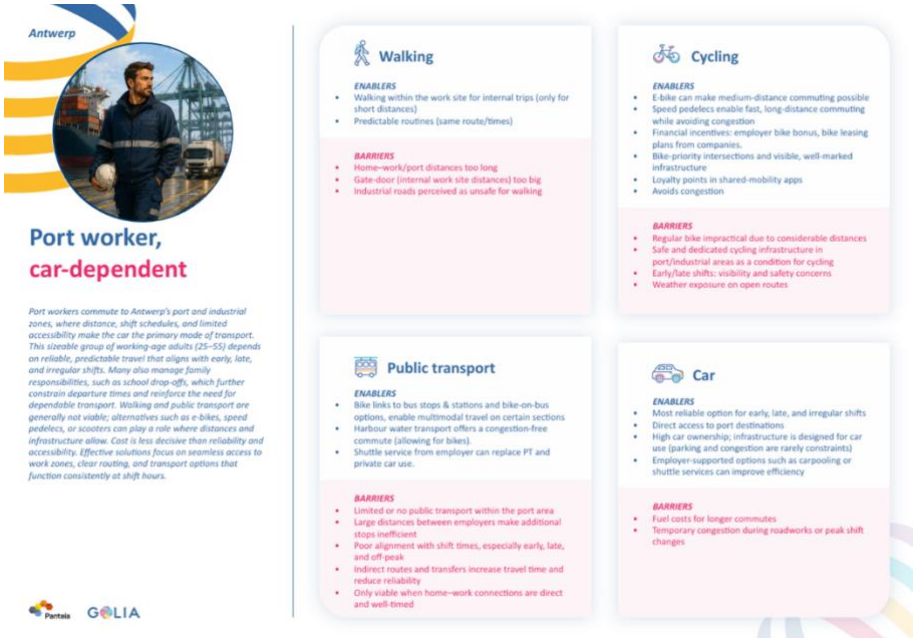
This step was based on the same literature described in Section 3.1.1, which highlights that behaviour is shaped by a combination of physical, social, and economic factors.

The grouping of personas and the identification of enablers and barriers also supported the transition from a descriptive analysis to a more operational framework. In particular, it allowed for a clearer link between:

- User groups
- Behavioural patterns
- Mobility modes
- and potential policy measures

This approach is in line with behaviour-change methods, which suggest that user groups should be simplified into clear and usable categories, while still keeping the main differences between them. This is important to ensure that the analysis remains practical and can be used to support the following tasks.

The result of this step was the final persona framework for each city, which combines user profiles with key barriers and enablers for each transport mode, as well as targeted nudges and incentives. This framework provided a structured way to link user behaviour with possible policy measures in Antwerp, Florence, and Pilsen. Below one example for each city. All the personas can be found in Annex A.



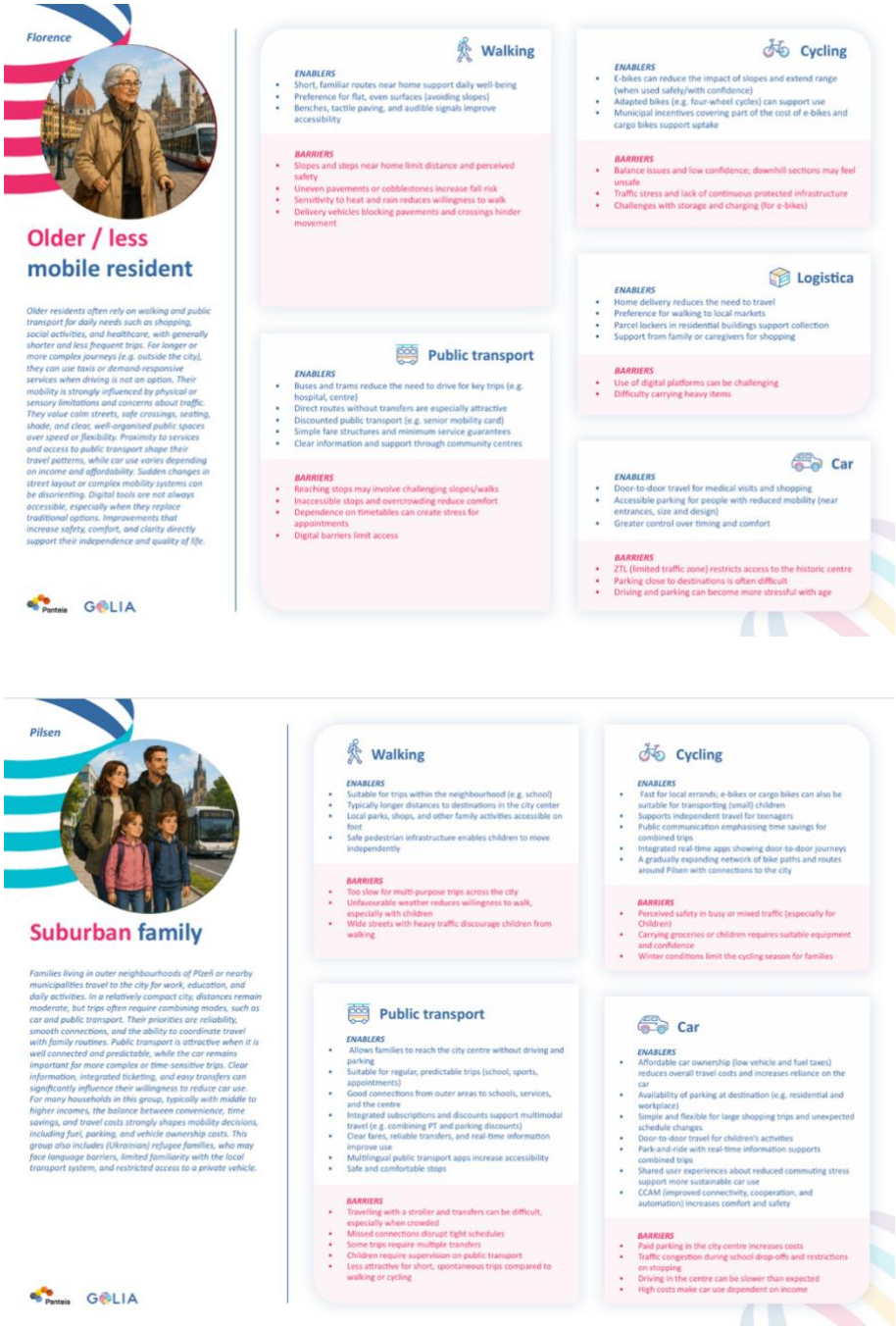


Figure 3. Examples personas

3.2 Final persona framework

The results of Step 7, including the grouped personas and the identification of barriers and enablers, were presented during the GOLIA General Assembly. This provided an opportunity to discuss the outcomes with project partners and representatives from the pilot cities.

A **first round of validation** was carried out during this session, where cities and consortium partners reviewed the proposed personas, attributes, and associated nudges and incentives. Feedback focused on

ensuring that the personas accurately reflected local conditions, mobility challenges, and policy priorities in each city.

Following this, a **second round of validation** was conducted directly with the pilot cities. This step allowed for further refinement of the personas, with a stronger focus on local context, feasibility, and clarity. Adjustments were made to better reflect real-life situations, simplify descriptions where needed, and ensure alignment with the cities' objectives, particular characteristics and ongoing initiatives.

This iterative validation process ensured that the final personas were not only grounded in literature and theory, but also **relevant, realistic, and usable** for local stakeholders.

3.2.1 Validation ICB

To validate the relevance of the identified mobility enablers and ensure that they reflect real-world mobility needs and experiences, a validation exercise was conducted through the project's Impact Creation Board (ICB) and its extended stakeholder network. The validation focused on assessing whether the proposed enablers correspond to the daily mobility practices, preferences, and barriers experienced by different city personas across transport modes. In addition to validating the identified enablers, the exercise also provided qualitative insights that helped refine and strengthen the persona framework developed within the project.

The validation was carried out through an online survey distributed among ICB members and their wider professional networks. Respondents were invited to provide input only for the transport modes and persona groups relevant to their expertise or lived experience. This approach ensured that the feedback reflected practical knowledge and context-specific insights rather than general assumptions. The survey combined predefined response options with open-ended questions, allowing respondents to both validate existing enablers and suggest additional considerations.

In total, 127 responses were collected from a broad mix of stakeholders. The largest share of respondents came from government bodies, municipalities, public transport operators, and publicly owned mobility organisations (35%), followed by industry associations and mobility networks (32%). Research institutions and academia accounted for 13% of responses, while private sector organisations represented 10%. Additional contributions were received from NGOs and non-profit organisations. This distribution ensured that the validation reflected a wide range of institutional and operational perspectives, although the sample remained more strongly represented by public and network-oriented actors than by commercial stakeholders.

The responses covered several persona groups identified within the project. The strongest representation was obtained for the city centre resident (41% of responses) and suburban commuter (33%), allowing for more extensive validation of the enablers associated with these personas. Smaller but still valuable contributions were received for older residents, young urban families, residents with reduced mobility, tourists, and logistics service providers. Validation for students and industrial shift workers remained limited due to the lower number of responses. Despite these differences, the survey generated a substantial body of qualitative input across all transport modes, supporting a broader understanding of urban mobility needs and behavioural drivers.

Overall, the validation exercise confirmed that many of the identified enablers strongly align with the practical experiences and expectations of mobility users and stakeholders. Across all transport modes, recurring themes emerged around safety, accessibility, reliability, integration between modes, and the quality of the public realm. The results also demonstrated the importance of considering mobility as part of wider daily routines and urban living conditions rather than as isolated transport choices.

For walking, respondents consistently emphasised the importance of safe, accessible, and attractive pedestrian environments. Key enabling factors included safe crossings, reduced conflicts with cyclists and motorised traffic, well-maintained sidewalks, adequate lighting, seating, and greenery. Respondents also highlighted the importance of proximity to daily services and compact urban design concepts, such as the '15-minute city', which reduce the need for longer trips and encourage walking as part of everyday routines. Walking was frequently described not only as a transport mode, but also as an important element of comfort, health, and accessibility within urban environments.

The validation results for cycling and micromobility similarly highlighted the importance of high-quality infrastructure and multimodal integration. Respondents stressed the need for protected and segregated cycling lanes, secure bicycle parking, and safe connections between residential areas, transport hubs, and city centres. Integration with public transport systems was considered particularly important for enabling longer or multimodal trips, especially among suburban commuters. Additional enabling factors included access to shared bicycles and cargo bikes, affordability, and supportive facilities such as workplace showers and secure parking. Respondents also noted that cycling becomes more attractive when supported by consistent infrastructure planning and comfortable year-round conditions.

Public transport-related responses strongly focused on service quality and reliability. Frequent and predictable services, shorter travel times, and clear network structures were among the most frequently identified enablers. Respondents also highlighted the importance of affordable and integrated ticketing systems, good first- and last-mile connections, and accessible infrastructure for different user groups, including older residents and persons with reduced mobility. Comfort and safety were also recurring themes, with respondents referring to cleanliness, crowding, lighting, and the overall travel experience. Several respondents stressed that public transport uptake depends not only on infrastructure availability, but also on the perceived ease, reliability, and attractiveness of the service compared to private car use.

The findings regarding car use and parking reflected a more conditional relationship between users and private vehicle use. Respondents generally associated car use with situations where alternative modes were insufficient or impractical, such as transporting heavy goods, reaching remote destinations, or combining multiple activities within one trip. Parking availability, park-and-ride systems, and real-time information on parking occupancy were identified as important enabling factors. At the same time, several respondents questioned whether car use should be further encouraged in urban areas, reflecting broader sustainability concerns and support for multimodal transport systems. These findings suggest that car use is increasingly perceived as complementary rather than central within sustainable urban mobility systems.

Finally, the logistics-related responses demonstrated the importance of convenience, flexibility, and accessibility in urban delivery systems. Respondents highlighted the value of home delivery services, parcel lockers, and urban logistics hubs, particularly for goods that are difficult to transport through active mobility modes. Environmental considerations also emerged in several responses, with participants expressing support for delivery solutions that reduce congestion and pollution. The integration of logistics services into broader urban mobility and public infrastructure systems was identified as an important area for future development.

Overall, the validation exercise provided important confirmation that the identified enablers reflect the practical mobility needs and behavioural considerations of different user groups. The qualitative feedback received through the survey further enriched the persona framework by adding contextual and experience-based insights that could not be captured through predefined categories alone. While the level of validation differed across personas, the exercise strengthened the robustness of the identified enablers and supported their further use within the project's modelling and policy development activities. Annex B includes the report of the survey analysis.

4 New practices and solutions

4.1 Methodology

This chapter presents the results of the systematic mapping and evaluation of current urban mobility solutions. By aligning innovative practices with the strategic visions of Antwerp, Florence and Pilsen, we have compiled a catalogue of interventions designed to support the transition toward a more user-centric, equitable and sustainable mobility planning.

The methodology for this chapter unifies the processes of desk research, solution identification and impact assessment into a single, integrated framework. This ensures that every evaluated practice is directly linked to the SOs distilled from the partner cities' visions.

The sources consulted span project reports (e.g., Horizon Europe, Interreg), case study reports and academic publications, as well as specialist magazine or newspaper articles. Internally shortlisted projects/studies/examples built the research's foundation, leveraging several project-internal mobility experts' experiences and knowledge bases. In addition, a conventional keyword search was conducted, filling the gaps and ensuring only relevant examples are featured. To ensure a coherent evaluation of the chosen mobility solutions, examples with tangible, quantified results were selected. Moreover, the context in which the respective results were yielded was analysed, to ensure applicability for the evaluation of the mobility solution or practice.

4.1.1 Identification via specialised desk research

The identification process began with a comprehensive audit of existing urban mobility knowledge bases (e.g., EU Urban Mobility Observatory), guided by the cities' SOs. Each city provided an initial pitch, outlining their achievements, challenges, and future visions for urban mobility and logistics. These presentations helped the T1.1 partners define the scope of the research.

Antwerp, for instance, aims to reduce the share of personal motorised traffic in the broader transport region to 50% - down from the current 58% - building on its success in the city centre, where this share is already around 41%. To achieve this, Antwerp seeks stronger collaboration among public authorities, particularly with the metropolitan authority, focusing on data sharing, mobility planning, and the deployment of sustainable alternatives to personal motorised transport. Liveability is another key priority for Antwerp, especially in areas near the ring road. To support the modal shift, the city faces the challenge of upgrading its active mobility networks (such as cycling infrastructure) and integrating PT options through advanced digital tools, route planner, and MaaS platform *Smart Ways to Antwerp*. Smart Ways to Antwerp (*Slim naar Antwerpen*) is the official mobility program of the City of Antwerp, designed to reduce traffic congestion by promoting sustainable transportation. It encourages locals, commuters, and visitors to switch from private cars to biking, walking, public transit, and shared mobility (e.g., e-scooters and shared cars).

In **Florence**, the challenge is deeply intertwined with the city's UNESCO heritage and historic urban fabric. Road safety and congestion in these areas are critical pain points, exacerbated by the constant influx of tourists and commuters competing for limited public space. To address this, Florence is prioritising the optimisation of urban logistics, streamlining freight distribution and last-mile delivery to minimise congestion while preserving accessibility. The city is also working to expand 30 km/h speed limit zones across districts, aiming to reduce emissions and protect vulnerable road users. However, navigating the governance required to implement these measures consistently remains a complex task.

Similarly, **Pilsen** confronts its own mobility paradox, particularly in its industrial zones, where car dependency is high and integration of transport systems is fragmented. The city's FUA extends 30 km beyond its core, encompassing a patchwork of villages that struggle to connect seamlessly with PT, active mobility, and emerging technologies like Connected Cooperative Automated Mobility (CCAM). Operational challenges are further compounded by siloed data across transport, energy, environment, and social sectors, hindering the development of data-driven strategies such as digital twins. To succeed, Pilsen must not only unify its data infrastructure but also build trust and governance frameworks that align smart-city initiatives with the needs and expectations of its broader community.

The specific challenges and strategic visions outlined by Antwerp, Florence, and Pilsen provided the foundation for the research scope. To ensure a structured evaluation, these priorities were distilled into a set of SOs, which served as the primary criteria for selecting and assessing mobility solutions.

Specific Objectives per City:

ANTWERP		
General Objective	**SO**	**Specific Objective**
OA1 **DECREASE CAR DEPENDENCY IN THE WHOLE TRANSPORT REGION**	**SOA1.1**	Increase liveability of areas previously dominated by cars
	SOA1.2	Maintain accessibility for sustainable logistics, including in central and pacified areas
	SOA1.3	Enhance cycling in peri-urban areas
	SOA1.4	Enhance cycling in urban areas
	SOA1.5	Enhance the reliability of PT to stimulate ridership
	SOA1.6	Promote sustainable alternative models to car ownership
	SOA1.7	Reach broader citizen engagement
OA2 **IMPROVE THE ADOPTION, FUNCTIONALITIES AND COVERAGE OF SMART WAYS TO ANTWERP**	**SOA2.1**	Involve the metropolitan area in the planning
	SOA2.2	Involve the metropolitan area in data sharing
	SOA2.3	Efficiently reach the target audience when communicating
	SOA2.4	Promote a marketplace for mobility to improve the user experience
OA3 **REACH AN INCLUSIVE POLICY MAKING APPROACH**	**SOA3.1**	Include / adopt co-creation methods when planning mobility solutions
	SOA3.2	Focus on engagement of in general hard-to-reach groups of residents
	SOA3.3	Promote involvement and planning for diverse users
	SOA3.4	Involve local businesses and Logistics Service Providers (LSPs) in logistics planning

Table 2: SOs Antwerp

FLORENCE		
General Objective	**SO**	**Specific Objective**
OF1 **PROMOTE INNOVATIVE LOGISTICS POLICIES AND STRATEGIES FOR THE UNESCO AREA OF THE CITY CENTRE**	**SOF1.1**	Optimise use of public space for sustainable urban logistics
	SOF1.2	Reduce distance between origin and destination for logistics service providers and promote adoption of micro-hubs
	SOF1.3	Promote sustainable urban logistics modes and models
	SOF1.4	Engage with citizens, local business and tourists
OF2 **IMPROVE ROAD SAFETY, AIMING AT REDUCING THE NUMBER OF ROAD CASUALTIES AND INJURIES IN LINE WITH EU VISION ZERO**	**SOF2.1**	Reduce speed limits in the city centre, extend 30 km/h zones
	SOF2.2	Rethink and redesign roads to incentivise safer driving behaviours
	SOF2.3	Promote interventions to protect vulnerable road users
	SOF2.4	Promote road safety education
OF3 **PROMOTE AN INTERDISCIPLINARY APPROACH AND COLLABORATION ACROSS DIFFERENT SECTORS AND STAKEHOLDERS TO ACHIEVE A SUSTAINABLE, SAFE, DIGITAL AND EQUITABLE MOBILITY ECOSYSTEM**	**SOF3.1**	Improve quality of public space by adopting an interdisciplinary/multi-level governance
	SOF3.2	Promote awareness campaigns, engaging citizens and city users
	SOF3.3	Ensure equitable access to mobility for all users (MaaR)
	SOF3.4	Align land use, planning and mobility strategies
	SOF3.5	Align plans and initiatives across regional, metropolitan, municipal levels

Table 3: SOs Florence

PILSEN		
General Objective	**SO**	**Specific Objective**
OP1 **EXTEND SMART CITY INITIATIVES AND REACH**	**SOP1.1**	Better exploit existing digital assets
	SOP1.2	Build mobility management approach involving the city / FUA and neighbouring communities
	SOP1.3	Improve data sharing across different stakeholders
	SOP1.4	Integrate multisectoral data exchange
	SOP1.5	Elaborate a smart city and data federation strategy / vision
	SOP1.6	Produce new open data outputs from the current digital twin
OP2 **IMPROVE LIVEABILITY OF THE CITY GIVEN: PECULIAR CITY TOPOLOGY, CHANGES IN SOURCE OF EMPLOYMENT OF CITIZENS AND DIVERSITY CONSIDERATIONS**	**SOP2.1**	Involve large employers (SMEs: 250+ employees) in mobility planning
	SOP2.2	Create opportunities for connections between groups from different cultural backgrounds
	SOP2.3	Set up communication framework with citizens, employees, companies, visitors
	SOP2.4	Promote active modes of travel
	SOP2.5	Enhance and extend multimodal transport, including peripheral areas of the city
OP3 **MAKE PILSEN A CCAM-READY CITY**	**SOP3.1**	Promote on demand PT to complement the current transport offer
	SOP3.2	Build citizen support and trust for CCAM
	SOP3.3	Adapt physical infrastructure to more sophisticated transport modes
	SOP3.4	Adapt connected and digital infrastructure to ensure readiness for more connected vehicles
	SOP3.5	Coordinate multi-sectoral collaborations to implement innovative mobility and logistics solutions

Table 4: SOs Pilsen

These SOs served as the primary selection criteria for the mobility solutions featured in this research. Each solution was carefully mapped to ensure it directly addresses one or more of these identified needs, resulting in a comprehensive catalogue where every objective is effectively tackled.

To ensure the relevance of the solutions to the current context, special attention was given to innovative and emerging concepts, including autonomous shuttles (CCAM), 15-minute city frameworks, and integrated mobility hubs.

4.1.2 Building upon previous EU-funded research & innovation initiatives

As also further referenced in Regulatory frameworks and innovative governance (5), GOLIA builds upon previous projects. The *CREATE* project (Congestion Reduction in Europe: Advancing Transport Efficiency) is "designed to assist cities in their forward planning to achieve sustainable mobility, a reduced dependence on private cars and a new focus on improving the 'liveability' of cities through the design of high quality 'places', by reducing traffic dominance" (Cristea et al., 2018). The CREATE project developed guidelines (D5.3) and those "guidelines provide clear advice to cities as to how they can learn from and adapt the experiences of the transport evolution in other cities to advance their ambitions for sustainable mobility greater city liveability" (Cristea et al., 2018). The core principle is that cities can accelerate their transition to sustainable mobility by learning from past life cycles of other cities rather than just planning from a current baseline. CREATE's approach is particularly relevant in that it addresses social welfare maximisation and social cohesion.

4.1.2.1 Three stages of urban mobility

The CREATE guidelines set up an interesting way of looking at cities, which GOLIA picks up and applies. CREATE classifies cities based on their historical relationship with car dependency:

- **Stage 1**: Car dependent cities with growing car use
- **Stage 2**: Cities that begin to become car independent, levelling off in car use
- **Stage 3**: Car independent cities with declining car use

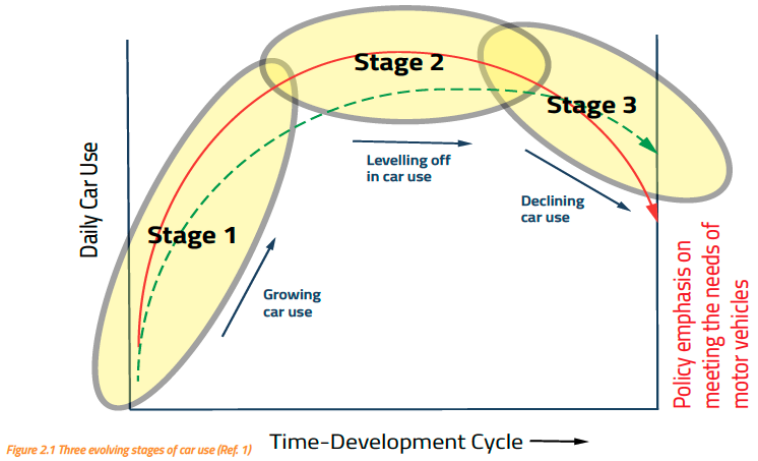


Figure 4: CREATE's 3 evolving stages of car use (Cristea et al., 2018)

In the context of GOLIA, our partner cities represent different stages of this evolution. No thorough assessment of the local mobility systems was conducted, but the cities can broadly be assigned as follows: **Pilsen** operates primarily at **Level 1**, **Florence** occupies a hybrid **Level 1-2** status, and **Antwerp** is the most advanced in this framework, reaching **Level 2-3** through its large-scale modal shift initiatives.

Building on the three stages, CREATE defined three types of policies that can be mapped with the stages of cities. Those three policy types align with three visions of a city that developed over time:

- **Policy type C** (“*car-oriented city*”): For example, road building, car parking, lower density, decentralisation
- **Policy type M** (“*sustainable mobility city*”): PT, cycle networks, transit-oriented development, road-space reallocation
- **Policy type P** (“*a city of places*”): Public space, street activities, traffic restraint, mixed use developments

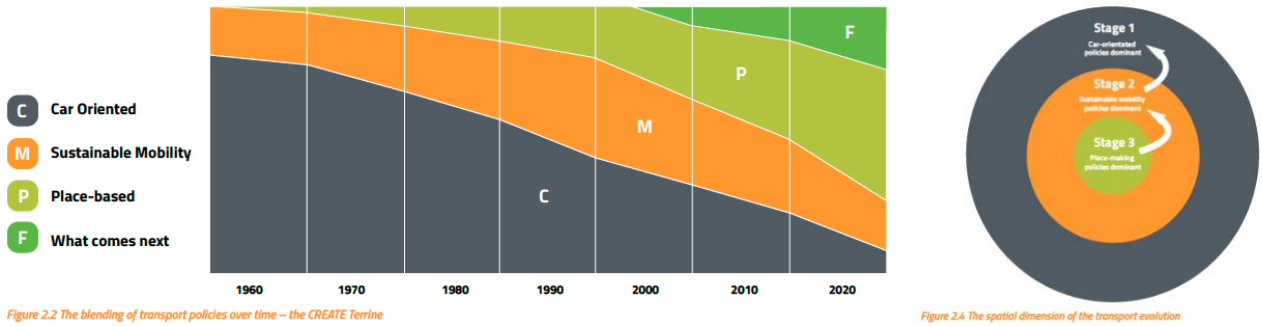


Figure 5: CREATE's transport policies evolution (Cristea et al., 2018)

4.1.2.2 Next level of innovation: social value

Interpreting the CREATE guidelines, they suggest the most innovative, state-of-the-art in urban mobility planning is the shift from managing movement (vehicles or people) to focusing on place-making. This "next level" of innovation treats transport capacity as a resource to be converted into **social value**.

This approach is picked up and applied in GOLIA. This deliverable, D1.1, and the chapter on mobility practices and solutions is collecting positive examples and tries to learn from them. Moreover, it particularly focuses and highlights the special importance of social value – involving the ICB expertise.

4.1.2.3 Alignment with GOLIA

Accordingly, the development of mobility solutions takes the differentiation and categorisation of mobility solutions into consideration. As discussed in methodology section, however, the selection of mobility solutions and practices is not only based on the policy levels but mainly based on the cities’ SOs as the initial and main reference point that must be addressed. SOs require specific solutions, so in our development and selection of mobility solutions, we cannot solely follow the pattern CREATE, suggesting only P-policies for Stage 3 contexts. Technical, M-Type policies are also part of the solution-mix. They act as enablers in the first place, building the foundation of sustainable mobility, to then allow P-type policies to succeed.

Having said that, for Florence and Antwerp, most objectives align with the focus on social value. Pilsen has a more technical-dominant focus on technical solutions, but nonetheless is also addressing P-type solutions, mainly through OP3.

CREATE’s approach is particularly relevant in that it addresses social welfare maximisation and social cohesion. Those are core-goals of GOLIA. Thus, the transition toward place-based planning represents a structural commitment to the Social Optimum. By utilising P-Policies as enablers, GOLIA aims to develop a governance model that balances diverse stakeholder interests to maximise the Social Optimum Mobility Index (SOMI). These P-type interventions are essential for fostering social cohesion, as they reclaim

dangerous transit corridors for use as safe, co-monitored community spaces designed for all user segments. Ultimately, this facilitates a just mobility transition where technical M-type infrastructure serves as the necessary enabler for a broader system-thinking approach. By prioritising social welfare and equity, GOLIA ensures that the integrated city of the future is fundamentally a city of places, co-designed for and by its citizens.

4.1.3 Categorisation and clustering

To ensure a clear and structured analysis of the mobility solutions and practices discussed in GOLIA, we organised the identified solutions into five thematic clusters. Because the volume of individual mobility practices made separate evaluations impractical, we grouped them based on shared characteristics and their specific policy functions. The common logic across all clusters is, what kind of public action they represent and how they intervene in the mobility system, rather than which mode they target or which user group they serve. The clustering enables a cross-sector assessment of solutions based on how they intervene (infrastructure, services, digital tools, governance, etc.), rather than limiting the analysis to transport modes considered in isolation. This way, we capture integrated and hybrid measures more effectively, reflecting how real urban mobility interventions combine multiple modes, actors, and policy instruments.

Each cluster groups solutions that:

- Are typically designed, funded, or steered by similar public actors,
- Operate through comparable instruments,
- Generate impact through similar causal pathways.

In that sense, the clustering is functional, not modal.

This categorisation allows for a cross-sectoral evaluation, moving beyond traditional transport silos:

- **Spatial and street design interventions**
- **Sustainable service and operational innovations**
- **Intelligent mobility management and digital planning**
- **Governance, regulation, and institutional tools**
- **Behavioural incentives, nudges, and collective practice**

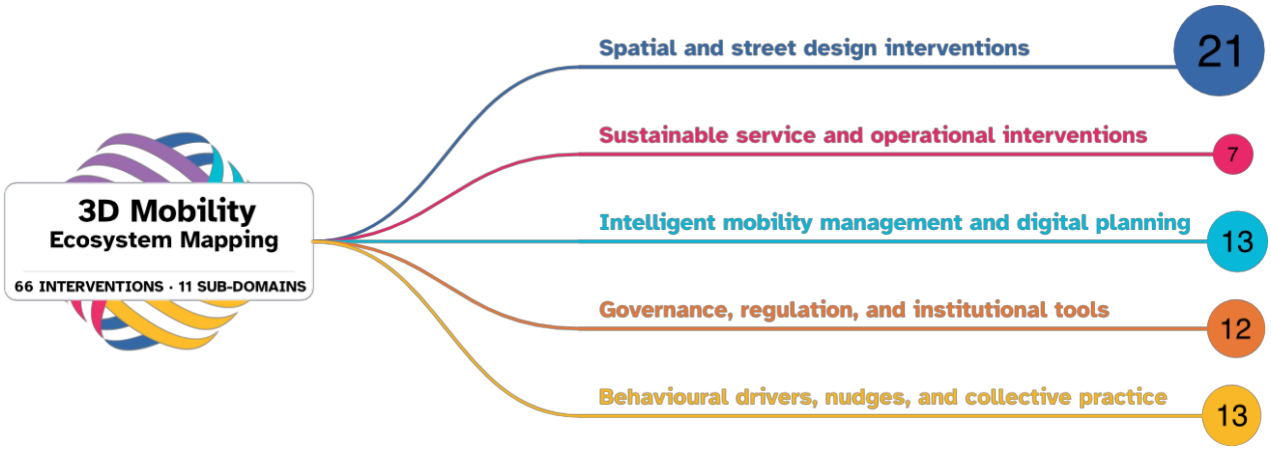


Figure 6: Mobility solution clusters

The overall coherence is sketched below, including sub-clusters, in which the specific mobility solutions and practices were mapped into.

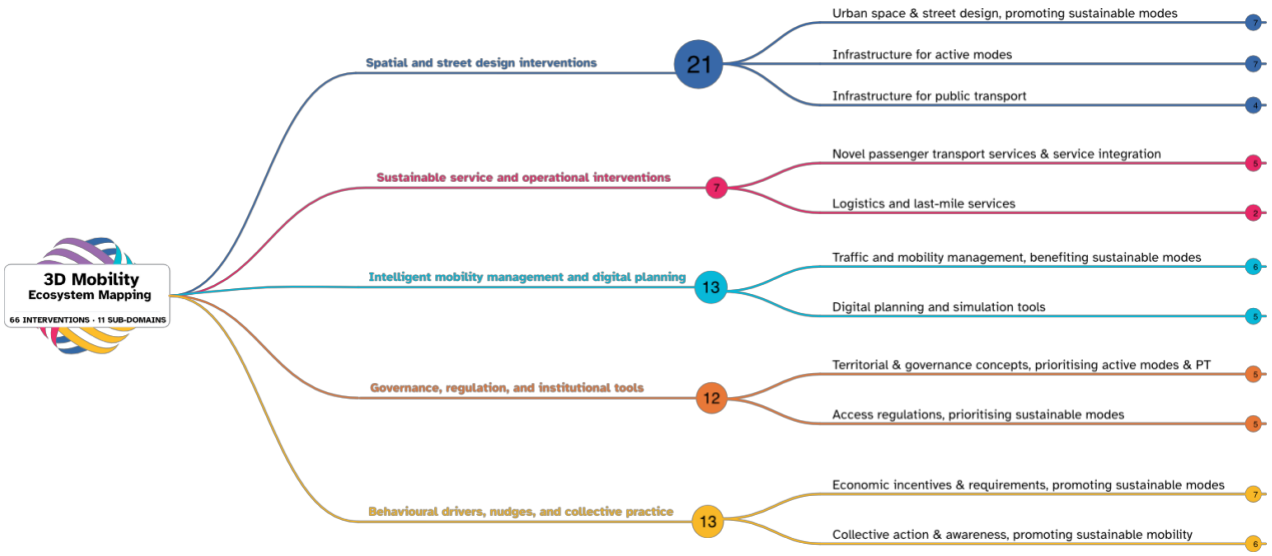


Figure 7: Mobility solution clusters & sub-clusters

4.1.4 The multi-dimensional evaluation framework

To provide concrete evidence of how different solutions can address the SOs of the partner cities, this chapter employs a multi-step method. This structured framework ensures the solutions are not only technically sound but also socially robust:

- First, the team investigated **specific, well-contextualised examples** of the respective mobility solution, with tangible and quantified data.
    - Out of the specific examples, while prioritising tangible and quantified results, examples from **European pilots / projects** were preferred, if available.
    - To ensure a robust evaluation, each example details the **geographic and operational context** in which results were yielded. This approach allows for a realistic assessment of a solution's **transferability**, distinguishing between **universal benefits** and those **dependent on specific contexts** like urban fabrics or governance models.
- Additionally, when the previously described approach did not yield sufficient results, **theoretical studies or reports** were added to the sources of the evaluation.

ICB-involvement

Following the completion of the evaluation, the members of the ICB were involved, to complement the research. Aligning with the focus-scope of the GOLIA-project, we asked them to provide information on how the selected solutions foster or can foster social cohesion.

ICB inputs are reported as qualitative insights within the 'Evaluation & Impact' sections of each cluster. While the core evaluation is primarily driven by quantified pilot data, ICB members provided specialised assessments rooted in their respective fields of expertise. Although the ICB experts specifically focused on identifying **drivers of social cohesion** to support the maximisation of GOLIA's social welfare objectives,

the framework also integrated their broader assessments. These interdisciplinary inputs serve to validate the research findings from a multi-stakeholder perspective, ensuring the catalogue remains both socially robust and practically relevant.

Each insight from the ICB is reported in a two-paragraph structure:

- First, a summary of the positive impacts on social cohesion is reported on.
- Secondly, potential risks the discussed solutions bring along are sketched out. In response to this and as general advice on how to maximise positive impact on social cohesion, mitigation strategies and optimal implementation guidelines are presented.

Methodological note on the ICB synthesis: While the specialised assessments regarding social cohesion and implementation risks were driven directly by the qualitative expertise of the ICB members, the structural alignment, academic synthesis, and formal in-text cross-referencing were executed by the deliverable authors. The ICB provided raw practitioner insights and highlighted a repository of relevant background literature, projects, and case studies. We subsequently conducted a review of these sources to build a robust, referenced narrative that integrates these expert perspectives directly into the GOLIA evaluation framework.

The complete input of the ICB is reported in Annex C.

Evaluation logic & structure

This unified approach ensures that the solutions presented in the following sections are not only technically sound but are also socially robust and aligned with the overarching governance strategies of the GOLIA project.

To ensure clarity and keep a hierarchical structure “from more general to more specific”, each solution-cluster in the following sub-chapters is structured the same way:

- Following the name of the cluster, a brief explanation of what the cluster contains is provided, as well as specific mobility solutions and practices that belong into this cluster, and finally the impact pathway, how those solutions materialise.
- Secondly, it is listed which of the SOs are addressed by this cluster.
- Lastly, the impacts of the cluster are discussed. The impact section is ordered hierarchically as well:
    - It begins with an introductory summary of the primary impacts identified across its respective practices. These introductory paragraphs provide a high-level synthesis of findings.
    - The document then delves into the granular evaluation of specific solutions by reference to real-world examples.

To maintain technical rigor while avoiding redundancy, full bibliographic citations and detailed evidence-based results are reserved for the individual 'Evaluation & Impact' and 'Real-world Examples' sections that follow these summaries.

4.2 Mapping of mobility solutions and practices

The following sub-chapters present the evaluation of the clustered mobility solutions and practices.

4.2.1 Spatial and street design interventions

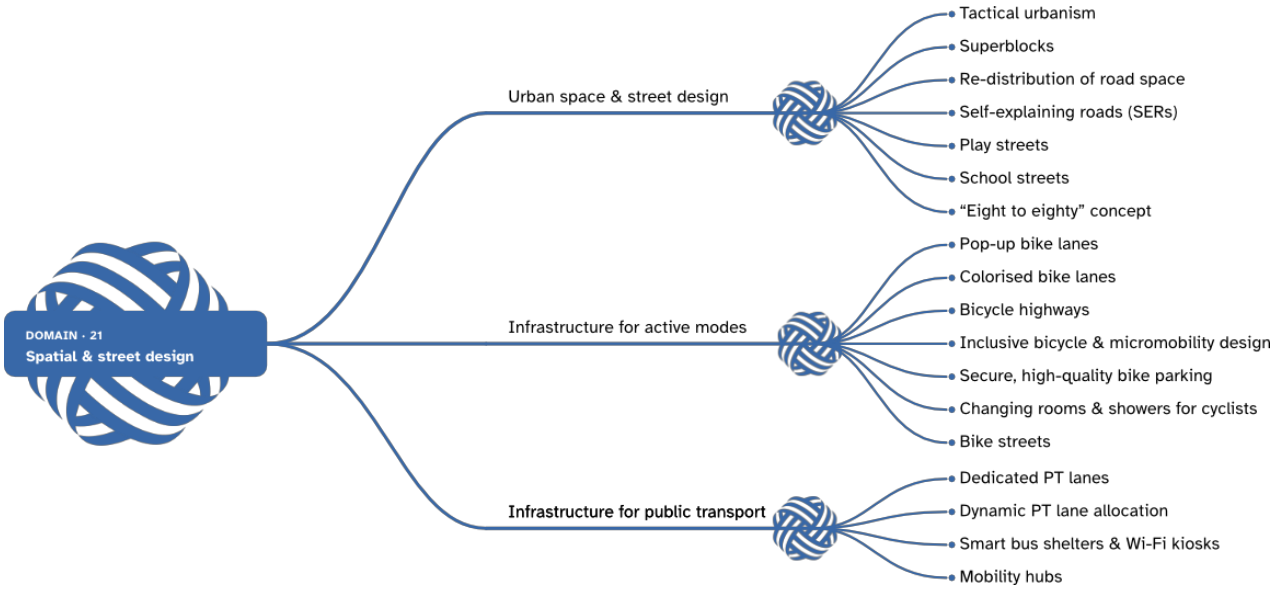


Figure 8: Cluster: Spatial and street design interventions

This cluster focuses on the **physical reallocation of road space** to prioritise sustainable transport and other types of urban use over motorised traffic. By redesigning streets and other urban spaces, these interventions trigger a **modal shift** by enhancing the **perceived safety and comfort** of pedestrians and cyclists.

4.2.1.1 Urban space and street design, promoting sustainable modes

Urban space and street design solutions that promote sustainable mobility focus on the physical reallocation and redesign of streets. By shifting the "default settings" of the urban environment, cities can move from car-centric transit corridors to people-centric public spaces.

Examples:

- *Tactical urbanism*
- *Superblocks*
- *Re-distribution of road space*
- *Self-explaining roads (SERs)*
- *Play streets*
- *School streets*
- *"Eight to eighty"-concept*

Urban space and street design for promoting sustainable modes can be impactful, as the physical spatial change facilitates a modal shift due to improved perceived safety and comfort. This, in turn, increases the quality of public spaces.

SOs addressed

- SOF1.1, SOF2.1, SOF2.2, SOF2.3, SOF2.4, SOF3.1, SOF3.3, SOF3.4,
- SOA1.1,
- SOP2.4

Evaluation & Impact

Drawing from the evidence presented in the case studies below, urban space and street design interventions are the physical hardware for a sustainable transition and can create a self-enforcing environment where sustainable choices become the most convenient and safest options. By reallocating road space, making it less attractive for car traffic, cities can trigger "traffic evaporation", a phenomenon where car dependency decreases overall, without simply displacing congestion from the places of intervention to neighbouring streets.

Urban space and street design interventions that promote sustainable modes directly enable GOLIA objectives by re-balancing the urban hierarchy. By prioritising pedestrians and cyclists, these measures systematically de-prioritise high-volume throughput in favour of localised social and economic activity. Moreover, beyond mobility, street redesign offers more space to combine objectives: for instance, it can act as a tool for climate adaptation (heat/flood mitigation, e.g., by recovering areas for more green space) and social equity by creating free and accessible public space for social interaction.

Real-world examples & pilots

There is a range of popular examples that can be assigned to this sub-cluster of urban space and street design.

Barcelona's "***Superilles***", also known as "Superblocks", represent the structural reorganisation of the Eixample district, which has the shape of a grid, to reclaim 70% of road space (of the redesigned streets) for social use and active mobility. The following effects were yielded:

- **Traffic evaporation**: the (car-) traffic levels on streets in which interventions took place decreased by 14.8% relative to the rest of the city (Nello-Deakin, 2022).
    - *Context*: It must be noted, that the Superilles also succeeded because the Eixample grid allowed parallel roads to accommodate their relatively small traffic increase (+0.7% on immediately adjacent streets).
- **Emissions & air quality**: Superblocks in the Sant Antoni district saw a 25% decrease in NO_2 and 17% decrease in Particulate Matter PM10 (Pérez et al., 2025).
- **Modal shift**: A complete implementation of the original project could shift 230,000 daily motorised trips to active transport or PT (Instituto de Salud Global de Barcelona (ISGlobal), 2019).
- **Health Return on Investment (ROI) / Benefit-Cost Ratio (BCR)**: The implementation of all 503 planned superblocks is estimated to prevent 667 premature deaths annually through reduced NO_2, noise, heat, resulting in annual economic benefits / ROI of €1.7 billion (Mueller et al., 2020; Pérez et al., 2025).
    - *Context*: The high population density maximises health ROI / m^2 asphalt removed.
- **Business**: Evidence from early superblock implementations indicates increased footfall and improved conditions for local commerce, including opportunities for outdoor markets and events, which can support retail activity (IREC & Echave, 2025).

- *Context*: The high population density means a single superblock affects thousands of people (Pérez et al., 2025).

Milan's ***"Piazze Aperte"*** are a city-wide tactical urbanism programme using collaboration pacts with residents to introduce and manage new public squares. The results include the following impacts:

- **Public space accessibility**: The open squares project used paint and planters to create around 40 new public spaces. As a result, approximately half of Milan's residents now live within a 15-minute walk of a neighbourhood square. The programme has been associated with positive local reception and increased use of public space (URBACT, 2024).
  - *Context*: The success was driven by collaboration pacts where residents co-managed the spaces. The initial scepticism was overcome through residents' social ownership.
- **Business**: Preliminary results show potential positive contributions of the Piazze Aperte to business dynamics in reference neighbourhoods (Sdino et al., 2025).
  - *Context*: Pedestrian-friendly environments increased footfall and staying time. Moreover, during the Covid-19 pandemic, tactical interventions provided space for outdoor seating, acting as economic lifeline for local cafes and shops.

London saw different interventions. Mainly and most popular are ***"School Streets"*** and ***"Low Traffic Neighbourhoods" (LTNs)***. The functionality is that those work as a traffic filtering in residential areas or around schools. They are designed to reduce through-traffic on minor roads, using filters like bollards, planters, or cameras to stop vehicles from using side streets as shortcuts and to protect vulnerable road users during peak hours.

- **Traffic evaporation**: 46 of London's *Low Traffic Neighbourhood* schemes showed an average 46.9% reduction in traffic volume within interior streets, with an only marginal increase of 0.7% on boundary roads, proving the evaporation effect (Coalition for Healthy Streets and Active Travel (CoHSAT), n.d.).
- **Emissions & air quality**: Closing the roads around schools has reduced pollution. Monitoring at 18 primary schools using Breathe London sensors found that *School Streets* schemes reduced nitrogen dioxide (NO_2) concentrations by up to 23% during school pick-up and drop-off periods (Mayor of London, 2021), which is strongly supported by parents, research published by the Mayor Sadiq Khan reveals.
  - *Context*: To measure the air quality benefits of the new *School Streets*, 30 cutting-edge sensors from the Breathe London network were installed at 18 primary schools across Brent, Enfield and Lambeth to record nitrogen dioxide levels. The air quality monitoring project, funded by FIA Foundation and Bloomberg Philanthropies, was launched in September 2020 to give the most accurate indication yet of how the School Streets scheme is working.
- **Safety**: A 50% reduction in injuries was measured in areas where road space was reallocated for *LTNs* (Coalition for Healthy Streets and Active Travel (CoHSAT), n.d.).

<u>Highlights/insights from the ICB</u>

Beyond the quantifiable impacts reported above, the **ICB** inputs suggest that ***road-space redistribution*** can strengthen **social cohesion** when it converts traffic-dominated corridors into safe, accessible and people-oriented public spaces. This interpretation is consistent with literature on street-space allocation and public space: ITF argues that street-space allocation should put people before vehicles and assess how space serves the population, while UN-Habitat links well-designed and well-managed public spaces

to meeting places, social ties, cultural identity and sense of place (International Transport Forum (ITF), 2022; UN-Habitat, 2016). Schuster et al. further show that everyday walking and cycling can create incidental, unplanned interactions with the social and physical environment, which contribute to local social cohesion (Schuster et al., 2025).

While the ICB identifies important social-cohesion benefits, it also highlights inclusivity as a key implementation risk. This is particularly relevant for marginalised groups, people with reduced mobility, lower-income users and people whose daily routines depend on specific forms of access. UITP notes that vehicle-access restrictions and related measures can increase inequalities if diverse citizen needs are not considered, while recent reporting from Brussels illustrates how pedestrianisation can create conflicting accessibility effects for different groups, including elderly residents, wheelchair users and visually impaired people (Alves, 2026; UITP, 2025). To mitigate these risks, the ICB recommends co-creative design approaches and a mix of engagement measures involving residents, affected users, businesses, transport actors and civil-society organisations. This recommendation is supported by UITP's guidance on town halls, focus groups, workshops, advisory panels and community engagement, particularly with marginalised communities, as well as by UN-Habitat's emphasis on dialogue, participation and co-management in public-space design and management (UITP, 2025; UN-Habitat, 2016). Mordret/UITP also stresses that citizens should be involved from the early stages when adapting urban spaces, with tactical urbanism used as a low-cost way to test and adjust solutions before permanent implementation (International Association of Public Transport (UITP), 2021; Mordret & Stainer, 2021).

4.2.1.2 Infrastructure for active modes

Infrastructure for active modes comprises continuous, dedicated, safe, and legible networks and facilities that enable walking, cycling, micromobility as everyday modes.

Examples:

- *Bike streets*
- *Coloured Pavement Markings for Bicycle Lanes*
- *Bicycle highways*
- *Inclusive design of bicycles and other micromobility modes*
- *Secure and high-quality bike-parking*
- *Changing rooms and showers for cyclists (at work)*
- *Pop-up Bike lanes*

Improved, high-quality infrastructure provision implies increased usability, that can trigger higher uptake. The benefits out of this include health improvements and emission reductions.

SOs addressed

- SOF1.1, SOF2.2, SOF3.3,
- SOA1.1, SOA1.3, SOA1.4, SOA3.3,
- SOP2.4, SOP3.3

Evaluation & Impact

An attractive infrastructure provisions constitutes the central pull factor. Infrastructure for active modes, therefore, potentially lays the foundation for a modal shift away from motorised individual traffic towards active, sustainable modes.

Moreover, there are superordinate gains: beyond impacts on the mobility system, tangible gains are socio-economic and health returns, primarily driven by savings in public health (reduced sick days and mortality) and reduced congestion.

Real-world examples & pilots

The **Netherlands** are a popular example with their "**fietssnelwegen**" / "**doorfietsroutes**", which are high-quality, direct, and comfortable cycling routes designed to connect major residential areas with workplaces, schools, and/or PT hubs, often covering distances of 10–20 km: The design (-goal) is to minimise stops, traffic lights, and intersections with motorised traffic. Positive impacts on the transport system include:

- **Safety**: Separation from heavy traffic on long-distance routes for commuters on "*Snelfietsroutes*" yielded significant stress reduction, which is also reflected in a 90% satisfaction rate regarding perceived safety (Tour de Force, 2026).
- **Modal shift**: Research shows that access to clothes-changing facilities at the workplace is positively associated with a higher likelihood of commuting by bicycle. This can be particularly relevant for longer commuting distances, where additional barriers to cycling may arise (Heinen et al., 2013).
- **Intermodality**: Providing *secure & high-capacity parking at railway stations* (e.g., the 12,500-space Utrecht Centraal hub) is a primary driver for the “train + bike” model. 45% of the Dutch train passengers now arrive at the station by bicycle (Dutch Cycling Embassy, 2021; van Kampen et al., 2021).

Copenhagen is renowned for its cycling-culture. "**Supercykelstier**" (= cycle superhighways) are a network of bicycle highways, designed to connect the surrounding suburbs with city centres, making long-distance commuting by bike a fast, safe, and efficient alternative to cars. They are designed for commuters, minimising stops, reducing interaction with car traffic, and providing smooth, wide paths. Positives for the mobility system that were yielded include:

- **Pollution & emissions**: The Danish cycle superhighways network is estimated to be saving 1,500 tonnes Carbon Dioxide (CO2) annually. Extrapolating this value to the full planned network, 1.1 million car trips / year could be avoided (Helledi & Skyum, 2020; Keim & Cerny, 2021; Office for Cycle Superhighways, 2019).
- **Modal shift**: The cycle superhighways lead to 1 million fewer car trips and 6 million more bike trips in the annual traffic volume (Keim & Cerny, 2021; Office for Cycle Superhighways, 2019). The expansion of the cycle superhighway network led to a 52% average increase in bicycle traffic on upgraded routes. 14% of new cyclists previously travelled by car, directly reducing congestion & associated emissions (Office for Cycle Superhighways, 2020).
- **Health**: In the Greater Copenhagen area, increased physical activity among commuters results in 40,000 fewer sick days / year that can be brought down to the cycle superhighways. Moreover, 30% lower mortality for adults who bike every day, and a €765 million socio-economic surplus, largely driven by these health improvements are results of the cycling infrastructure (Keim & Cerny, 2021; Office for Cycle Superhighways, 2019).

- **ROI**: For the Danish cycle superhighway network, the calculated internal rate of return measures 11%. Primary factors are health savings and reduced congestion (Copenhagenize, n.d.).

Berlin's "*Pop-up bike lanes*" were a "temporary action" during the Covid-19 pandemic, as people generally preferred physical separation to avoid infection. However, many pop-up bike lanes have been transformed into permanent ones, yielding the following positive outcomes:

- **Modal shift**: Pop-up bike lanes were followed by a 25% increase in cycling during the Covid-19 pandemic (Koop, 2022). More than 2.3 million cyclists were counted in Berlin in June 2020, a 25% increase year-on-year, according to ADFC Berlin (Allgemeiner Deutscher Fahrrad-Club Landesverband Berlin e. V., 2020).
- **Pollution & emissions**: Pop-up lanes reduced the NO_2 exposure for cyclists, as they move cyclists further away from emissions of motorised traffic (Schmitz et al., 2021).
- **Safety**: Despite increased cycling, the research finds no conclusive change in accident counts after installation. Nonetheless, average car speeds fell by 8–12%, suggesting a traffic-calming effect. Because street-level cyclist counts were unavailable, the study could not determine whether per-cyclist accident risk fell (Schrauth, 2022).

Another relevant intervention important to mention is **Vienna's *Mariahilfer Strasse***. To not only focus on cycling infrastructure, the Viennese case also adds an example of pedestrianisation. In the street Mariahilfer Strasse, a redevelopment of the shopping street brought seating, more space for pedestrians and cyclists, new trees, and less traffic (ORF Wien, 2025). The measure is cited as an international model for climate protection and traffic calming in urban areas (City of Vienna, 2020).

- **Public Space Quality**: The redesign replaced street-level car parking with 87 new seating areas and 27 tree gardens. Dialog furniture (public benches) is now placed approximately every 30 meters along the entire inner street (Team Focus, 2020).

Another example of pedestrianisation is **Brussels**, transforming the ***Boulevard Anspach***, a major 800-metre car-centric artery in central Brussels, into a car-free pedestrian zone.

- **Leisure use & social interaction**: The pedestrian zone Boulevard Anspach has become the fourth busiest street in Brussels by 2024, with 29,100 daily by-passers (The Brussels Times Newsroom, 2025).

<u>Highlights/insights from the ICB</u>

Beyond physical network improvements, the **ICB** emphasises that ***inclusive bicycle and micromobility design*** can support **social integration** by enabling groups that are often excluded from shared mobility, including older people and people with reduced mobility, to participate in active travel. The *Interreg North Sea SMALL* example from **Varberg** supports this narrower point: the municipality is testing adapted vehicles, including cargo bikes and tricycles, with elderly people and people with reduced mobility, using co-creation to understand user needs, preferences and barriers (Angsthelm, 2025). The broader ICB interpretation is that such approaches can help users feel recognised by local institutions and more connected to community life, especially where municipalities maintain dialogue with different user groups and adapt planning practice accordingly.

The ICB also identifies important risks and trade-offs. The *SMALL* example directly supports the concern that inclusive micromobility can face cost and operational barriers: adapted vehicles are expensive, traditional free-floating or docking models are difficult to operate for these vehicle types, and existing shared-bike systems may be poorly perceived by elderly people because of parking issues and aggressive riding (Angsthelm, 2025). The wider concern that short pilot phases may fail to build lasting trust should remain attributed to the ICB unless an additional source is added. To reduce these risks, the ICB

recommends that inclusive micromobility measures are accompanied by clear street-space management, careful service design and continued engagement with affected user groups. The Varberg example supports this recommendation through its emphasis on testing vehicles with users, working with reference groups, organising public engagement activities, and educating the municipal organisation about different accessibility needs (Angsthelm, 2025).

4.2.1.3 Infrastructure for public transport

Like active modes, infrastructure for PT ensures increasing the reliability, speed, and attractiveness of PT through spatial and infrastructural prioritisation and improved interfaces.

Examples of specific mobility solutions:

- *Dedicated PT-lanes*
- *Dynamic PT-lane allocation*
- *Smart bus shelters and Wi Fi kiosks*
- *Mobility hubs*

Priority and quality improvements facilitate better performance of the PT system, generating an increased ridership, which benefits the overall transport system efficiency.

SOs addressed

- SOF1.3,
- SOA1.5,
- SOP1.1, SOP1.2, SOP2.5, SOP3.5

Evaluation & Impact

Investments in and improvements of PT infrastructure positively impact reliability: dedicated (e.g., bus-) infrastructure transforms PT into a competitive alternative to private cars, boosting ridership and optimising the operations of PT. Also, they contribute to space-efficiency: mobility hubs can help reclaim common space by reducing demand for on-street parking and enabling urban space to be reallocated, especially when they are combined with shared mobility, good PT links, and parking management policies. Lastly, they lead to emission mitigation: overall, fleet electrification is a key goal for reducing transport emissions, but a modal shift, enabled by high-quality PT infrastructure, is still preferable.

Real-world examples & pilots

Bremen introduced the so-called "***mobil.punkt***". These are larger mobility points with 4-12 carsharing vehicles, PT service offer, easy cycling and pedestrian access, taxi stands, as well as other neighbourhood facilities. Their positive impacts led to:

- **Modal shift**: Evaluations suggest that Bremen's model has contributed to a substantial reduction in private car ownership and parking pressure. Earlier assessments found that each shared car replaced around 16 private cars, while the 2025 evaluation reports that, using the calculation standard of the German Car Sharing Association, each carsharing vehicle in Bremen replaces 18.8 privately owned vehicles. With more than 28,000 users and a fleet of 650 vehicles at the time of the 2025 study, the report concludes that there are more than 11,000

fewer privately owned household cars on Bremen's streets. This frees urban space that can be repurposed for other public uses, including greening (Schreier et al., 2025).

- **Car ownership**: carsharing households in Bremen own far fewer cars than the city average. While the average Bremen household has 0.9 cars and drives about 10,000 km per year, carsharing households have only 0.4 cars on average and drive roughly 3,500 km per year. In addition, 64% of carsharing households are car-free, compared with 22% of non-member households. Together, these findings indicate that Bremen's mobility hubs and carsharing system support a shift away from private car ownership and reduce demand for street space (Schreier et al., 2025).

The Transport for **London** (**TfL**) made 85km of **bus-lanes** permanent, with many of them operating 24/7, to improve service reliability, reduce journey times, and decrease congestion on the busiest routes. Dedicated lanes are marked with red paint, signage, and symbols: They are primarily for buses, but also for licensed taxis, and emergency vehicles. The following positive impacts were achieved:

- **Time savings**: The overall 300+km bus lanes improved journey times by ca. 14% and boosted ridership by 15% (Soliman, 2025).
- **Operations**: Improved bus speeds allowed routes to operate at the same frequency but with fewer vehicles, enabling 100+ peak-time buses being redeployed elsewhere, ultimately optimising taxpayer-funded operational budgets (International Association of Public Transport (UITP), 2025).
- **Air quality**: A meta-study found that a modal shift, reducing the overall vehicle kilometres travelled (VKT), is 5x more effective at reducing non-exhaust emissions (Particulate Matter PM2.5, from tires and brakes) than fleet electrification (Le Petit et al., 2025).

In **Paris**, **smart shelters** include voice-announcement systems for the visually impaired as well as tactile solutions. The shelters were redesigned larger and more accessible, to specifically accommodate wheelchairs and strollers, that were previously blocked by older, narrower designs (Beletreche & Albertini, n.d.). This led to different advancements:

- **Green infrastructure**: 50 of the new shelters feature planted roofs as part of the city's Climate Plan. While green roofs can contribute to environmental benefits such as heat mitigation and rainwater retention, the specific functions and scale of these effects are not detailed in the source (Beletreche & Albertini, n.d.).
- **Accessibility**: As described above, accessibility and barrier-free entrances were significantly improved.

The **Interreg NWE** project "***eHUBS***" involved 6 pilot cities, including Amsterdam and Leuven, that were piloting mobility hubs. Project-results contain improved ecological sustainability:

- **CO2 emissions**: By inducing a modal shift from private cars to electric shared vehicles, available at the hubs, the project enabled the reduction of 1,500 tonnes of CO2 per year (eHUBS, 2022, 2023).

Highlights/insights from the ICB

Beyond operational efficiency, the **ICB** notes that ***dedicated PT infrastructure*** can act as a **social equity** tool where it improves the speed, reliability and accessibility of services used by groups that depend most on PT. This is supported by UITP's example of San Francisco's 14 Mission corridor, where 80% of riders are considered low-income and bus-priority measures reduced travel time by 31%, improved reliability by 25%, and increased the number of jobs reachable within a 30-minute public-transport journey

(International Association of Public Transport (UITP), 2025). More generally, UITP argues that reliable and accessible bus and metro improvements for lower-income communities are important to improve connectivity and avoid exclusion from sustainable mobility transitions (UITP, 2025). The ICB also frames ***mobility hubs*** as visible "carrots" in urban policy: tangible public investments that make multimodal mobility easier to understand and use. This interpretation is consistent with *SmartHubs* findings, which define smart mobility hubs as dedicated, recognisable places where shared and sustainable modes are connected to public transport, and which stress that hubs should be physically, digitally and democratically integrated (Geurs et al., 2024). The **social cohesion** argument is strongest where hubs are treated as public-space interventions rather than only transport interfaces. *SmartHubs* explicitly recommends placemaking as part of hub design and notes that hubs can offer seating, greenery, cafés, kiosks, shops and services, while De Beleyr & Desmedt similarly emphasise that "Hoppin points" can create added value for both travellers and local residents through play areas, greenery and services (De Beleyr & Desmedt, 2022; Geurs et al., 2024). The stronger claim that such hubs become "social anchors" should remain framed as an ICB interpretation, supported by *SmartHubs*' finding that hubs can cultivate a sense of community and contribute to a more liveable environment (Geurs et al., 2024).

However, the ICB identifies significant socio-economic risks, such as the potential for displacement or gentrification following major corridor or hub improvements. UITP 2025c recommends that transport improvements be accessible, safe and reliable for lower-income communities "to prevent displacement and improve connectivity" (UITP, 2025). The digital-exclusion risk is more directly evidenced: *SmartHubs* finds that people with physical impairments and low digital skills are less likely to use shared mobility services when these are not adapted to their needs, and the Brussels living lab specifically investigated how digital kiosks could support vulnerable users and people with low digital skills; The *Cedefop* project's "digital skills indicator" can be used as wider contextual evidence, even though not as a mobility-specific source (Geurs et al., 2024; Martinez et al., 2023). To address these risks, the ICB recommends applying an inclusion lens from the outset, combining digital tools with human support, co-design and practical safety measures. This is aligned with UITP's recommendation to use equity assessments, engage local communities through consultations, focus groups and surveys, and ensure that negative impacts on vulnerable groups are minimised (UITP, 2025). It is also aligned with *SmartHubs* recommendations on participatory processes, co-design, user-friendly interfaces, analogue information, and training or assistance for citizens with limited digital mobility skills (Geurs et al., 2024). The Brussels living lab further supports the need for support personnel, clear signage, barrier-free facilities, lighting and secure, lively environments, while the La Ligne H exploratory walk illustrates how participatory safety audits can lead to concrete actions such as better lighting, cleaning and adjusted commercial/security staff presence (La Ligne H, 2025; Martinez et al., 2023).

4.2.2 Sustainable service and operational innovations

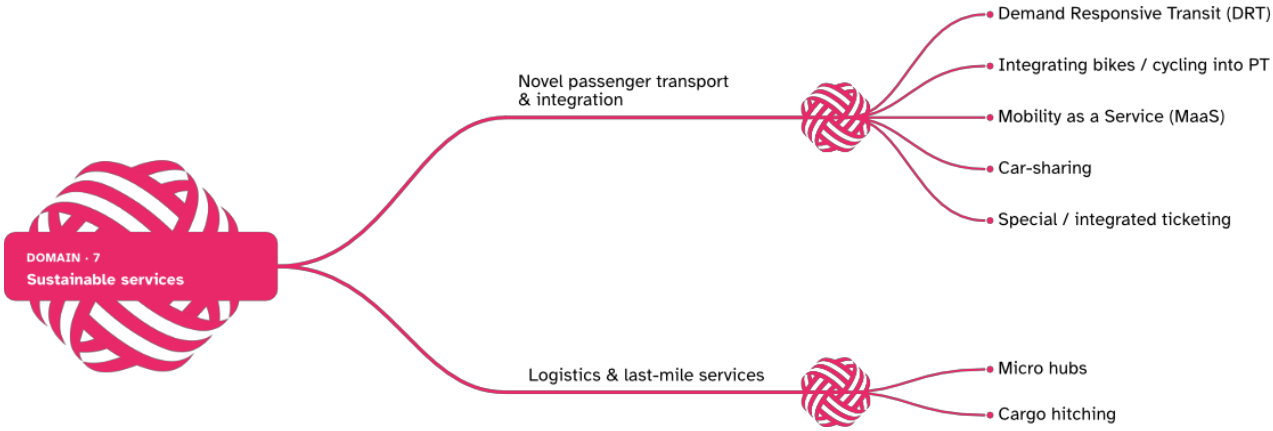


Figure 9: Cluster: Sustainable service and operational innovations

These solutions provide **competitive alternatives to private car ownership**. The primary objective is to **improve overall accessibility** while **reducing total VKT**.

4.2.2.1 Novel passenger transport services & service integration

Offering or adapting transport services so that sustainable options become available, competitive, and inclusive is an important step for improving the share of sustainable transport means. Service integration and convenience reduce friction, complexity, and cognitive effort associated with using sustainable and multimodal transport.

Examples:

- *Demand Responsive Transit (DRT)*
- *Integrating bikes/cycling into PT*
- *Mobility as a Service (MaaS)*
- *Carsharing*
- *Special or integrated ticketing*

The service adaptation leads to improved accessibility and can trigger behavioural changes, which ultimately can contribute to reduced car dependence. A service integration facilitates reduced transaction costs and therefore enables increased multimodality, positively impacting the user satisfaction.

SOs addressed

- SOF1.1, SOF1.3, SOF1.4,
- SOA1.3, SOA1.4, SOA1.6,
- SOP2.5, SOP3.1

Evaluation & Impact

Synthesising the evidence from real-world examples detailed below, modern operational solutions like DRT and multimodal integration serve as essential bridges for low-density areas, connecting residents to mass transit without the inefficiency of underutilised vehicles. These middle-tier services are positioned

as an alternative in the niche between taxis and PT. Drawing from the evidence presented below, in the long term, such services potentially can lead to the decoupling of emissions through an integration of electrification into autonomous and/or pooled transport models.

Complementing the operational shifts, service integration acts as the "digital glue" of sustainable mobility, lowering effort barriers by unifying planning, booking, and payment into a single interface. Large-scale, simplified ticketing systems demonstrate that lowering price and complexity barriers trigger a systemic shift, which eventually results in CO2 reductions and decreases in car usage.

Real-world examples & pilots

Amsterdam's "***Mokumflex***" was a 12-month DRT pilot programme, designed to replace fixed, low-ridership bus lines in low-density areas with a flexible, on-demand taxi service. It improved several aspects:

- **VKT reduction**: Replacing fixed-route buses with DRT in low-density areas reduced total passenger kilometres travelled by 89%, significantly cutting local energy consumption (Coutinho et al., 2020).
- **User satisfaction**: 94% on-time trips were yielded and consequently rated satisfying / very satisfying. Reliable on-demand service provision could be a more effective and better perceived strategy for low-density areas than maintaining underutilised fixed-route bus lines (Coutinho et al., 2020).

Berlin's "***BerlKönig***" is an app-based ride-pooling service operated by BVG (Berlin's PT operator). The service ended in July 2022, with the scheduled conclusion of the four-year pilot project. It was officially replaced by a new, similar BVG call-bus service named Muva**.** *BerlKönig* served as an alternative to taxis, as users book rides via app and share the vehicle with other passengers.

Results that reflect specific findings of the Berlkönig pilot are missing, but general studies on DRT assess positive outcomes:

- **Emissions**: Simulations of autonomous and electric DRT systems in European contexts demonstrate the potential for 60% decrease in CO2 and Nitrogen Oxide (NOx) emissions / passenger trip, when replacing traditional internal combustion engine transit (Fadlelseed et al., 2025).

The "***BiTiBi***-project (*Bike-Train-Bike*)" conducted **European pilots** in Barcelona, Milan, Liverpool and in Belgium. The project promotes sustainable urban mobility by integrating cycling with PT, primarily trains. This has positive impacts:

- **CO2e reduction**: 136 tonnes of Carbon Dioxide Equivalent (CO2e) / year were saved during the pilot phase across 3 regions. In a hypothetical EU-wide 2030 scenario (2030), a potential reduction of 784,005 tonnes CO2e / year across Europe was calculated for if the bike-train-bike model scaled. This is driven by replacing private car commutes with the integrated active+public travel (Assessoria d'Infraestructures i Mobilitat sl (AIM), 2016).

Meta-studies from the literature also report another positive effect of allowing bikes on PT:

- **Modal shift**: The catchment area of a station can increase by roughly a factor of 3–5 compared to walking distances. This expansion improves accessibility and makes longer combined cycling-and-public-transport trips more feasible and may support shifts away from car use, although the extent of such modal change is not yet well established (Kosmidis & Müller-Eie, 2024).

Vienna's "*WienMobil*" is a Business-to-Government (B2G) (public-led) model where the PT operator acts as the orchestrator, integrating private shared mobility around the city's high-frequency transit backbone. This impacted the adoption:

- **Uptake**: Research shows that adoption of Mobility-as-a-Service (MaaS) is primarily driven by convenience, affordability, technological appeal, and service reliability, while explicit sustainability motivations tend to play a secondary role (An & Shen, 2025). The high uptake and satisfaction in Vienna are underlined by the fact that there are more annual transit pass holders than registered cars with 1.3 million regular PT customers vs. 736,000 cars (CIVITAS, 2020).
    - *Context*: The success is rooted in the €365 annual pass. Vienna did not try to reinvent the wheel. It simply made an existing product easier to use by integrating it with bike-sharing and carsharing. An important background factor is "seamlessness": users accepted MaaS because the integration reduced the cognitive load of switching between modes.

Gothenburg's MaaS application is called "***UbiGo***": It is a web-based smartphone application, combining PT, car sharing, rental car service, taxi and bike-sharing services. It impacted the transport system:

- **Traffic volume reduction**: 40% of the participants changed their car-related behaviour. Many users opted to sell and/or not buy a private car, leading to lower traffic volumes in trial areas (Aaltonen et al., 2020; Dimitriou & Sartzetaki, 2020).
    - *Context*: An important information is that UbiGo targeted households, not individual travellers. Providing a subscription that covers family needs (including larger cars for the weekends) secures a car-like reliability.

Germany's "***Deutschlandticket***", "***9€*** or ***49€-Ticket***" is/was a monthly cancellable subscription for all types of (local) public transport ("Nahverkehr") services, valid in all Germany, excluding high-speed long-distance trains. It brought several sustainability improvements:

- **CO2 reduction**: The 3-month 9-Euro Ticket pilot resulted in an estimated reduction of 1.8 million tonnes CO2, by shifting trips from road to rail (Verband Deutscher Verkehrsunternehmen (VDV, 2022).
- **VKT reduction**: Users of the 9-Euro ticket reduced their private car usage on average by 16 km/week, an average 10% decrease of the usual driving volume (Andor et al., 2025).
  Other sources, however, challenge such conclusions: Some conclude that the 9-Euro ticket hardly made car drivers shift away from car travel overall, with car trips reduced by only about 4–5%, simply triggering stronger effects on leisure rail use than on commuting
    - *Context*: Mobile-phone trip data was analysed for mapping and painted a picture only very few users using the 9-Euro ticket to replace their daily car commute (Liebensteiner et al., 2025).
- **Uptake**: Regional train trips increased by 34% during the integrated ticket period, representing an additional 430,000 passengers per day who gained access to the network (Liebensteiner et al., 2025).

Brussels's car sharing, which combines station-based and free-floating services, contributes to the transport transition:

- **Modal shift**: 6 in 10 people have given up their car due to the availability of shared car services (both station-based & free-floating). Station-based systems seem to permanently replace cars more strongly for some households, while free-floating options attract a younger audience and help prevent future car purchase (Bruxelles Mobilité - Brussel Mobiliteit, 2026).

Highlights/insights from the ICB

Beyond digital efficiency, the **ICB** emphasises that novel passenger services like ***DRT*** and ***MaaS*** function as essential tools for **social equity**. Voluntary DRT systems, such as the "*Mobitwin*" network, provide critical door-to-door connectivity for less mobile citizens, effectively preventing loneliness and reducing socio-economic imbalances caused by mobility gaps. Furthermore, integrated platforms and ***shared micromobility*** enhance first- and last-mile accessibility while offering affordable alternatives that lower uptake barriers for a broader segment of the population. When these services are deeply integrated with the overall public transport network, they significantly reduce isolation in underserved areas.

Beyond digital efficiency, the **ICB** emphasises that novel passenger services such as ***DRT***, ***MaaS*** and voluntary community transport can contribute to **social equity** when they extend the reach of PT and serve people whose mobility needs are not sufficiently covered by fixed-route services. This is supported by UITP's framing of DRT as a flexible service that can complement or replace fixed-route public transport, including first/last-mile, off-peak, special-needs and paratransit use cases (International Association of Public Transport (UITP), 2021). Voluntary community transport services such as *Mobitwin* in Belgium provide a more specific example: *Mobitwin* connects vulnerable people who can no longer travel independently with voluntary drivers, uses phone-based ride requests, provides home pick-up, and explicitly aims to prevent social isolation. Evidence from paratransit research similarly shows that such services are important for persons with disabilities when public transport cannot be used, and that transport barriers affect participation in different areas of life (Egger et al., 2022). Integrated platforms, ***MaaS*** and ***shared micromobility*** can further improve first- and last-mile **accessibility** when they are embedded in the wider public transport network. UITP defines MaaS as the integration of mobility services into a single offer, including booking and payment, and stresses that DRT can address social goals such as extending public transport's reach into underserved areas (International Association of Public Transport (UITP), 2021). Shared micromobility can also support access to PT and provide a convenient and relatively affordable alternative to car ownership, although its benefits depend on regulation, coverage and integration with the public transport system (Homem de Gouveia et al., 2023). The ICB, therefore concludes that such services significantly reduce isolation.

However, the ICB identifies a recurring risk of digital exclusion. This concern is supported by the fact that several vulnerable-user services still rely on analogue access channels: *Mobitwin* members request rides by phone, while POLIS identifies non-discrimination by phone or payment as a consumer-protection issue for shared micromobility, including the need for alternatives for people without smartphones or debit/credit cards (Homem de Gouveia et al., 2023). The *Cedefop* project can be used as broader contextual evidence that digital-skills levels vary across the population. The concern that profit-driven spatial distribution may overlook vulnerable groups was furthermore raised by the ICB. To mitigate these trade-offs, the ICB recommends that digital mobility services are co-created with users and paired with analogue alternatives where needed. Strong public governance is also required to ensure that MaaS and shared micromobility support public service goals rather than only commercial service optimisation. UITP argues that public actors should act as "strategic integrators" and set the right rules and incentives because individual mobility business models tend to focus on their own efficiency rather than the efficiency of the integrated offer or wider sustainability goals (International Association of Public Transport (UITP), 2021). In practical terms, this can include requirements for suburban or underserved-area coverage, data sharing, parking management, social fares, non-discriminatory access and monitoring of service patterns (Boccioli & Homem de Gouveia, 2025; Homem de Gouveia et al., 2023).

4.2.2.2 Logistics and last mile services

Last mile logistics services optimise urban freight and last-mile delivery while reducing negative externalities in dense urban contexts.

Examples:

- *Micro-Hubs*
- *Cargo Hitching*

The consolidation and sharing of logistics operation spaces make operations possible with fewer vehicle kilometres, which reduce impacts and improve the urban environment.

SOs addressed

- SOF1.2, SOF1.3,
- SOA1.2

Evaluation & Impact

Innovative last-mile logistics solutions help to decouple the rising demand for e-commerce from negative externalities of heavy freight. By shifting to consolidated, smaller, shared delivery modes, cities can reduce the physical and environmental footprint of urban goods movement.

However, both micro-hubs and cargo-hitching attempts often proved to be too economically and/or operationally inefficient, which continues to hinder their uptake. Economic viability could significantly improve through a full horizontal collaboration and public policy support.

Real-world examples & pilots

"***KoMoDo***", an ***EU Urban Mobility Observatory case study***, in **Berlin** implemented the concept of a micro-depot and cargo bikes in the Prenzlauer Berg area, with some success:

- **Citizens' acceptance**: Fewer double-parked vans, lower local nuisance, and successful scaling interest from operators were yielded. This can be associated with a positive local acceptance (European Commission, 2021; Zhen, 2021).
    - *Context*: Residents show openness to alternative parcel logistics concepts in Berlin. There is a positive perception of the environmental benefits, but still some preference for conventional delivery remains, mainly due to limited willingness to pay (Gruber et al., 2023).
- **Political acceptance**: The EU Urban Mobility Observatory presents cargo-bike and micro-hub approaches such as KoMoDo as promising urban-logistics solutions, indicating institutional support for further deployment. (European Commission, 2021).
    - *Context*: The strong political commitment to logistics innovations is often linked to SUMPs, which view logistics as a public service rather than just private operations.

Berlin's "***Kiezbote***" took a similar approach: it used a "white-label" micro-hub to consolidate Business-to-Consumer (B2C) parcels from various service providers, which were then delivered to residents by cargo bikes within specific 2-hour time windows. Assessed impacts of Kiezbote include:

- **GHG emissions**: CO2 emissions can be reduced by 60% when parcels are delivered by cargo bike from the neighbourhood micro-hub instead of using conventional vehicles (Seeck & Engelhardt, 2021).
- **Citizens' acceptance**: Customer surveys on satisfaction and willingness to use service again collected generally positive responses (Seeck & Engelhardt, 2021).

Zurich has a "***Waste Cargo-tram***". They make use of decommissioned PT tram carriages to collect waste along the line. During the pilot phase the tram collected 272 tonnes of waste in 35 rides (Greco et al., 2021). Although not a perfect example of cargo hitching, the use of PT lines / decommissioned vehicles for other operations can be efficient and comply with current stricter regulations on emissions without requiring a fleet update:

- **Economic viability & GHG emissions**: The Zurich cargo tram demonstrates how waste collection can be shifted onto existing rail infrastructure, reducing reliance on truck-based collection and avoiding local tailpipe emissions. The system leverages existing assets, which can improve operational efficiency in specific contexts (Greco et al., 2021).
- **Traffic volume**: The cargo-tram for waste collection also reduced traffic by reducing the demand for trucks carrying out the collection task (Greco et al., 2021).

Rotterdam simulated a large-scale micro-hub implementation, aimed at optimising logistics for the city's upcoming Zero-Emission Zone (ZEZ). Deliveries will be handled in a two-stage process: goods are first consolidated at micro-hubs via trucks and then delivered within the "micro-hubs catchment area" (MCA), using zero-emission vehicles. However, the results were not promising for larger future adoption:

- **Financial viability**: micro-hubs can be technically effective for environmental goals but can only work economically under specific conditions: high demand density, shared operations, strong collaboration, and careful planning and placement. Otherwise, they tend to be costlier than traditional van-based logistics. (de Bok et al., 2024).
    - *Context*: A full horizontal collaboration and public policy support can make a more beneficial model.

<u>Highlights/insights from the ICB</u>

Beyond streamlining freight, the **ICB** underscores that ***integrating last-mile logistics into urban hubs*** fosters safer, quieter, and more accessible public spaces while boosting urban economic growth. By consolidating ***parcel lockers***, loading zones, and ***micro-hubs*** at transit interchanges, cities can support stronger everyday **social interaction** and improve the **perceived quality of life** across diverse neighbourhoods. To optimise this use of urban space, a data-driven framework leveraging traffic data and key performance indicators (KPIs), such as highway proximity and freight operator accessibility, is essential for identifying candidate sites with the highest logistical potential. Furthermore, the use of ***cargo bikes for delivery*** offers a unique social "gateway", providing low-barrier access to labour for individuals without specific technical skills, such as migrants, thereby promoting **social integration** through employment. Accessible networks of parcel lockers also contribute to community connectivity by reducing the isolation of residents who can reach these points by foot or bicycle.

Beyond streamlining freight, the **ICB** underscores that ***integrating last-mile logistics into urban hubs*** can contribute to safer, quieter and more **accessible** public spaces when logistics functions are planned together with passenger mobility, public-space management and local accessibility needs. This interpretation is consistent with *MOVE21*, which tested integrated passenger-freight solutions, automated microhubs, zero-emission logistics using cargo bikes and electric vehicles, and multimodal hub concepts

within urban nodes (Move 21, n.d.). It is also supported by Li's observation that cargo bikes, drones and delivery robots require micro-logistics hubs close to customers, alongside new regulation for parking, routing and safety (Li, 2024). The ICB claims more broader that such hubs strengthen everyday social interaction. For ***parcel lockers*** and out-of-home delivery points, the strongest evidence concerns **accessibility** and **spatial optimisation** rather than social cohesion directly. Ferran & Axinte show how spatial analysis can identify public parcel-locker locations that maximise accessibility for most residents within short walking or cycling distances, while also helping public authorities identify underserved areas and negotiate with logistics service providers (Ferran & Axinte, 2026). *The Loge-Hubs* project provides a complementary data-driven logistics-hub approach, using data on warehouses, pickup points, loading zones and traffic sensors to optimise logistics-hub locations and last-mile delivery routes. These sources support wording around "equitable access to delivery services" and "data-driven siting", but not the stronger claim that parcel lockers reduce social isolation. The ICB also points to the potential social value of ***cargo-bike logistics*** as an **employment** pathway. This is supported most directly by the *So.De* example from **Milan**. Moreover, the ICB claims that cargo-bike logistics offers "low-barrier access to labour".

However, the ICB identifies several strategic risks. Financial sustainability remains a concern where logistics hubs or micro-hubs depend on temporary public funding or lack sufficient commercial uptake. Physical inclusion is added to the risks: Ferran & Axinte recommend that parcel lockers be safe, accessible, allow wheelchair manoeuvring space, avoid conflicts with pedestrian flows and follow universal-design principles (Ferran & Axinte, 2026). The ICB's concern about "space overloading" is also plausible, since urban logistics competes for limited urban space and can contribute to congestion, safety risks and environmental impacts. Cargo-bike logistics also requires careful infrastructure-readiness assessment. Chatziioannou et al. identify road-environment factors that shape cargo-bike safety and ease of movement, including bicycle infrastructure, surface quality, lighting, speed, traffic load, intersections and lane width. The same source links cargo-bike deployment to SUMP measures such as dedicated cycling facilities, low-emission zones, loading/unloading areas, urban consolidation centres and traffic-calming interventions (Chatziioannou et al., 2026). Training for workers is a sensible ICB recommendation. To ensure long-term viability, the ICB recommends public-private cooperation, open or shared parcel-locker models, infrastructure-readiness checks and co-planning with businesses and logistics service providers. This is well aligned with *MOVE21*'s emphasis on public-private collaboration and integrated passenger-freight planning, and Ferran & Axinte's recommendation that municipalities use consultations and negotiations with LSPs to reach common ground on parcel-locker deployment (Ferran & Axinte, 2026; Move 21, n.d.).

4.2.3 Intelligent mobility management and digital planning

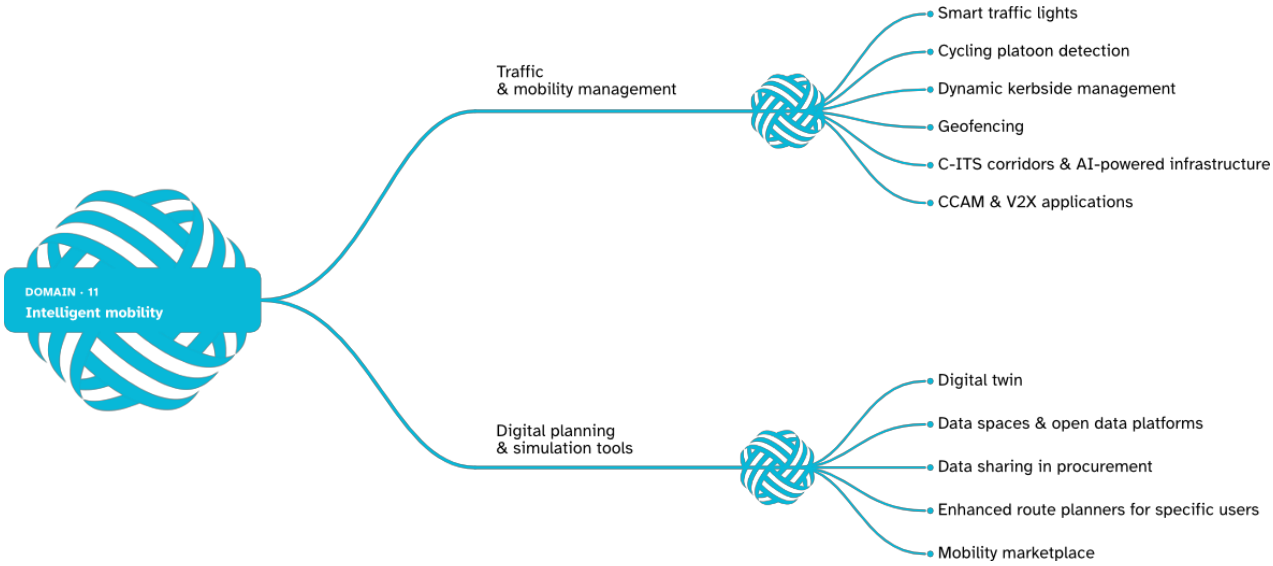


Figure 10: Cluster: Intelligent mobility management and digital planning

This cluster leverages technology to achieve **efficiency and evidence-based planning**. These tools generate impact through the **real-time optimisation** of the transport network and the **reduction of idling**.

4.2.3.1 Traffic and mobility management benefitting sustainable modes

Traffic and mobility management that benefits sustainable modes means actively managing traffic flows and giving priorities to certain modes in real time, through dynamic control and prioritisation systems, favouring sustainable modes.

Examples:

- *Smart traffic lights*
- *Cycling platoon detection*
- *Dynamic kerbside management*
- *Geofencing*
- *C-ITS corridors and AI powered infrastructure*
- *CCAM and Vehicle-to-Everything (V2X) applications*

A dynamic controlling of traffic flows improves the continuous flow while ensuring priority for the more relevant modes. This can result in efficiency and safety gains for the overall transport system.

SOs addressed

- SOA1.2, SOA1.3, SOA1.4,
- SOF1.3,
- SOP1.1, SOP3.2, SOP3.3, SOP3.4

Evaluation & Impact

Traffic and mobility management's main upside is that it yields efficiency gains through digitalisation, by optimising and streamlining operations.

Digital tools add to the portfolio for steering future mobility, enabling the prioritisation of preferred, hence, more sustainable modes of transport.

Real-world examples & pilots

Copenhagen's "***Green Wave***" is an advanced traffic management system. The Green Wave is a result of 380 new intelligent traffic signals (State of Green, 2016), designed to detect groups of cyclists and adjust the traffic lights to keep them green. Several advantages emerge:

- **Traffic flow**: Sensors detect platoons of 5+ cyclists, extending the green light phases to allow groups to pass without stopping. This reduces stop-and-go energy loss of active travellers and minimises the idling of conflicting motor traffic (Centre for Public Impact, 2016).
  Moreover, the number of stops for cyclists fell from 6 stops to <1 stop per trip on certain corridors. Platoon detection further optimises the traffic flows by ensuring larger groups are not split by red lights, which also increases the perceived safety and comfort of the route (Centre for Public Impact, 2016).
- **Travel time**: The smart traffic light system reduces travel times for cyclists by 10%, and travel time for buses is expected to decrease by up to 20% (C40 Cities, 2016). Due to platoon detection, cyclists traveling out of town at 20 km/h experienced a 17% decrease in travel time during rush hour (Centre for Public Impact, 2016).

The ***Port of Barcelona*** is implementing advanced, data-driven, digital solutions for kerbside and traffic management as part of a "smart port" initiative, aiming to optimise the movement of >4,000 daily trucks. Measures include real-time monitoring and the introduction of virtual gates to manage port access. This impacts the operations:

- **Emissions reduction**: Virtual Gates / SICAD at the port of Barcelona resulted in annual reduction of 6,978 tons CO2 and 23 tons other polluting emissions by streamlining truck movements (PierNext, 2023).
- **Fuel savings**: Automated entry and virtual gate management reduced truck access times by 37%, directly translating to €2.4 million saved fuel costs annually and, moreover, reduced idling in the surrounding urban areas (PierNext, 2023).
- **ROI**: The port's investment of €52.6 million in digital and dynamic management tools generated €450 million in direct annual savings for the community, translating into a BCR of approximately 8.5:1 (PierNext, 2023).
- **Capacity**: The digitalisation of loading/unloading operations in the Terminal Operating System (TOS) reduced berthing and processing times by 2.2 million minutes (equivalent to 4.2 years of collective wait time) per year (PierNext, 2023).

Highlights/insights from the ICB

Beyond the efficiencies of real-time network optimization, the **ICB** highlights that advancements in **CCAM** and **autonomous vehicles** offer significant potential for ***social cohesion***. These technologies are expected to facilitate congestion reduction and the liberation of urban and peri-urban space for community use, while delivering broader environmental benefits. Crucially, the strategic deployment of

such systems can increase accessibility for historically segregated communities, ensuring that digital innovation translates into improved mobility for all residents.

Beyond real-time network optimisation, the **ICB** highlights that ***CCAM*** and ***autonomous mobility*** could contribute to **social cohesion** if they are deployed as shared, integrated public-mobility services rather than as isolated vehicle technologies. This interpretation is supported by PAVE Europe's assessment that highly automated vehicles may improve network efficiency, reduce congestion, enable more flexible public transport and support environmental objectives when combined with electric vehicles and shared-mobility models (Kämpfer et al., 2024). Teer & Mook similarly argue that autonomous mobility can complement high-capacity public transport, improve last-mile connectivity and reduce reliance on private vehicles, potentially freeing urban space for parks, affordable housing and other community uses (Teer & Mook, 2025). The strongest equity argument concerns accessibility. Kämpfer et al. state that Autonomous Vehicles (AVs) can enable demographic groups traditionally excluded from individual mobility, including elderly people, young people and people with disabilities (Kämpfer et al., 2024). Teer & Mook further argue that autonomous public transport could improve service availability in underserved rural and suburban areas, thereby reducing social inequalities linked to poor transport access (Teer & Mook, 2025). Further, without specific evidence, the ICB claims that AVs will improve access for "historically segregated communities".

However, the ICB identifies a risk that these technologies could reinforce existing mobility challenges if they are not implemented through an inclusive approach from the outset. This concern is consistent with Teer & Mook's diagnosis of current PT challenges, including geographic disparities, vulnerable users with specific mobility needs, technological integration barriers and public mistrust (Teer & Mook, 2025). The ICB also adds a "digital divide" as a specific risk on social cohesion. To mitigate these risks, the ICB recommends a people-first innovation approach based on user engagement, coordination across public authorities and direct involvement of the people who use, operate and shape the city. This is aligned with PAVE Europe's emphasis on transparency, public understanding, direct experience and public trust in AV deployment (Kämpfer et al., 2024; Teer & Mook, 2025). Workforce transition should also be explicitly addressed: Teer & Mook argue that upskilling will be critical as roles such as bus drivers transition towards AV monitoring, fleet management, system maintenance and human-in-the-loop supervision (Teer & Mook, 2025).

4.2.3.2 Digital planning and simulation tools

Digital planning and simulation tools support evidence-based decision-making in the planning, monitoring, and evaluation of mobility policies, before and during their implementation.

Examples:

- *Digital twin*
- *Data spaces and open data platforms*
- *Data sharing in procurement*
- *Enhanced route planners for specific users*
- *Mobility marketplace*

Better knowledge leads to better decisions, which enable more effective policies.

SOs addressed

- SOF3.3,

- SOA2.2, SOA2.4, SOA3.4,
- SOP1.1, SOP1.3, SOP1.4, SOP1.5, SOP1.6, SOP2.3

Evaluation & Impact

Digital tools, as a virtual laboratory, improve forecasting and anticipation, ensuring better efficiency and effectiveness of the implementation of new policies or other measures, while minimising political and financial risks.

Real-world examples & pilots

Transform Transport's "***UX Mobility***" for **Milan** addresses the limitations of standard route planners, often focusing exclusively on shortest paths, while neglecting physical and psychological needs of vulnerable users. The study looked at transforming urban mobility by integrating softer walkability factors into digital navigation tools to ensure safer and more inclusive city experiences.

- **Inclusive Walkability**: The multi-user route planner in Milan, *UX Mobility*, developed a multi-user pedestrian route planner that incorporates walkability indicators and user preferences, producing route suggestions that differ from the shortest path in order to better reflect the needs of different user groups (transform transport, 2025).

A **simulation study** on enhanced digital and algorithmic route planning tools found that those benefit the transport system's impact:

- **Fuel consumption reduction**: V2X-enabled energy-efficient dynamic routing application achieved fuel savings of up to 14.7% in a downtown Los Angeles peak-hour scenario, by preventing unnecessary idling and stop-and-go events (Farag & Rakha, 2023).
    - *Context:* Best results were yielded at a 50% connected-vehicle market penetration rate (Farag & Rakha, 2023).

Antwerp's multimodal route planner "***Smart ways to Antwerp***" offers and combines all modes of transport in Antwerp in one platform in an innovative way.

- **Modal shift & inter-modality**: Conventional route-planners can yield car-centric results, often assuming a traveller is travelling by car. Innovative approaches move away from car-centricity, emphasising multi-modal trips, while also integrating cities' policies and strategies to manage and steer traffic around zones – all of this, while leveraging real-time data (Slim naar Antwerpen, n.d.). This shift has often also been noticed in Google Maps in some cities, where Maps can suggest alternative transport methods to driving, as previously announced by Google (Brandt, 2023).

Highlights/insights from the ICB

Beyond serving as a virtual laboratory to reduce financial and political implementation risks, the **ICB** emphasises that ***data spaces*** and ***open data platforms*** can support more coordinated and public-interest-oriented mobility planning and can be fundamental for achieving coordinated and **equitable service design**. UITP's work on data sharing in public transport supports this general logic: data sharing can unlock new insights, improve processes, enable new products and help cities develop better mobility planning and solutions (UITP, 2020).

The ICB also identifies a critical trade-off: digital optimisation may primarily serve operational efficiency, business models or commercially attractive service areas, rather than vulnerable users or low-demand communities. To mitigate this risk, the ICB recommends clear standards, open interfaces and governance arrangements that keep digital planning aligned with public-interest objectives.

4.2.4 Governance, regulation, and institutional tools

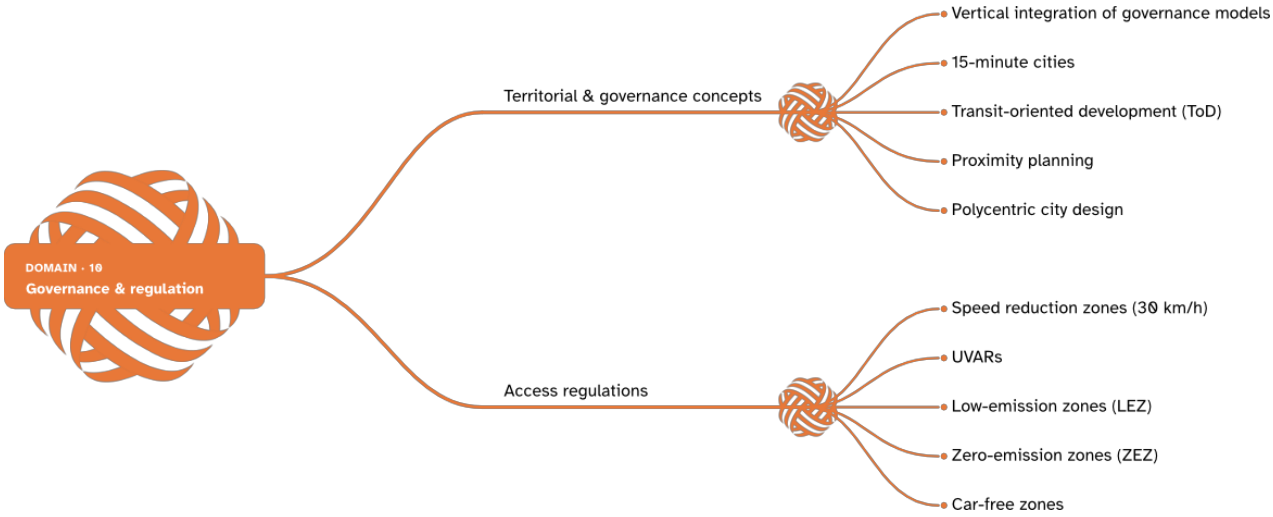


Figure 11: Cluster: Governance, regulation, and institutional tools

This cluster addresses the **strategic and regulatory boundaries** within which urban mobility operates. It targets long-term decarbonisation and air quality by deploying territorial concepts, alongside **direct access regulations**.

4.2.4.1 Territorial and governance concepts, prioritising active modes and PT

Territorial and governance concepts, prioritising active modes and PT set the strategic direction and coordination frameworks across sectors and scales for sustainable future developments.

Examples:

- *15' city*
- *Polycentric city-design*
- *Vertical integration of governance models*
- *Transit-oriented development (ToD)*
- *Proximity planning*

The strategic alignment ensures a coherent policy mix which facilitates cumulative long-term impact.

SOs addressed

- SOF1.2, SOF2.2, SOF3.4, SOF3.5,
- SOA2.1,
- SOP1.2

Evaluation & Impact

Proximity planning aims to locate services within walking and/or cycling distance, to reduce the necessity for motorised trips.

Governance frameworks are the common ground, aligning municipal departments, private stakeholders, and citizen groups toward long-term sustainability goals.

Real-world examples & pilots

Paris' urban planning model of the "***Ville du Quart d'Heure***" means to design neighbourhoods ensuring residents' access to essential services within a 15-minute walk or bike ride.

- **Car & emissions reduction**: Since the Ville du Quart d'Heure's implementation, car traffic in central Paris decreased by approximately 40%. This shift coincided with measures such as the removal of approx. 70,000 parking spots, and contributed to improvements in local air quality, including drops in local CO2 and Nitrogen Dioxide (NO_2) levels (Reid, 2020, 2023; Zevi, 2025).

Italian regions on the "***NUTS-2 level***" developed a regional model, designed to combine the efforts of multiple urban centres, to create a more balanced, cooperative, and inclusive territory.

- **Social cohesion**: There is a positive association between polycentric spatial structures and social cohesion. Distributing services across multiple nodes rather than a single centre may support more inclusive access to services for a larger share of the population (Burgalassi et al., 2019).

Lisbon's "***Há vida no meu bairro***" is an urban planning initiative, focused on fostering vibrant and accessible neighbourhoods, which is central to the "15-minute city" concept. It is a combination of structural urban redesign, legislative reform, and the creative repurposing of existing spaces.

- **Active mobility**: Residents in proximity-rich zones made 8.7% more non-motorised trips and used PT 6.5% more frequently than those in low-proximity areas (Omwamba et al., 2025).

The "***Universal Proximity-Emissions Framework***" is a **global scientific analysis of cities**, quantifying how the 15-Minute City paradigm serves as a primary tool for urban decarbonisation by substituting car dependency with active mobility:

- **Carbon footprint**: Proximity of services statistically correlated with a significant reduction in transport-related CO2. Lower CO2 emissions per capita were assessed for residents in proximity-based neighbourhoods compared to the city average (Marzolla et al., 2025).

Highlights/insights from the ICB

Beyond the strategic coordination of territorial frameworks, the **ICB** emphasises that ***TOD*** and ***proximity planning*** can help establish more people-first, human-scale urban environments when they concentrate daily services, housing and mobility options around high-quality public transport, walking and cycling. This is consistent with ITDP's "TOD Standard", which is structured around the principles of walking, cycling, connected street networks, transit proximity, mixed uses, density, compactness and reduced car dependence (ITDP, n.d.). ITDP further links TOD to **inclusive access**, **healthier environments** and **socioeconomic equity**.

However, the ICB identifies gentrification and displacement as primary risks when TOD and proximity planning increase the attractiveness and value of well-connected neighbourhoods. To mitigate these risks, the ICB recommends embedding affordability and anti-displacement measures into TOD from the outset, including inclusionary zoning, affordable-housing requirements and protections against excessive rent pressure.

4.2.4.2 Access regulations, prioritising sustainable modes

Access regulations, prioritising sustainable modes help controlling (limiting, redirecting, or conditioning) access, circulation, and use of space to discourage unsustainable behaviour.

Examples:

- *Urban Vehicle Access Regulation (UVAR)*
  - *Speed reduction zones (30 km/h)*
  - *Low emission zones (LEZ)*
  - *Zero emission zones (ZEZ)*
  - *Car-free zones*

Restrictions can trigger behavioural adaptations, which can be the fundamental catalyst of more sustainable mobility behaviour, such as reduced car use and, hence, emissions.

SOs addressed

- SOF1.1, SOF1.3, SOF1.4,
- SOA1.2

Evaluation & Impact

Access regulations help yielding better air quality, generating better public health, as well as safety, mainly by filtering through-traffic and creating a "safe-haven" for active modes.

As evidence – presented below – suggests, local commerce typically benefits from restricted vehicle access, as shopping behaviour is shifting toward nearby, pedestrian environments.

Real-world examples & pilots

London's "*Ultra Low Emission Zone (ULEZ)*" is a central pillar of the city's air quality and public health strategy, removing older and more polluting vehicles from London's roads. It has made a wide range of impacts:

- **Pollutants**: Within the first 6 months of the ULEZ expansion, roadside NO_2 concentrations fell by 36%, and road transport NOx emissions dropped by 31% (Urban Access Regulations EU, n.d.).
- **Health**: A 2025 study by the University of Bath assessed that the LEZ/ULEZ policies led to a 18.5% sick leave reduction and a 10.2% decrease of respiratory issues, contributing to higher life satisfaction scores among residents (Beshir & Fichera, 2025).
- **Commerce**: Contrary to merchant fears, an expansion of ULEZs led to increased footfall on local high streets, particularly in deprived areas, as residents shifted shopping activity to nearby, more accessible commercial hubs (Wu et al., 2025).
- **Public health ROI**: Clean air zones can generate annual public health savings of >£37 million by reducing job absenteeism and chronic respiratory illness treatments (Beshir & Fichera, 2025).

Ghent's "*Car-free city*" approach includes the introduction of five car-free zones. They do not only serve the purpose of creating more space for pedestrians and cyclists but are also a measure to prevent motorised traffic from crossing city. This benefits other road users:

- **Safety**: The implementation in the city centre resulted in 25% more cyclists and a significant decrease in traffic accidents, while through-traffic was reduced by 60% (Bundesministerium für Wohnen, 2017).

Rotterdam's "*ZEZ for city logistics*", which can also be found in **other Dutch cities** are Zero Emission Zones for city logistics, banning new fossil-fuel commercial vans and trucks from designated areas. This impacts the logistics operations:

- **Fleet transformation**: Data from 18 Dutch Zero-Emission Zones for Freight (ZEZ-F) indicates a rapid acceleration in adoption of electric vans and trucks, with operators citing the zones as the primary driver for switching to 100% emission-free fleets (Sušická et al., 2025).

Highlights/insights from the ICB

Beyond direct improvements to air quality and public health, the **ICB** emphasises that ***UVARs*** can contribute to **social equity** when they are designed as part of a wider package of inclusive mobility measures. UITP frames UVARs and clean air zones as tools that can reduce emissions, congestion and road danger while reallocating space towards walking, cycling, public transport, greenery and social public places; it also notes that these measures can support marginalised groups where they improve active mobility and public transport access for people who cannot afford private transport (UITP, 2025). C40 similarly presents clean air zones as measures that reduce toxic air pollution, prioritise people over cars and promote walking, cycling and public transport, while Watkins et al. stress that LEZs and ZEZs need to be tailored to local socio-economic context and designed for social acceptability and fairness (C40 Cities, 2024; Watkins et al., 2024). The health-equity case is strongest for exposure to air pollution and, more cautiously, noise. UITP notes that air pollution disproportionately affects children, older people and vulnerable groups, while Watkins et al. identify LEZs as a tool for improving air quality and health outcomes in urban areas (UITP, 2025; Watkins et al., 2024). Noise reduction should be treated as a potential co-benefit rather than an automatic effect: C40 links clean air zones to quieter and safer roads, and UITP's New York case reports a 45% drop in noise complaints after congestion charging, but this is a case-specific result rather than a universal UVAR outcome (C40 Cities, 2024; UITP, 2025).

At the same time, the ICB notes that UVARs can be perceived as socially imbalanced, especially when they restrict older vehicles or impose access costs without credible alternatives. This concern is directly supported by UITP, which warns that limiting private or polluting vehicles can increase inequalities if diverse citizen needs are not considered, and by Watkins et al., who identify lower-income groups, large families, people with reduced mobility, residents and businesses as groups that may face negative impacts such as vehicle-replacement costs, alternative transport costs or access difficulties (UITP, 2025; Watkins et al., 2024). To mitigate regressive effects, the ICB recommends complementary measures such as expanded PT, cycling infrastructure, shared mobility and targeted financial support. This is well aligned with UITP's 4 A's framework, which states that alternative mobility should be available, accessible, affordable and acceptable before or alongside UVAR implementation (UITP, 2025). Watkins et al. similarly recommend clean, affordable and accessible alternative mobility, together with financial support such as grants, bonuses, cheaper public transport tickets or other support tailored to those who need it most (Watkins et al., 2024). Exemptions should also be included, but framed carefully. UVAR exemptions should be clear, fair and limited, with specific attention to people with reduced mobility and adapted vehicles, while too many exemptions can reduce scheme effectiveness and confuse the public. UITP makes this point in practical terms: equity-based mitigation may include subsidies, exemptions or discounts for low-income commuters, essential workers and people with mobility impairments, but cities should avoid overly complex exemption regimes that undermine the main environmental objectives (UITP, 2025).

4.2.5 Behavioural drivers, nudges, and collective practice

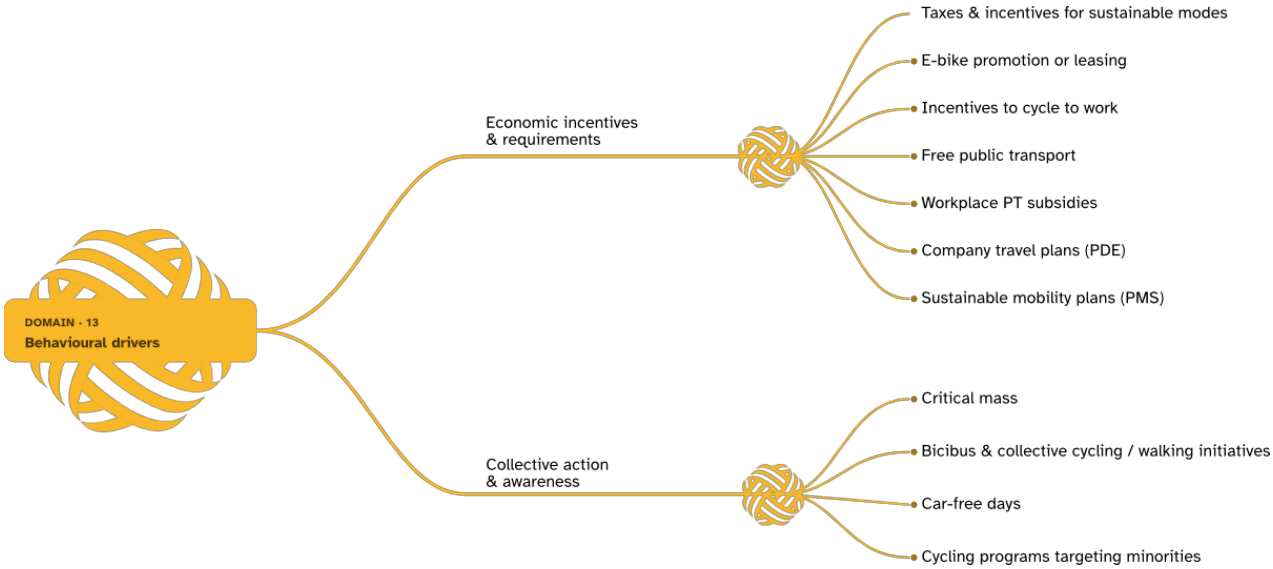


Figure 12: Cluster: Behavioural drivers, nudges, and collective practice

While previous chapters focused on the city's physical and digital infrastructure, identifies two primary levers: **financial rationalisation** through economic incentives and **social legitimisation** through collective action.

Stakeholder engagement processes are detailed extensively in deliverable ***D1.2 ENGAGEMOVE***. Therefore, this section focuses on the mechanisms that lower the barrier to entry for sustainable modes. Consequentially, the following SOs are not addressed:

- **SOA2.3**: *Efficiently reach the target audience when communicating*
- **SOA3.1**: *Include / adopt co-creation methods when planning mobility solutions*
- **SOA3.2**: *Focus on engagement of in general hard-to-reach groups of residents*

4.2.5.1 Economic incentives and requirements, promoting sustainable modes

Economic incentives and requirements, promoting sustainable modes, influence people's and business' choices through financial signals, costs/benefits, and obligations.

Examples:

- *Taxes and incentives for sustainable modes*
- *E-bike promotion or leasing*
- *Incentives to cycle to work*
- *Free public transport*
- *Workplace PT subsidies*
- *Company travel plans (PDE)*
- *Sustainable mobility plans (PMS)*

Price signals can trigger behavioural response which can be key drivers behind a modal shift.

SOs addressed

- SOF1.3, SOF1.4, SOF3.2, SOF3.3,
- SOA1.3, SOA1.4, SOA1.6,
- SOP2.1, SOP2.4, SOP2.5

Evaluation & Impact

Positive impacts due to economic incentives and requirements must often be depicted in a cross-sector context. Returns on investment are typically yielded in a different field: while costs emerge for setting incentives, the benefits may emerge in other fields, nonetheless by reduced emissions.

However, there are modal shift issues regarding the purposefulness of some incentives: It cannot be linearly interpreted that free and/or incentivised PT leads to a modal shift from private cars to PT. In fact, it can also attract former active mode users.

Real-world examples & pilots

Since March 1, 2020, **Luxembourg** offers ***free public transport*** nationwide on all buses, trams, and trains for residents, cross-border commuters, and tourists.

- **Emissions**: A 2025 assessment of the nationwide free PT policy estimated a 6.7% reduction in road transport CO2 emissions and a 10% drop in NO_2 levels (Eibinger & Fernando, 2025).

Tallinn offers ***free public transport*** too, including buses, trams, and trolleybuses, for registered residents since 2013.

- **Modal shift** (***NEGATIVE EXAMPLE / Lessons Learned***): There was a 14% jump in PT-ridership triggered, but also a 40% decrease in walking trips. Free services can cannibalise active modes (Turp-Balazs, 2026).
- **ROI**: While fare revenue declined (around €12 million annually), the policy coincided with increased tax revenues linked to 37,000 new registered residents, although the extent to which this can be attributed directly to free PT remains debated (Alaküla, 2019).

The **Government of the Netherlands** offers different way to make biking to work more appealing and accessible e.g., by ***incentives to purchase a bike***. There are five different tax schemes to support the use/purchase of bicycles, e-bikes and speed-pedelecs, which depend on the employment situation of the beneficiary. Companies, for example, can provide tax-free kilometre reimbursement for employees who commute to work biking (up to 23cents per kilometre). Self-employed workers can deduct the purchase of the bicycle from their profit (Buy or Lease a Company Bicycle, n.d.).

- **Accessibility**: Although final numbers on the impact of the “fietsplan” are not yet available, the measure has the potential to improve the accessibility to cycling to a broader audience, decreasing economic barriers.
  Moreover, there is already evidence that electric bikes can increase the commuting distance conducted with such mode. Therefore, when removing economic barriers and making e-bikes available to a broader audience, traffic and emission could improve given the shift from cars to e-bikes.

Highlights/insights from the ICB

Beyond the direct behavioural shifts triggered by price signals, the **ICB** identifies that ***economic incentives and requirements*** serve as a **socially effective** tool that can particularly benefit lower-income groups. When financial signals are correctly aligned with sustainability goals, they reduce economic barriers to access, ensuring that sustainable mobility choices become a viable and equitable option for a broader segment of the population.

However, the ICB highlights critical risks and trade-offs, specifically the regressive impact of certain taxes, such as fuel duties or congestion charges, which can disproportionately affect lower-income households who spend a higher share of their income on transport and may have fewer alternatives to private car use. Furthermore, there is a risk of unequal access to incentives flagged by the ICB: for instance, subsidies for electric vehicles or specialised cycling infrastructure may primarily benefit higher-income groups who can afford high upfront costs, potentially widening existing social inequalities. To mitigate these effects, the ICB recommends that revenues generated from these taxes be strategically reinvested into affordable and accessible public transport, particularly in underserved or peripheral areas, to ensure all communities benefit equitably from the transition.

4.2.5.2 Collective action and awareness, promoting sustainable mobility

Collective action and awareness, promoting sustainable mobility shifts (social) norms, visibility, values, and collective practices around mobility.

Examples:

- *Critical mass*
- *Bike buses and other collective cycling and walking initiatives*
- *Car-free days (CFD)*
- *Cycling programmes targeting minorities*

Only when norms change, sustained behaviour change is possible.

SOs addressed

- SOF1.1, SOF1.4, SOF2.3, SOF2.4, SOF3.2,
- SOA1.6, SOA1.7,
- SOP2.2, SOP2.4

Evaluation & Impact

Periodic collective events raise lasting awareness and provide tangible experiences. Creating temporary baselines shifts public expectations and, consequently, political will.

Real-world examples & pilots

Brussels' *car-free Sundays* are scheduled events where private motor traffic is restricted for a full day across streets or even entire districts, to reclaim urban space for walking, cycling, and community activities, which lead to:

- **Pollution reduction**: A single car-free Sunday (September 17, 2023: *European Mobility Week 2023*) resulted in minus 44-77% NO_2 emissions compared to an average Sunday. Moreover, noise levels near busy roads dropped by >20 decibels (EIT Urban Mobility, 2025).

Barcelona's bike bus ("***Bicibus***") is a collective mobility solution, where a group of children (and their adult guardians) ride their bicycles to school together, following predetermined route with specific stops & timetables, much like a traditional bus, but with further advantages:

- **Health**: Shifting 40% of the car trips to cycling would prevent 76.15 deaths annually in Barcelona City through increased physical activity and reduced air pollution (Rojas-Rueda et al., 2012).
- **Safety**: A survey among participants uncovered that 66% of the BiciBus participants completely agreed that riding in a group is the primary factor for feeling safe enough to cycle in city traffic. This means overcoming a safety barrier for 92% of the surveyed parents (Simón i Mas et al., 2024).

A **global overview** (literature review) on "***CFDs***" investigated planned, temporary restrictions on private car use to prioritise walking, cycling, and public transit, and found positive impacts:

- **Pollution reductions**: NOx reductions were often substantial, such as 95% in Brussels (Glazener et al., 2022).
- **Social cohesion**: Participants report being motivated by social interaction and social opportunities. In fact, CFDs were found to support community bonding and provide entertainment in urban areas (Glazener et al., 2022).

"***Critical Masses***" are monthly, leaderless, decentralised bicycle demonstrations held in hundreds of cities worldwide, often on the first or last Friday of the month, to promote cycling, advocate for better infrastructure, and reclaim public space from cars. So is the Critical Mass of the **Metropolis GZM, Poland**.

- **Social cohesion**: Spending time with friends (59.7%), riding in large groups (60.4%) are the primary drivers of participation, fostering a sense of community among local cyclists (Kwiatkowski, 2024).

Highlights/insights from the ICB

Beyond the broader shift in social norms and values, the **ICB** emphasises that ***awareness campaigns*** can help reshape sustainable e-commerce by influencing how consumers choose between delivery options. Phillips & Pernot show that retailer communications can affect delivery choices through several routes, including attitudes, perceived social norms, behavioural control, choice salience and trust in the sustainability message. Their work also identifies delivery price, delivery time, precision, vehicle type, consumer motivations and sustainability awareness as relevant factors shaping delivery choices (Phillips & Pernot, 2026). While the industry currently prioritises speed as a primary selling point, the ICB notes that opting for slower delivery reduces transport pressure and enables logistics providers to optimise their routes. The ICB further notes that encouraging customers to choose standard or slower delivery can reduce logistics pressure by giving operators more flexibility to consolidate deliveries and optimise routes.

To ensure initiatives resonate effectively, the ICB recommends that campaigns present sustainable delivery as affordable, accessible and easy to choose. The ICB also recommends framing sustainable e-commerce as a shared effort between consumers, retailers, platforms, logistics providers and public authorities, rather than placing responsibility solely on individual consumers.

5 Regulatory frameworks and innovative governance

5.1 Methodology

The methodology combined desk research, internal synthesis and expert validation, following a progressive and multi-layered approach. Below, the methodology followed is presented step by step.

5.1.1 Understanding Multilevel Governance

As first step, an overview of definition, status and EU relevance of **multi-level governance** has been conducted as it constitutes the overarching framework within which the governance approaches of the mobility solutions examined in this deliverable are situated. This included assessing the distribution of competences across local, regional, national and European levels, the coordination mechanisms that enable vertical alignment, and the institutional interdependencies that influence the feasibility and scalability of mobility innovations. The multilevel governance perspective served as a bridge between the conceptual foundations and the empirical analysis, clarifying how different layers of authority shape the design, implementation and regulation of mobility measures. This multilevel governance framework was then **contextualised and grounded in practice through the examination of three use cases**, represented by the three GOLIA partner cities. These cases provided concrete insights into how governance dynamics unfold in real urban contexts, allowing the theoretical framework to be validated, nuanced and adapted to the operational realities of city-level mobility planning and implementation.

5.1.2 Detailed assessment of governance approaches across mobility solutions

Starting from the multilevel governance framework, the analysis then moved to a finer level of detail to illustrate how its principles are practically applied in the governance of individual mobility solutions. The methodology adopted is outlined below, step by step.

5.1.2.1 Defining the analytical governance scope within the three-dimensional mobility ecosystem

The mobility solutions analysed in Chapter 4 were clustered into coherent groups**.** This initial classification was essential to define the scope of the analysis, avoid redundancy, and ensure that the governance assessment focused on meaningful functional categories rather than on a fragmented list of individual measures. The clustering exercise provided the structural foundation for the subsequent methodological phases. This process resulted in 13 governance focuses; the table below presents them in relation to the mobility solutions analysed in Chapter 4.

An extensive literature review was undertaken to establish the conceptual foundations of the work. Academic and policy sources, as well as relevant deliverables from EU project (such as GOLIA and CREATE) were used to frame mobility innovation as a governance challenge, examining how regulatory frameworks, public–private cooperation models, data governance, market dynamics, safety

requirements, equity considerations and broader public-value objectives shape the implementation of new mobility solutions. This phase provided the analytical lens through which the subsequent empirical work was interpreted, ensuring coherence with state-of-the-art governance theory and European policy orientations.

MOBILITY SOLUTION	GOVERNANCE FOCUS
Tactical Urbanism	Governance of urban space and urban "rules" (30km/h city)
Superblocks	
(Re-) Distribution of road space (public space)	
Self-explaining roads (SERs)	
Speed reduction (30 km/h zones in (inner-) cities)	
Play-street (German: "Spielstrasse")	
School streets	
“8 to 80” concept	
Bike streets	Governance of sharing mobility
Colourised Bike Lanes	
Bicycle highways	
Inclusive design of bicycles and other micromobility modes	
Secure and high quality bike-parking	
Changing rooms and showers for cyclists (at work)	
Pop-up Bike lanes	
Dedicated PT lanes	Governance of public transport infrastructures
Dynamic PT lane allocation	
Smart bus shelters and Wi Fi kiosks	Governance of Public Transport Services
Mobility hubs	Governance of mobility hubs
Demand Responsive Transit (DRT)	Governance of MaaS and integration of mobility services
Integrating cycling into public transport	
Allowing bikes on PT	
Mobility as a Service (MaaS)	
Special or integrated ticketing	
Micro hubs	Governance of infrastructure for logistics to enhance collaboration

Cargo hitching	
Smart traffic lights	Governance of Dynamic kerbside management
Cycling platoon detection	
Dynamic kerbside management	
Geofencing	Governance of CCAM
C-ITS corridors and AI powered infrastructure	
CCAM and V2X applications	
Digital twin	Governance of Mobility Dataspaces
Data spaces and open data platforms	
Data sharing in procurement	
Enhanced route planners for specific users	
Mobility marketplace	
15' city	Vertical and Horizontal governance integration
Polycentric city-design	
Vertical integration of governance models	
Transit-oriented development (ToD)	
Proximity planning	
UVARs	Governance of UVAR
Low emission zones (LEZ)	
Zero emission zones (ZEZ)	
Car free zones	
Taxes and incentives for sustainable modes	
E bike promotion or leasing	
Incentives to cycle to work	
Free public transport	
Workplace PT subsidies	
Company travel plans (PDE)	
Sustainable mobility plans (PMS)	
Participatory budgeting	Innovative decision-making in mobility

Citizen juries and forums	
Citizen science initiatives	
Mobility workshops and focus groups	
Hackathons	
Commoning	
Local apps for engagement	
Critical mass	
Bicibus and other collective cycling initiatives	
Car free days (as engagement events)	
Cycling programs targeting minorities	

Table 5: Mapping of mobility solutions & governance

5.1.2.2 In-depth analysis of the governance approaches adopted for each mobility solution

The in-depth analysis of the governance approaches adopted for each mobility solution across Europe and beyond. This included reviewing regulatory arrangements, institutional roles, operational responsibilities, funding mechanisms and coordination practices observed in different contexts. Rather than presenting each solution individually in the main body of the deliverable, the analysis was reorganised into five functional families — physical infrastructure, urban space measures, digital space and data-enabled infrastructures, demand-side measures, and supply-side measures. This structuring choice improves readability and allows cross-cutting governance patterns to emerge more clearly, supporting mobility practitioners in understanding recurring challenges, transferable practices and the systemic nature of mobility governance. Each mobility solution has been analysed according to the following points:

- Regulatory frameworks
- Governance models
  - Description
  - Governance approach
  - Advantages
  - Challenges
  - Examples (mapping)
  - Regulatory/legal gaps
- Market Dynamics and Competition
- Political influence
- Funding schemes
- How to co-define the best governance scheme

This resulted in a very extensive analysis, comprising 13 detailed sheets (one for each mobility solution), which were validated by the Impact Creation Board as described in the following section.

5.1.2.3 Validation with the Impact Creation Board

The governance assessment developed through desk research was then submitted to the Impact Creation Board for review and integration. The validation focused on four key dimensions: the relevance and applicability of the proposed governance models; the identification of priority sectors for collaboration and funding; the detection of alignment gaps across local, regional, national and European governance levels; and the collection of best practices for each governance area.

This process strengthened the robustness, transferability and practical relevance of the analysis, ensuring that the deliverable reflects both theoretical insights and practitioner-driven perspectives. In addition, the ICB validation phase provided concrete operational guidance on governance implementation, offering inputs that go beyond the state of the art and anchoring the analysis in real-world experience.

Below is the template used to collect validation inputs from ICB members.

Integration Step required	What to do	Why your input is important
1. Validation and Integration of Governance Models	- Confirm the relevance of the proposed governance models - Highlight any emerging or hybrid models not yet considered (please provide references) - Identify operational differences across local, national, and EU context	To strengthen the robustness and transferability of the template, avoiding oversimplification
2. Identification of Key Sectors for Collaboration and Funding Schemes	- Identify up to three priority sectors for cross-sector collaboration (e.g. energy, commerce, healthcare, tourism) and explain how this collaboration is beneficial (e.g. common objectives, data integration, need for holistic approach) - Highlight relevant funding instruments (e.g. Horizon Europe, CEF, regional funds, NRRPs) - Share examples of co-financing or replicable public-private partnership model	To map financial levers and strategic partnerships for each governance model
3. Identification of Alignment Gaps and Needs Across Governance Levels	- Highlight misalignments between governance levels (local, regional, national, EU) - Identify regulatory, institutional, or procedural barriers to implementation - Propose harmonisation tools (e.g. Climate City Contracts, digital platforms, local pacts)	To support the development of resilient and interoperable governance frameworks.
4. Provision of Best Practices per Governance Model	- Share at least one best practice for each governance model analysed (please provide references) - Specify: context, stakeholders involved, instruments used, outcomes achieved - Highlight success factors and conditions for transferability	To enrich the template with concrete evidence and replicable cases

Table 6: ICB-input template

5.1.2.4 Developing a summary for the report

The analysis of the 13 mobility solutions has been synthesised in this deliverable around functional families of mobility measures rather than individual solutions. This approach reflects the fact that many mobility innovations share similar governance requirements even when they involve different modes, technologies or operational contexts. For instance, measures that reshape public space often raise comparable issues related to legal mandates, enforcement, public acceptance and maintenance, while digital and data-enabled solutions typically require clear rules on interoperability, data access, privacy, public oversight and vendor dependency.

The main body of this deliverable therefore focuses on these cross-cutting governance aspects, while the detailed analysis of each individual governance model is provided in the Annex D. These detailed sheets will also serve as the knowledge base for the interactive tool to be integrated into the GOLIA website, enabling rapid and user-friendly access to the specific content developed.

5.2 Multilevel governance: definition and examples

5.2.1 Background and definitions

From centralised towards decentralised governance

In 'Making Decentralisation Work: A Handbook for Policy-Makers'[1], the OECD understands multilevel governance as part of a general transition towards decentralisation, which over the past five decades has been a major trend across OECD countries (including most of Europe, North America, and several Asia-Pacific nations), resulting in a shift of powers and responsibilities from central governments to elected subnational authorities. Rather than a simple transfer of authority, this shift has also impacted political, administrative and fiscal dimensions, with outcomes depending heavily on institutional design. Today, regions and cities account for over 40% of public expenditure and more than half of public investment, playing an expanding role in policy areas linked to major policy domains such as transport, energy, climate, education and health. The OECD Handbook also describes how the move towards decentralisation has not been uniform. Systems differ widely in the degree of autonomy granted to subnational governments and in their financing structures. Importantly, decentralisation is increasingly understood as a "reconfiguration of intergovernmental relations". Central governments retain a strategic and coordinating role, while many responsibilities are shared across levels of government. Another major trend has been the upscaling of subnational governance. Municipal fragmentation has led to reforms encouraging integration, inter-municipal cooperation and the development of metropolitan governance bodies, particularly since the 1990s. At the same time, administrative regions have become prominent in many countries: a majority of countries have experienced an increase in regional authority since the 1970s. Overall, the trend has been towards more economically significant, functionally complex and differentiated systems of multilevel governance. However, the OECD emphasises that decentralisation's effectiveness depends on clear assignment of responsibilities, adequate fiscal resources (avoiding unfunded mandates), strong administrative capacity and mechanisms to manage fragmentation and coordination across jurisdictions.

Multilevel governance: definition and EU relevance

The concept of multilevel governance in the European Union emerged alongside the strengthening of the subsidiarity principle introduced by the Treaty on European Union (Maastricht Treaty[2]). The Treaty formally established subsidiarity as a guiding principle for EU action, stating that decisions should be taken as closely as possible to citizens and that the Union should act only when objectives cannot be sufficiently achieved by Member States alone. This principle laid the institutional foundations for a system of

[1] Making Decentralisation Work: A Handbook for Policy-Makers', OECD, 2019
[2] https://portal.cor.europa.eu/subsidiarity/whatis/Pages/SubsidiarityfromMaastrichttoLisbon.aspx?utm_source=chatgpt.com

governance involving multiple territorial levels (i.e. European, national, regional and local), each contributing to policy design and implementation. The Treaty also created the European Committee of the Regions, giving cities and regions a formal consultative role in EU policymaking where regional or local competences are affected. Together, subsidiarity and the involvement of regional and local authorities reflect the EU's multilevel governance model, which aims to ensure that policymaking responsibilities are shared across levels of government while maintaining decisions as close as possible to citizens.

The European Committee on Democracy and Governance describes multilevel governance (MLG), as a cooperative system of policymaking and implementation that brings together international, supranational, national and subnational authorities, alongside civil society and private actors. Originating in EU integration and regionalisation processes, MLG has evolved into a framework structured around three dimensions:

- vertical relations between levels of government;
- horizontal coordination within each level;
- the involvement of multiple stakeholders in participatory decision-making.

It operates through a mix of hierarchical, networked and market-based approaches and takes institutional form in federal and decentralised unitary states, inter-municipal and metropolitan cooperation, cross-border regions, and transnational instruments such as European Groupings of Territorial Cooperation (EGTCs). At the heart of MLG is the principle of subsidiarity, closely associated with EU governance, which holds that public responsibilities should be exercised by the lowest level capable of effectively performing them, while higher levels provide coordination, support and oversight where necessary. Linked to the **European Charter of Local Self-Government**, this principle reinforces local autonomy, democratic accountability and proportionality in the allocation of powers and resources. While MLG can enhance participation, policy coherence, innovation and balanced territorial development, it also increases institutional complexity and coordination demands, making clear legal frameworks, transparent accountability mechanisms and effective leadership essential to ensure that subsidiarity and cooperation function in practice rather than just in principle.

5.2.2 Status of multilevel governance as perceived by major European cities

A 2025 survey[3] conducted by EUROCITIES collecting responses from 86 mayors indicates that major European cities generally perceive multilevel governance as improving, but still uneven and constrained in practice. Nearly 69% of mayors report better cooperation with other levels of government over the past decade, reflecting growing recognition of the role cities play in addressing challenges such as climate change, migration and sustainable development, supported by initiatives like the Urban Agenda for the EU and the strengthened urban dimension of EU cohesion policy. However, progress remains incomplete: a small share of mayors report stagnation or decline in cooperation, often linked to increasing national centralisation. **Access to funding remains a key concern**, with EU funding perceived as the most difficult to obtain due to complex procedures and reliance on national intermediaries, while regional funding is generally considered more accessible and national funding can sometimes be influenced by political dynamics. Fiscal autonomy is also limited for many cities, with only 28% of mayors reporting strong control over budgets and taxation, leaving most municipalities dependent on conditional national transfers that

[3] https://monitor.eurocities.eu/wp-content/uploads/2025/05/Eurocities-Pulse2025-WEB-pages.pdf

constrain long-term planning. By contrast, mayors in countries with more decentralised governance systems such as Switzerland, Germany, and the Nordic states report more positive experiences, highlighting that **stronger fiscal autonomy enables cities to invest more confidently** in infrastructure, housing and climate policies. Overall, the findings suggest that while multi-level governance in Europe has improved in principle, many cities still lack sufficient financial independence and institutional influence, prompting mayors to call for greater decentralisation, more direct EU funding, simplified financial instruments and a stronger role for cities in European decision-making.

5.2.3 Multilevel governance applied: examples from climate, energy and mobility

Achieving Climate and Energy Goals through Multilevel Dialogue and Mission Governance

Effective climate action in the EU relies on multilevel governance, ensuring that climate and energy objectives are implemented across all territorial levels. Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action underlines that achieving climate neutrality requires coordinated efforts between EU institutions, national governments, and regional and local authorities. Article 11 further mandates structured multilevel dialogues, engaging local authorities, civil society, businesses, and other stakeholders in designing and monitoring national climate policies. These dialogues bring local knowledge into national strategies, strengthen transparency, policy coherence, and ownership of climate action.

Building on this approach, the Smart and Climate-Neutral City Mission, launched in 2021 under Horizon Europe, supports cities in leading the transition to climate neutrality by 2050. Through initiatives such as Climate-Neutral City Contracts, which set clear actions, responsibilities, and targets, cities coordinate investments, innovation, and collaboration with citizens, businesses, and government. This mission demonstrates how structured governance, citizen engagement, and strategic planning can produce measurable climate results while contributing to EU-wide targets.

The 2025 OECD report *Harnessing Mission Governance to Achieve National Climate Targets* highlights key governance principles that underpin successful missions. Strong institutions, strategic orientation with long-term political backing, meaningful societal engagement, and effective horizontal and vertical coordination are all critical. Adaptive implementation, integrating mission objectives into core government processes, encourages experimentation, learning, and continuous capability development. Finally, effective resource mobilisation—combining public funding, private investment, and market-shaping policies—ensures that economic incentives support long-term climate objectives.

The following examples – selected from the NetZeroCities case study repository - highlights selected best practice examples, showing how cities and regions across Europe are putting vertical and horizontal cooperation mechanisms in place to achieve tangible climate results, specifically in the domain of urban mobility:

Lahti – Sustainable Commuting Practice

Lahti, Finland, developed a **Sustainable Mobility Agreement** engaging municipal authorities, local employers, transport providers, and citizens to reduce commuting-related emissions. The initiative combined horizontal cooperation across city departments and private actors with vertical coordination linking regional transport authorities and national climate policies. Measures included promoting walking, cycling, and public transport, supported by incentives, infrastructure, and communication campaigns. The project demonstrated how collaborative governance and multi-stakeholder engagement can drive behavioural change, strengthen partnerships, and deliver measurable climate impacts that are replicable in other cities.

Helsingborg – Safe and Active School Mobility

Helsingborg implemented a programme to promote safe walking and cycling to school, combining infrastructure improvements with awareness campaigns targeting students and parents. The initiative reflects horizontal cooperation across municipal departments (mobility, education, urban planning) and engagement with schools and families, while aligning with broader national road safety and climate objectives. It demonstrates how targeted, community-based interventions can reduce emissions, improve safety, and foster long-term behavioural change.

Bordeaux – Tackling Urban Congestion

Bordeaux addressed congestion through integrated mobility planning, combining traffic management, public transport improvements, and urban design measures. The approach required coordination across city departments and transport operators, alongside vertical alignment with regional mobility strategies and national transport frameworks. This example highlights how coordinated governance can reduce emissions, improve air quality, and enhance overall urban mobility efficiency.

Vitoria-Gasteiz – Superblocks and Shared Mobility

Vitoria-Gasteiz introduced Superblocks and shared mobility solutions to reduce car dependency and prioritise active and public transport. The initiative involved horizontal collaboration between urban planning, mobility, and environmental departments, as well as strong citizen engagement, while aligning with regional and national sustainability policies. It illustrates how rethinking urban space can deliver both environmental and social benefits at scale.

EU Transport Policy Frameworks and the Need for Multilevel Governance

A range of EU transport and related policy frameworks have a direct impact on urban mobility systems and increasingly require coordinated action across governance levels. From planning and implementation to monitoring and enforcement, local and metropolitan authorities play a crucial role in translating EU

objectives into concrete measures on the ground. This makes multilevel governance essential, ensuring that European, national, regional, and local actors work together to deliver coherent, effective, and locally adapted mobility solutions.

A central framework is the **Trans-European Transport Network** (TEN-T) policy of the European Union which will be explore more in detail in the next paragraph (5.2.4). The revised TEN-T Regulation strengthens requirements for 431 urban nodes on the core and comprehensive networks, specifically the obligation to adopt and implement Sustainable Urban Mobility Plans (SUMPs) and to ensure multimodal integration, last-mile freight solutions and better coordination at the Functional Urban Area (FUA) level. Although not a common practice yet, it requires cities to be directly engaged in aligning local mobility systems with European corridor strategies and work programmes. At the same time, it also implies that corridor governance structures must actively involve urban nodes in planning and decision-making processes, since effective integration between corridor operations and urban mobility systems cannot rely on cities alone taking the initiative to engage with higher-level transport governance frameworks.

The EU **Urban Mobility Framework** (2021) complements TEN-T by promoting SUMPs as the standard planning instrument for cities and linking access to EU funding (e.g. under the Connecting Europe Facility or Cohesion Policy) to high-quality mobility planning. Although not legally binding in itself, it shapes expectations for local governments in areas such as active mobility, public transport, digitalisation and urban logistics. This role is reinforced by the revised TEN-T framework, which requires urban nodes on the TEN-T network to adopt a SUMP by 2027. To facilitate the rollout of SUMPs and urban mobility indicators (UMIs), Member States are encouraged to set up national SUMP supporting frameworks (NSSPs) providing guidance, knowledge exchange, capacity building and financial support. National SUMP Contact Points are in turn supported through a coordination platform set up by the European Commission DG MOVE. By promoting knowledge-sharing and cross-border cooperation, the platform aims to ensure a consistent and high-quality approach to urban mobility throughout Europe.

The **European Green Deal** and the **Fit for 55-package** set binding greenhouse gas reduction targets that cascade down to the transport sector. Policies such as **ETS 2** (extension of emissions trading to road transport), **CO_2 standards** for vehicles, and the **Alternative Fuels Infrastructure Regulation** (AFIR) require cities to plan charging and refuelling infrastructure, manage traffic demand and accelerate the shift to zero-emission mobility. Air quality legislation, particularly the **Ambient Air Quality Directives**, obliges Member States to meet pollutant limit values, often requiring local measures such as low-emission zones, traffic restrictions, or modal shift policies. Urban authorities are typically responsible for designing and enforcing these measures.

The **Clean Vehicles Directive** (revised in 2019) sets mandatory procurement targets for low- and zero-emission buses and public fleets, directly affecting municipal transport operators and contracting authorities. Similarly, **PSO** (public service obligation) rules for passenger transport under Regulation 1370/2007 govern how cities tender and subsidise public transport services.

Road safety policy, especially the EU's **Vision Zero** framework, influences urban speed management, infrastructure design and enforcement strategies. Data-sharing and intelligent transport systems legislation under the revised **ITS Directive** also requires local authorities to deploy interoperable digital mobility services and traffic data systems.

Finally, **Cohesion Policy** and the **Recovery and Resilience Facility** shape urban mobility indirectly by conditioning funding on reforms and investments consistent with EU climate, digital and transport objectives, often requiring integrated territorial planning and cooperation across levels of government.

Taken together, these policies make local governments key actors in delivering EU transport, climate and environmental objectives, reinforcing the need for strong multilevel governance and coordination at the urban and metropolitan scale.

The following examples, drawn from case studies on the EU Urban Mobility Observatory website, illustrate how cities use a multilevel governance approach to implement local sustainable transport initiatives while advancing EU transport policy objectives.

Vienna City-Wide Parking Pricing and Zone Expansion

Vienna (Austria) has expanded its short-term parking zones to cover virtually the whole agglomeration and introduced structured pricing and time limits to manage demand. The program involved collaboration between city transport planners, municipal enforcement officers and neighbourhood associations to design equitable pricing and permit schemes. It also required vertical coordination with national policy guidance on mobility and air quality as well as with regional SUMP recommendations, clearly linking local parking management to broader sustainable mobility strategies. Public surveys indicate majority support, showing how coordinated planning and stakeholder engagement can build acceptance for demand-oriented parking strategies.

Stockholm Region Zero-Emission Bus Transition Model

The Stockholm Region Public Transport Authority (Sweden) is gradually electrifying its bus fleet as part of a long-term strategy that builds on decades of greening public transport and strong multilevel governance. Local and regional authorities set procurement targets and contracts that allow operators to invest in clean technology, while a Public Transport Contract Committee brings together regional governments, municipalities, and private operators to align procurement standards and best practices. This approach – highlighted by the Big Buyers Working Together Community of Practice on procurement of Zero-Emission Bus Systems and Services – presents a Nordic example of coordinated planning, shared technical standards, and pooled expertise to meet EU CO_2 reduction targets.

Bielefeld Low Emission Zone

Bielefeld (Germany) implemented a Low Emission Zone (LEZ) as part of the EU-funded *ReVeAL* project (Regulating Vehicle Access for Improved Liveability). These measures included spatial restrictions and regulatory controls limiting access for high-emission vehicles in central areas. The process involved local cooperation between city mobility planners, environmental departments, local business associations and citizens to design and agree on access rules, enforcement and exemptions. At the same time, vertical coordination was achieved with regional authorities and alignment with national air quality standards and EU sustainable mobility policy frameworks. This collaborative governance approach helped Bielefeld manage traffic, reduce emissions, and improve the liveability of urban spaces, providing a valuable model for other European cities developing UVAR schemes.

Gdańsk Traffic Calming and Community Safety Campaigns

Gdańsk (Poland) implemented a coordinated urban traffic calming and road safety programme focused on reducing speeds and improving safety in residential and high-pedestrian zones. The initiative brought together horizontal cooperation between municipal transport, urban planning and enforcement departments, neighbourhood councils, schools and local NGOs to co-design speed reduction measures, signage and community awareness activities. Vertical coordination involved alignment with national road safety priorities and EU road safety frameworks such as Vision Zero, with support from Poland's participation in the EU Road Safety Exchange and sharing best practices at EU-level road safety events. This collaborative approach combined engineering, education and enforcement to enhance safety for pedestrians and cyclists while strengthening local ownership of safety outcomes.

5.2.4 Multilevel governance for urban nodes on the TEN-T Network: a higher level of complexity

As introduced above, the Trans-European Transport Network (TEN-T) policy of the European Union aims to create a coherent, multimodal transport network across Europe that ensures the seamless movement of passengers and freight, strengthens territorial cohesion, and supports the EU's climate and competitiveness objectives. It links railways, roads, inland waterways, maritime routes, ports, airports and urban nodes into a single strategic framework, supported by common standards and EU funding instruments such as the Connecting Europe Facility.

The revised TEN-T Regulation reinforces the role of urban nodes, major cities and metropolitan areas located along the core and comprehensive networks, by formally recognising them as critical hubs where long-distance and local transport flows intersect. This recognition also comes with specific legal requirements: by 2027, designated urban nodes must adopt Sustainable Urban Mobility Plans and begin reporting mobility data (as defined in the Delegated Act on Urban Mobility Indicators, which is expected to be published in June 2026), followed by the development of multimodal passenger hubs by 2030 and the integration of multimodal freight terminals and hydrogen refuelling infrastructure by 2040 to ensure seamless, zero-emission connectivity across the TEN-T network. The revised framework therefore shifts urban nodes from being passive transit points to active governance actors responsible for integrating long-distance corridors with local mobility systems, reducing congestion and emissions, improving multimodal connections, and aligning urban transport planning with broader European network standards and climate goals.

Implementing these obligations will require stronger and more extensive cooperation, not only across governance levels and among local partners, but also between stakeholders within the respective corridors. The complexity of MLG for urban nodes is described in the 2026 'Report on Urban nodes - Cooperation Between Cities and Stakeholders of Their Functional Urban Area'[4], developed by the Urban Nodes Subgroup within the EC's Expert group on Urban Mobility. It finds that effective cooperation at the level of Functional Urban Areas (FUAs) is essential for implementing TEN-T urban node requirements yet remains institutionally complex because functional mobility patterns rarely align with administrative borders. Across the EU, governance approaches vary widely: some countries rely on formal metropolitan or inter-municipal authorities (e.g. France, Poland, Portugal), others on voluntary or contractual arrangements (e.g. Finland's 'MAL' agreements, Sweden's West Sweden Agreement, the Netherlands' Groningen–Assen partnership), transport associations (as in Germany's Verkehrsverbünde), national legislative SUMP frameworks (e.g. Slovenia, Greece, Spain), or regional transport platforms with limited legal powers (e.g. Flanders in Belgium). The key finding is that effectiveness depends less on how FUAs are delineated and more on enabling conditions such as stable funding, national guidance, technical capacity, reliable data and monitoring systems, and strong political leadership. Implementation challenges include fragmented competences, overlapping plans across governance levels, limited resources in smaller municipalities, evolving functional boundaries driven by infrastructure and commuting changes, and questions of democratic legitimacy and accountability. The report concludes that while Europe already demonstrates a rich diversity of workable models, successful FUA cooperation requires supportive national frameworks, clear coordination mechanisms, and alignment with Sustainable Urban Mobility Plans, ensuring that TEN-T obligations reinforce rather than duplicate or complicate existing governance structures. The challenges related to urban nodes governance are also extensively described in a 2024

[4] https://transport.ec.europa.eu/document/download/d3820870-fb45-4378-8bf8-474611649f1d_en?filename=EGUM_Report_Urban_Nodes.pdf

issue of the Network Industries Quarterly, a publication by the Florence School of Regulation, which includes findings from SCALE-UP and MOVE21, two EU-funded urban nodes projects which involved GOLIA partner cities Antwerp and Florence.

5.2.5 Focus on multilevel governance in GOLIA partner cities Antwerp, Florence and Pilsen

Antwerp

As described by the SCALE-UP project, Antwerp is a key urban node on the TEN-T core network, located on major corridors linking the North Sea with the Baltic and the Mediterranean and connected to the Rhine-Alpine freight axis. The urban node ecosystem brings together public and private stakeholders, including the City of Antwerp, the Port of Antwerp Bruges, the Antwerp Transport Region, the Province of Antwerp, the Flemish Region Department of Mobility & Public Works, and private partners like Be-Mobile and Traject NV, to co-create and test multimodal strategies for passengers and freight. Activities include smart freight routing, multimodal hubs, shared micromobility services, dynamic routing tools, and integrated real-time data platforms. Governance combines vertical coordination (city to regional and national levels) with horizontal collaboration across organizations, aligning local measures with regional plans and TEN-T objectives, evaluating impacts, and supporting replication in other European nodes. Challenges include fragmented decision-making across governance levels, the need for secure and interoperable data governance, ongoing trust-building for cross-sector collaboration, and the incomplete integration of multimodal hubs into SUMPs and aligned passenger-freight planning. The EC has endorsed Antwerp's Climate City Contract and Action Plan, granting the city the Mission Label in recognition of its commitments.

Florence

Florence is a historic urban centre in Tuscany, Italy, positioned along the Scandinavian-Mediterranean Corridor, which links northern Europe with the Mediterranean, making Florence part of a broader European multimodal network. The city is a major rail junction served by Firenze Santa Maria Novella, one of Italy's busiest stations, connecting the Bologna–Florence and Florence–Rome high-speed railway lines, which are part of the European high-speed rail network and support both regional and long-distance passenger flows. Locally, sustainable mobility is underpinned by an expanding tram and bus network with services linking the airport, central areas, and suburbs, alongside cycling infrastructure and shared mobility services that help reduce congestion and emissions. Transport policy and planning are coordinated by the Municipality of Florence in collaboration with the Metropolitan City of Florence and the Tuscany Region, aligning local mobility strategies with national and EU priorities such as Sustainable Urban Mobility Plans (SUMPs) and TEN-T requirements. The Climate City Contract and Action Plan submitted by Florence is endorsed by the EC, resulting in the city being awarded the Mission Label.

Pilsen

Pilsen is a major city in western Czechia, strategically located along international road corridors linking Prague with the German border and connecting the city to the broader TEN-T network. Although Pilsen is not formally designated as a TEN-T core urban node, its transport infrastructure integrates the city into pan-European networks through motorway links, a key rail junction connecting Prague, Cheb, and Germany, and extensive regional and international bus services. The local mobility ecosystem includes a comprehensive municipal tram, trolleybus, and bus network, operated by Plzeňské městské dopravní podniky (PMDP), which facilitates both daily commuter flows and connections to intercity transport. Transport policy and planning in Pilsen are coordinated by the City of Pilsen, the Plzeň Regional Authority, and the Czech Ministry of Transport, enabling alignment of local, regional, and national mobility priorities.

The city also fosters innovation in smart mobility, experimenting with connected transport systems, 5G infrastructure, and intelligent transport technologies, positioning Pilsen as a living lab for future urban mobility solutions.

5.3 Overview of governance approaches

Building on the multilevel governance perspective presented in the previous section, this section shifts the focus from the general institutional framework to the governance conditions required for specific mobility solutions to be implemented effectively. The analysis of multilevel governance has shown that urban mobility policies depend on vertical coordination between European, national, regional and local authorities, as well as on horizontal cooperation across sectors, departments, operators, private actors and civil society. This provides the institutional background for the following analysis.

Within GOLIA, governance is treated as the enabling layer that connects mobility objectives, technical and spatial solutions, user behaviour and public value. Innovative mobility measures can support more sustainable, inclusive and adaptive urban mobility systems, but their impact depends on the rules, responsibilities, funding schemes, market arrangements and monitoring mechanisms that shape their implementation. For this reason, the following section analyses governance not as an abstract concept, but as a practical condition for making mobility solutions operational, legitimate and scalable.

The section presents the GOLIA-specific governance analysis developed for the selected mobility solutions. To avoid duplicating the detailed solution-by-solution assessment included in the Annex D, the main text provides a synthetic reading organised around five analytical groups: physical infrastructure; urban space measures; digital space and data-enabled infrastructures; demand-side measures; and supply-side measures. This structure allows recurring governance issues to be identified across different solutions, while keeping the focus on the practical conditions that cities need to address when moving from mobility innovation to implementation.

5.3.1 Governance approaches across mobility solutions

The following section translates the governance perspective introduced above into a structured analysis of the mobility solutions considered in GOLIA. While the full solution-by-solution governance assessment is reported in Annex D, this chapter provides a synthetic reading of the main governance implications emerging across the different types of measures. The objective is therefore not to reproduce the detailed analytical templates, but to identify the recurring regulatory, institutional, market, political and funding conditions that can support or hinder implementation.

Based on this logic, the section is structured around five analytical groups: physical infrastructure, including nodes and arcs; urban space measures; digital space and data-enabled infrastructures; demand-side measures, including incentives, regulation and behavioural change; and supply-side measures, including services, marketplaces and operational tools. For each group, the analysis highlights the governance conditions that appear most relevant for GOLIA cities and for the broader development of adaptive, inclusive and socially oriented mobility systems.

5.3.1.1 Physical infrastructure

Physical infrastructure refers to the material backbone of the mobility system. In the GOLIA analysis, this group includes both nodes and arcs. Nodes are the fixed points where flows are generated, exchanged,

consolidated or redistributed, such as mobility hubs, public transport stops, intermodal facilities, micro-hubs for urban logistics, parking areas converted into mobility assets, and other access points to shared or collective mobility services. Arcs are the linear elements that connect these nodes and structure movement across the city and its functional urban area, such as public transport corridors, dedicated or dynamic public transport lanes, cycling routes, pedestrian links, freight access corridors and strategic road segments.

The governance of physical infrastructure is therefore different from the governance of individual mobility services. Infrastructure is long-lasting, spatially fixed and politically visible. Once a corridor, hub or logistics node is built or redesigned, it shapes user behaviour, operator incentives and public-space allocation for many years. For this reason, infrastructure decisions must be treated as governance decisions. They determine which modes are prioritised, which actors gain access to scarce space, which users are better served, and which forms of mobility become easier or harder in everyday practice.

This is particularly relevant for GOLIA because the partner cities face infrastructure-related challenges at different scales. Antwerp is dealing with multimodal integration, regional coordination and the need to support alternatives to private car use across a wider transport region. Florence must address the constraints of a dense and historic urban environment, where logistics, road safety, public transport and heritage protection compete for limited space. Pilsen has a strong need to extend multimodal connectivity, improve links with peripheral areas, and adapt its physical and digital infrastructure to more advanced mobility systems, including connected and automated mobility. In all three cases, the governance issue is not simply whether infrastructure exists. The key question is whether infrastructure is planned, funded, regulated and managed in a way that supports sustainable, inclusive and adaptive mobility.

For arcs, the central governance challenge is the allocation and operational control of corridors. Dedicated public transport lanes, dynamic lane allocation and cycling corridors require clear legal authority over road space. Public authorities must be able to define who has priority, when priority applies, how exceptions are handled, and how rules are enforced. Dynamic infrastructure increases this complexity because the rule can change according to time, congestion, events, service disruptions or environmental conditions. This requires a defined chain of command between planning bodies, road authorities, transport operators, enforcement bodies and, where relevant, technology providers. Without this chain, dynamic allocation risks remaining a pilot rather than becoming a stable part of urban mobility management.

Physical corridors also require alignment between infrastructure governance and service governance. A bus lane, tram priority measure or multimodal corridor delivers value only if the public transport service using it improves in reliability, speed, accessibility or perceived quality. This means that infrastructure measures must be connected to public service contracts, service-level targets, fleet deployment decisions and operational monitoring. If the public authority responsible for road space is not aligned with the authority responsible for service planning and contracting, the infrastructure investment may not translate into better outcomes for users. A coherent governance model should therefore connect corridor design, service obligations, funding responsibilities and performance indicators.

For nodes, governance concerns access, neutrality, interoperability and long-term management. Mobility hubs, interchanges and micro-hubs are not passive pieces of infrastructure. They concentrate services, users, providers, information systems and operational rules in a limited space. A mobility hub can host public transport, shared mobility, cycling facilities, carsharing, taxi services, charging infrastructure, lockers or local services. A micro-hub can support last-mile logistics, cargo-bike operations, parcel consolidation, click-and-collect services and low-emission distribution in sensitive areas. In both cases, the physical site becomes a regulated interface between public goals and private or semi-private operations.

The governance of these nodes should define who owns or controls the site, who can operate there, which minimum service standards apply, which accessibility requirements must be respected, how space is allocated among providers and how data are shared for monitoring. Public authorities may manage the node directly, delegate operations through concessions or contracts, or set up mixed public-private arrangements. Each model has advantages and risks. Direct public management can safeguard public objectives but may require capacity that some municipalities do not have. Private operation can bring efficiency and investment, but it requires strong contractual safeguards to prevent selective access, excessive commercialisation or weak attention to equity. Hybrid models can work when roles, risks and revenues are explicitly allocated.

Micro-hubs show this logic clearly. Their governance depends on their location, territorial scale and logistics function. A neighbourhood micro-hub in a low-traffic area requires flexible and proximity-oriented governance, often involving local businesses, logistics operators and the municipality. A hub located near a railway station, parking area or intermodal node requires stronger rules on shared access, interoperability and coexistence between operators. A larger urban distribution centre at the metropolitan edge requires more standardised governance, stronger technical requirements and integration with regional logistics planning. The narrower the spatial scale, the more collaborative the governance can be. The broader the strategic function, the more formalised the coordination needs to become.

Funding is another core issue for physical infrastructure. These measures usually combine upfront investment with long-term operational and maintenance costs. Corridor redesign, signage, traffic control systems, charging points, shelters, docking areas, loading spaces and digital monitoring tools require capital expenditure. Their daily operation, enforcement, cleaning, maintenance, data management and adaptation require stable operational expenditure. Many infrastructure projects fail or lose effectiveness because the delivery phase is funded, while the long-term management phase is not. For this reason, the governance scheme should define from the beginning who pays for construction, who pays for operation, and how costs are shared between public authorities, operators, users and, where appropriate, developers or landowners.

The market dimension is also significant. Infrastructure creates competitive conditions. Access to a hub, a corridor, a loading bay or a high-demand interchange can become a source of market advantage. If access rules are unclear, larger operators may dominate, while smaller providers or community-oriented services may struggle to participate. If concession or partnership agreements are poorly designed, public infrastructure can become a semi-private asset controlled by a limited number of actors. This is particularly relevant for mobility hubs and logistics nodes, where the same physical site can support public transport integration, shared mobility, freight consolidation and local services. Governance must protect neutrality, avoid lock-in, and ensure that infrastructure remains aligned with public value.

Physical infrastructure is also politically sensitive because it redistributes space and visibility. Corridors and nodes affect drivers, public transport users, cyclists, pedestrians, residents, businesses, logistics operators and emergency services. Measures that prioritise one use often constrain another. Dedicated lanes can be perceived as reducing road capacity for cars. Logistics micro-hubs can raise concerns over land use, noise or access. Mobility hubs can trigger conflicts over parking, street clutter or commercial use of public space. These conflicts cannot be solved through technical design alone. They require transparent objectives, early stakeholder involvement, credible evidence on expected impacts, and clear communication on the public interest pursued by the measure.

From a governance perspective, the most robust approach is to treat physical infrastructure as part of a portfolio rather than as isolated projects. Cities need a common legal and strategic baseline, but different types of infrastructure require different governance intensity. Main corridors require clear authority, formal

coordination and stable funding. Local nodes require operational flexibility, user-oriented design and continuous adjustment. Logistics hubs require alignment between spatial planning, access regulation and business viability. Mobility hubs require interoperability, accessibility and neutral management. Across all types, three conditions appear essential: a clear competence map, a transparent funding model, and a monitoring system able to trigger adjustment when outcomes diverge from objectives.

In this sense, the governance of physical infrastructure is a central focus for GOLIA. It connects the material city with the institutional city. It makes policy priorities visible in space, but it also exposes the limits of fragmented mandates, unstable funding and weak coordination. Well-governed infrastructure can support modal shift, improve reliability, enable multimodality, reduce pressure on public space and make innovative mobility services more socially useful. Poorly governed infrastructure can create new conflicts, reinforce existing inequalities and lock cities into choices that are hard to reverse. The governance of physical infrastructure should therefore be understood as a precondition for turning mobility innovation into durable public value.

5.3.1.2 Urban space measures

Urban space measures concern the way streets, squares, kerbs and other public spaces are regulated, allocated and used in everyday urban life. Compared with physical infrastructure, which mainly refers to the material backbone of nodes and corridors, urban space measures focus on the governance of public space as a scarce, contested and socially meaningful resource. This group includes interventions such as road-space reallocation, 30 km/h areas, low-traffic neighbourhoods, school streets, play streets, superblocks, tactical urbanism, pedestrianisation, traffic calming, public-space activation, parking reorganisation and rules for kerbside use. These measures often rely on limited infrastructure works, but they can produce deep changes in mobility behaviour because they alter the hierarchy of uses within the street.

The main governance question is therefore how cities decide who public space is for. Urban space is never neutral. A street can prioritise vehicle throughput, local access, walking, cycling, public transport, freight loading, play, social interaction, greenery, commercial activity or safety. Each choice creates benefits for some groups and constraints for others. For this reason, urban space measures are among the most politically sensitive mobility interventions. They are visible, they affect daily routines, and they are often perceived directly by residents, shopkeepers, commuters, logistics operators and vulnerable users. Their success depends less on technical design alone and more on legitimacy, clarity of rules, enforcement capacity and the ability to manage conflict.

In the GOLIA framework, urban space measures are strongly connected to the transition from mobility planning as traffic management to mobility planning as social value creation. This is consistent with the broader logic of the 3D Mobility Ecosystem Map, where mobility solutions are assessed in relation to user behaviour, technical and spatial functions, and governance arrangements. Urban space interventions can support modal shift by making walking, cycling and public transport access safer and more attractive. They can also reduce exposure to traffic risk, improve air quality, recover space for local life, and make streets more usable for groups that are often disadvantaged by car-centred design, including children, older people, people with reduced mobility and people without access to a private car.

From a regulatory perspective, the first requirement is a **clear rights-based baseline**. Public space measures should not depend only on discretionary design choices or temporary political preferences. They need legal and planning principles that protect equitable access, transparency, accessibility, participation and accountability. This is particularly important when measures restrict car access, reduce parking,

reorganise loading space or introduce new rules for specific areas. If the public purpose is not clearly stated, opposition can frame the measure as a loss imposed on certain users. If equal access and safeguards against interest-group domination are weak, participation processes can be dominated by more organised or economically stronger interests. A rights-based approach helps define the minimum conditions that must apply across all urban space interventions, regardless of the specific local solution.

Binding standards are the second enabling condition. Many cities rely on guidelines for street design, accessibility, safety or public-space quality, but guidelines alone may be too weak when implementation is controversial. Urban space measures become more robust when minimum standards are embedded in planning law, traffic regulation, zoning provisions, public-space codes or municipal bylaws. These standards can define minimum requirements for sidewalks, crossings, cycling space, universal accessibility, maintenance, public lighting, loading areas, greenery, traffic calming and safety. They also reduce patchwork implementation across neighbourhoods. Without binding standards, outcomes may vary according to the capacity of individual departments, the pressure of local stakeholders or the priorities of each political cycle.

A third governance condition is **role clarity**. Urban space measures often sit between different departments and levels of government. Mobility departments may design the measure, public works may implement it, police or municipal enforcement bodies may control compliance, urban planning may regulate land use, environmental departments may monitor climate or air-quality impacts, and metropolitan or regional authorities may influence traffic flows beyond the municipal boundary. Without a competence map, responsibilities become blurred. This can delay implementation and create inconsistent enforcement. A workable governance scheme should specify who sets the objectives, who approves the design, who funds the works, who manages day-to-day operations, who enforces rules, and who is accountable for results.

Municipality-led governance is often the most direct model for urban space measures. The city defines the rules, translates them into local instruments, coordinates municipal departments, funds core interventions and monitors compliance. This model gives public authorities strong implementation power, especially where they control street regulation, permits, inspections and local standards. It is suitable for measures such as 30 km/h zones, school streets, pedestrian areas, traffic calming, parking restrictions and redistribution of road space. Its main weakness is that it requires political continuity and administrative capacity. Public resistance, legal ambiguity, weak enforcement resources and short-term political pressures can undermine even well-designed measures.

For more complex areas, urban space governance may need to become more adaptive and collaborative. **Dynamic governance** is relevant when interventions require continuous adjustment based on monitoring, community reporting or changing mobility patterns. Tactical urbanism is a clear example. A temporary intervention can be used to test a new street layout, observe impacts, collect feedback and then decide whether to scale, redesign or remove it. This reduces the risk of over-engineering solutions before their social effects are understood. The same logic applies to low-traffic neighbourhoods, school streets and kerbside management, where initial rules may need refinement after residents, schools, operators and enforcement bodies experience the measure in practice.

Commons-based co-governance can also be relevant, especially for spaces where the objective is not only movement control but social activation. Some streets and squares function as local civic spaces. Their value depends on how they are used, maintained and appropriated by communities. Co-management arrangements can involve residents, schools, local businesses, associations or community organisations in defining uses, organising activities and maintaining the space. This can strengthen ownership and reduce conflict, but it needs safeguards. Without clear rules, stronger groups may capture



the space, while weaker users remain excluded. Co-governance should therefore be based on fair access, transparent decision-making, explicit responsibilities and public oversight.

Public-private arrangements may support urban space measures when delivery or maintenance requires additional investment or operational capacity. For example, private actors may contribute to public-space improvements linked to development projects, commercial areas, mobility hubs or local services. These schemes can reduce pressure on municipal budgets and bring operational expertise, but they also create risks of commercialisation and unequal access. Public authorities need strong contract clauses to protect public use, affordability, inclusiveness and long-term maintenance. The same applies to value-capture instruments, developer contributions, concessions and sponsorship schemes. Public space should not become public only in ownership and private in practical access.

Funding remains a recurring challenge. Urban space measures are often cheaper than large infrastructure projects, but they still require stable resources. Temporary installations, signage, enforcement, street furniture, greenery, maintenance, monitoring and community engagement all generate costs. Many interventions fail after the first implementation because long-term operational expenditure is not secured. This is especially relevant for measures that require continuous management, such as school streets, tactical urbanism areas, play streets, shared spaces or redesigned kerbs. The funding model should therefore distinguish between initial capital expenditure and recurring management costs. It should also clarify whether revenues from parking, access regulation, local charges or development contributions can be ring-fenced for public-space outcomes.

Monitoring and feedback are essential because urban space measures often generate indirect and distributed effects. A street closure may reduce traffic in one area but alter flows elsewhere. A school street may improve safety perceptions but require stronger enforcement at peak hours. A superblock may increase public-space quality but raise concerns from residents or businesses during the transition. Cities need simple indicators to track safety, accessibility, traffic volumes, public-space use, compliance, satisfaction, business impacts and equity effects. Monitoring should combine technical data with community feedback. Data-driven adjustment can improve legitimacy, but only if data responsibilities, privacy safeguards and participation rules are clear.

Safety also needs to be embedded from the start. Urban space measures are often introduced to protect vulnerable users, but safety cannot be reduced to traffic engineering. It includes perceived safety, night-time accessibility, emergency access, visibility, inclusive design and proportional security measures. Security-by-design can help identify risks early and clarify responsibilities among planners, municipal authorities, police, emergency services and local stakeholders. At the same time, governance should avoid over-securitisation. Measures that rely excessively on barriers, surveillance or exclusionary control can reduce openness and weaken the democratic value of public space.

Finally, urban space measures must avoid sterilisation. Over-standardised rules can remove the local meaning of streets and squares, especially when design focuses on technical order but ignores plural uses. A high-quality public space is not only safe and compliant. It must also allow social interaction, local identity, informal use, temporary activities and everyday flexibility. For GOLIA, this is central. Urban space measures are not simply tools to reduce car dependency. They are instruments to make mobility governance more inclusive, adaptive and oriented toward public value. Their governance should therefore combine legal clarity, municipal authority, stakeholder participation, stable funding and feedback-driven adjustment. When these conditions are present, urban space measures can turn street regulation into a practical pathway toward safer, fairer and more socially cohesive mobility systems.

5.3.1.3 Digital space and data-enabled infrastructures

Digital space and data-enabled infrastructures refer to the informational layer that allows urban mobility systems to be observed, coordinated, managed and adjusted over time. This group includes digital twins, mobility data spaces, integrated data platforms, real-time traffic and routing systems, MaaS back-end architectures, shared ticketing and payment systems, kerbside management platforms, open data portals, operator data feeds, connected infrastructure for CCAM, and monitoring systems based on sensors, mobile data or community reporting. These tools do not simply support mobility governance. They increasingly become part of mobility governance itself.

The first implication is that data must be treated as infrastructure. In traditional mobility planning, infrastructure usually refers to roads, stations, depots, hubs or traffic control systems. In data-enabled mobility, the capacity to collect, structure, exchange and interpret information becomes equally strategic. Without reliable data on flows, services, user behaviour, emissions, accessibility, safety, parking, freight operations or public-space use, public authorities cannot manage mobility adaptively. At the same time, data infrastructure is not neutral. It defines what becomes visible to decision-makers, which actors can participate in the system, and which priorities are translated into operational rules.

For GOLIA, this is particularly relevant because the project aims to support a more adaptive and socially oriented governance model. Digital tools can help cities move from static planning to feedback-driven management. They can support the monitoring of policy impacts, the adjustment of measures over time, and the integration of different mobility services into a more coherent offer. They can also support the Social Optimum Mobility Index by providing the evidence base needed to assess mobility performance in relation to time, place and social outcomes. However, this potential can be realised only if the digital layer is governed through clear public objectives, shared standards and accountability mechanisms.

The governance of digital space begins with **data access and data sharing**. Many relevant datasets are not held by municipalities alone. They are produced by public transport operators, shared mobility providers, logistics service providers, MaaS platforms, navigation companies, parking operators, infrastructure managers, mobile network providers and users themselves. This creates a structural dependency between public authorities and private or semi-private actors. Cities need access to operational data to plan, regulate and monitor mobility. Operators may consider the same data commercially sensitive. A robust governance framework should therefore define which data are required, for which public purpose, at which level of aggregation, under which legal basis, and with which safeguards.

Interoperability is the second core condition. Digital mobility governance depends on the ability of different systems to communicate. This applies to MaaS platforms, ticketing systems, payment interfaces, real-time information, shared mobility feeds, kerbside rules, vehicle-infrastructure communication and digital twins. If every platform uses proprietary formats or closed interfaces, integration becomes costly and public authorities risk vendor lock-in. In contrast, open standards, common data models and clear application programming interfaces can reduce switching costs, improve transparency and allow smaller actors to participate. For this reason, interoperability should be set early as a governance requirement, not added later as a technical refinement.

MaaS illustrates this challenge clearly. A MaaS ecosystem is not simply an app that bundles services. It is a regulated market architecture in which public transport, shared mobility, information services, payment systems and user interfaces are connected through data and contractual relationships. Governance choices determine whether MaaS becomes a public-value tool or a platform controlled by a dominant intermediary. A commercial integrator may bring speed and user-oriented innovation, but can prioritise commercial visibility, data control and profitable services. A transport-as-integrator model may better

align with public policy but can be slower and less attractive to users. A neutral open back-end or regulated public platform can create a more balanced model, but requires stronger public capacity and stable funding. The key point for GOLIA is that platform governance must be designed deliberately.

Digital ticketing, payment and clearing should also be treated as governance issues. They define how revenues are allocated, how users access services, how operators are compensated, and how accountability is managed when something fails. If these elements are left to bilateral agreements or platform logic, public authorities may lose visibility over essential system functions. A clear scheme should define the role of the MaaS operator, the integrator, the transport authority, service providers and payment intermediaries. It should also set rules for consumer protection, service reliability, complaints, fare transparency and continuity of access for users who are less digitally equipped.

Dynamic kerbside management provides another example. The kerb is increasingly used by buses, taxis, delivery vehicles, private cars, shared mobility, charging infrastructure, waste collection and public space functions. Digital tools can help encode curb regulations, allocate access dynamically, monitor compliance and manage space more efficiently. Yet the political and institutional problem remains complex. Kerbside management cuts across transport, parking, logistics, enforcement, planning and digital innovation departments. If nobody owns the kerb as an operational system, digital tools can multiply fragmentation rather than solve it. Governance should therefore establish a clear operational lead, shared data responsibilities and rules for how digital information translates into enforceable street management.

Digital and data-enabled infrastructures also raise market and competition issues. Data can become a strategic resource. Actors controlling user interfaces, routing algorithms, payment systems or operational data can influence mobility choices and market access. This creates risks of platform power, discriminatory visibility, exclusion of smaller operators and dependency on private providers. Public authorities should therefore act as market orchestrators. Their role is not necessarily to operate every digital platform directly, but to set the rules under which platforms can operate: access conditions, interoperability requirements, data-sharing obligations, audit rights, portability provisions and public-interest safeguards.

Privacy, cybersecurity and ethical data governance are equally important. Mobility data can reveal sensitive patterns about people, places and behaviours. Even when datasets are aggregated, careless integration can create risks of re-identification, surveillance or unequal treatment. Connected and automated mobility increases this risk because it depends on continuous exchange between vehicles, infrastructure and platforms. Cybersecurity is therefore not only a technical matter. It is a public safety and liability issue. Governance should define minimum security requirements, incident responsibilities, audit procedures, data minimisation principles and limits on secondary use. The principle should be clear: data should be as open as possible for public value, but as protected as necessary for rights, safety and trust.

Equity is another major concern. Data-driven governance can improve inclusion, but it can also reproduce blind spots. Groups that do not use smartphones, digital payments, shared mobility apps or online consultation tools may become less visible in datasets. Neighbourhoods with weaker digital coverage or lower sensor density may appear less relevant in operational dashboards. Smaller operators may struggle to comply with demanding data standards. For this reason, digital governance should combine automated data with qualitative input, community reporting and targeted engagement. The objective is not to replace participation with data, but to use data to make participation and policy adjustment more informed.

Funding models must also recognise the difference between pilots and durable digital infrastructure. Many data-enabled solutions are first developed through innovation funding, but long-term value depends on maintenance, hosting, staff skills, cybersecurity, system updates, licensing, procurement management, data quality control and stakeholder coordination. These are recurring costs. If they are not funded, digital



systems deteriorate or remain isolated pilots. Public authorities should therefore distinguish between initial capital expenditure for system development and operational expenditure for long-term governance. Procurement should avoid excessive dependence on proprietary tools and should require portability, documentation and public access to critical functions.

Overall, digital space and data-enabled infrastructures are essential for the GOLIA governance model, but they require strong institutional design. Their value lies in making mobility systems more observable, integrated and adaptive. Their risk lies in shifting control from public authorities to opaque platforms, fragmented datasets or vendor-defined architectures. For GOLIA cities, the priority is therefore to build digital capacity without losing public direction. This means defining the public purpose first, assigning an orchestrator, setting interoperability and data-sharing rules early, protecting privacy and cybersecurity, ensuring inclusion, and funding the digital layer as a long-term public governance asset.

5.3.1.4 Demand-side measures (incentives, regulation and behavioural change)

Demand-side measures are interventions that act on mobility demand rather than directly expanding mobility supply. They seek to influence when, where, how and why people travel, and under which conditions users, firms and institutions choose one mobility option over another. In the GOLIA framework, this group includes incentives, pricing mechanisms, access regulation, parking policies, awareness campaigns, mobility credits, employer-based travel plans, school mobility schemes, behavioural nudges, co-creation activities, and user engagement measures. Their common feature is that they do not primarily build new infrastructure or operate new services. Instead, they shape the decision environment in which mobility choices are made.

The governance of demand-side measures is particularly important because behavioural change cannot be imposed through information alone. People do not change travel habits only because a more sustainable option exists. They change when the alternative is accessible, affordable, reliable, socially acceptable and easier to choose than the previous behaviour. This means that demand-side governance must combine regulation, incentives, communication, enforcement and trust-building. If one of these elements is missing, the measure may remain symbolic or produce effects only among already motivated users.

Demand-side measures are central to GOLIA because the project addresses mobility not only as a technical system, but also as a social system. The user personas developed in the behavioural pillar recognise that different groups have different needs, constraints and motivations. A commuter living in a peripheral area, a tourist visiting a historic centre, a parent accompanying children to school, a logistics operator serving local businesses and a low-income resident without a private car do not respond to the same instruments in the same way. Governance should therefore avoid generic behavioural policies and instead design measures that are targeted, evidence-based and sensitive to equity.

Regulation is the most visible form of demand-side intervention. Urban Vehicle Access Regulations, low-emission zones, zero-emission zones, speed limits, parking restrictions, time windows for deliveries and access rules for sensitive areas all influence demand by changing what is allowed, where and when. These measures can support decarbonisation, safety, air quality, liveability and more efficient use of public space. However, their legitimacy depends on a clear legal basis, transparent objectives and proportional implementation. If rules are perceived as arbitrary or punitive, resistance increases and compliance decreases. A robust governance framework should define the public purpose of the measure, the affected area, eligible exemptions, enforcement responsibilities, appeal mechanisms and review procedures.

Pricing and economic instruments form a second major category. Parking fees, congestion charges, differentiated access fees, public transport fare incentives, mobility credits, subsidies for shared mobility or active travel, and employer-supported mobility benefits can shift behaviour by changing relative costs. These instruments are powerful because they influence everyday decisions directly. Yet they also raise fairness issues. A charge that is effective for higher-income users can be regressive for lower-income users if no alternatives are available. A subsidy can reward behaviour that would have happened anyway if it is not targeted. A mobility credit can support inclusion, but only if users understand how to access it and if the eligible services meet their real needs. For this reason, pricing and incentives should be designed with explicit distributional safeguards.

Parking policy is a key demand-side lever because parking availability and price strongly influence car use. Reducing, pricing or reorganising parking can discourage unnecessary car trips and recover space for other uses. At the same time, parking reform is politically sensitive because it affects residents, commuters, businesses and logistics operators in visible ways. Governance should therefore connect parking measures to wider mobility goals. Parking restrictions are easier to defend when paired with better public transport, safe walking and cycling routes, shared mobility options, loading spaces for freight and clear communication on how recovered space will be used. Revenue allocation also matters. If parking revenues are transparently reinvested into local mobility and public-space improvements, acceptance can increase.

Behavioural nudges and communication measures operate through a different logic. They seek to make sustainable choices easier, more visible or position them as a norm across society. Examples include personalised travel planning, real-time information, wayfinding, public campaigns, gamification, mobility challenges, school-based education, workplace mobility programmes and targeted communication for specific user groups. These measures are often less coercive than regulation and less costly than infrastructure investment, but they are rarely sufficient alone. Their impact depends on credibility, repetition, timing and integration with real alternatives. A campaign encouraging cycling will have limited effect if users perceive cycling routes as unsafe. A campaign promoting public transport will fail if service reliability is poor. Behavioural measures should therefore accompany structural changes, not replace them.

Co-creation and engagement are also demand-side tools. They help shape acceptance, identify barriers and adapt measures to local needs. In GOLIA, this is relevant because the project aims to develop mobility governance with citizens and stakeholders, not only for them. Engagement can improve policy quality by revealing practical constraints that data alone may miss. It can also reduce opposition by making trade-offs explicit before decisions are finalised. However, participation requires governance safeguards. Without clear rules, engagement can be dominated by organised interests, while less visible groups remain under-represented. Public authorities should define who needs to be involved, how input will be used, what decisions are open to influence and how feedback will be reported.

Employer and institution-based measures are particularly relevant for functional urban areas. Many travel behaviours are shaped by work schedules, school routines, university activities, hospital access, industrial zones and large event venues. Pilsen's attention to large employers, Antwerp's regional modal shift objectives and Florence's need to manage tourist, commuter and logistics flows all point to the same issue: demand is not produced only by individuals, but also by organisations. Governance should therefore involve employers, schools, universities, hospitals, tourism actors and business associations in mobility planning. Measures can include staggered working hours, employee mobility plans, incentives for public transport passes, cycling facilities, shared shuttle schemes, logistics booking systems or visitor management strategies.

Demand-side measures also require strong monitoring. Behavioural change is often gradual and uneven. A measure may reduce car trips in one group while generating unintended effects in another. A low-emission zone may reduce polluting vehicles but increase costs for small operators. A parking reform may reduce car use in central areas but shift pressure to surrounding neighbourhoods. A subsidy may increase uptake but not reduce emissions if it mainly attracts users from walking or public transport. Cities need indicators that track actual behavioural effects, not only outputs. Relevant indicators may include modal shift, vehicle kilometres travelled, accessibility, compliance rates, user satisfaction, distributional impacts, emissions, safety outcomes and perceived fairness.

The political dimension is unavoidable. Demand-side measures often ask users to change habits, pay differently, accept restrictions or reconsider established routines. This makes them vulnerable to short-term political pressure. For this reason, governance should combine clear leadership with adaptive implementation. Pilot phases, staged rollouts, sunset or review clauses, compensation measures and transparent reporting can help manage uncertainty. The goal is not to avoid conflict completely, but to make conflict governable through evidence, dialogue and adjustment.

Overall, demand-side measures are a key bridge between mobility solutions and the social optimum pursued by GOLIA. They translate public objectives into everyday choices. Their effectiveness depends on the ability to combine hard regulation, fair incentives, credible communication, targeted engagement and continuous monitoring. When designed well, they can reduce unnecessary car use, support safer streets, improve access to sustainable modes and make behavioural change socially acceptable. When designed poorly, they can create resistance, inequity and weak compliance. For GOLIA cities, the main governance lesson is that behaviour cannot be treated as an individual responsibility alone. It is shaped by rules, prices, information, institutions and trust.

5.3.1.5 Supply-side measures (services, marketplaces and operational tools)

Supply-side measures refer to the services, marketplaces and operational tools that expand or reorganise the mobility options available to users, firms and public authorities. While demand-side measures influence choices through regulation, incentives and behavioural change, supply-side measures act on the availability, quality, integration and operational performance of mobility alternatives. In the GOLIA framework, this group includes public transport service improvements, DRT, shared mobility, carsharing, bike-sharing, Mobility as a Service, integrated ticketing, mobility marketplaces, urban logistics services, delivery coordination tools, fleet management systems, smart routing and other operational instruments that make sustainable mobility more usable in practice.

The governance of supply-side measures is central because services do not become socially valuable only by existing. They need to be planned, integrated, monitored and aligned with public objectives. A shared mobility scheme can reduce car ownership if it complements public transport and serves the right locations; it can also increase clutter, compete with walking or public transport, or concentrate only in profitable central areas. A MaaS platform can simplify multimodal travel; it can also become a gatekeeper that controls user interfaces, data and market visibility. A demand responsive service can improve accessibility in low-density areas; it can also become financially unsustainable if it is not clearly positioned within the wider public transport network. The public governance question is therefore not whether these services are innovative, but whether they strengthen the mobility system as a whole.

For GOLIA, the first principle is that public transport should remain the backbone of the urban mobility offer. Supply-side innovation should extend, complement and improve the public transport system, not fragment it. This is particularly relevant for services that operate in the intermediate space between fixed-

route public transport and individual mobility, such as DRT, shared shuttles, ride-pooling and shared micro-mobility. These services can support first- and last-mile access, serve peripheral or low-density areas, and provide flexibility where conventional fixed-route provision is inefficient. Their governance should define where they are meant to operate, which user needs they address, how they connect with the main public transport network, and how performance is assessed.

This requires strong coordination between service planning and operational delivery. Local and regional authorities need to define the public goals of the service: accessibility, modal shift, equity, emissions reduction, coverage of underserved areas, reduced car ownership or better integration with employment zones and public facilities. Operators then need clear service obligations, reporting requirements and performance indicators. If the measure is publicly supported, the contract or licence should specify service levels, data-sharing duties, accessibility requirements, fare integration, safety standards and user protection mechanisms. If the service is privately operated, the public authority still needs levers to ensure that it does not undermine wider mobility objectives.

Marketplaces are a specific supply-side challenge. A mobility marketplace aims to bring different services into a common environment where users can compare, book, pay for or combine mobility options. This can reduce friction and make multimodal travel more attractive. However, the marketplace is not only a technical interface. It is a governance structure that decides which services are visible, under which conditions they participate, how prices and offers are displayed, how data are exchanged, and how conflicts between providers are resolved. In Antwerp, for instance, the objective of promoting a mobility marketplace is directly linked to improving the user experience and supporting alternatives to private car use. The governance of such a marketplace should therefore protect neutrality, transparency and non-discriminatory access.

MaaS makes this issue explicit. Different governance models are possible: a commercial integrator, a transport-authority-led platform, a neutral open back-end, a regulated public platform, or a contracted integrator operating under public rules. Each model has different implications. A commercial integrator may move faster and offer a more attractive interface, but it may prioritise profitable services and retain strategic control over user data. A public or regulated platform may better safeguard policy objectives, but it requires stronger institutional capacity and funding. A neutral back-end can allow multiple front-end applications to compete while maintaining common public rules. The key governance decision is therefore to define who orchestrates the ecosystem and what powers this orchestrator has.

Operational tools raise similar issues. Smart routing systems, fleet management platforms, booking tools for freight deliveries, charging scheduling systems and real-time service management tools can improve efficiency and reduce negative externalities. For example, logistics coordination tools can reduce unnecessary vehicle movements, support consolidation, improve access to restricted areas and make low-emission delivery models more viable. In Florence, where the management of logistics in the historic centre is a key objective, such tools can help reconcile accessibility, heritage protection, emissions reduction and public-space quality. Yet these tools need clear rules on data access, operator participation, enforcement links and compatibility with local regulation.

Urban logistics services require particular attention because they involve a diverse set of actors with different resources and bargaining power. Large couriers and e-commerce platforms often have strong operational capacity, proprietary systems and market influence. Small logistics providers, local retailers, artisans and cycle-logistics operators may need shared infrastructure, neutral platforms and public support to participate. If governance relies only on market-driven delivery models, large actors may dominate space, data and infrastructure. If governance is too rigid, innovation and operational efficiency may be reduced. The most balanced approach is often a mixed model, where public authorities define the

rules and public-interest safeguards, while private and cooperative actors operate services under transparent conditions.

Funding is a recurring issue across all supply-side measures. Commercial services may finance fleets, platforms, customer interfaces and daily operations, but public authorities still bear costs for coordination, enforcement, integration, monitoring, public-space management and equity coverage. Services that are socially necessary are not always commercially viable, especially in low-demand areas, peripheral districts or vulnerable communities. This creates a viability gap. Governance should decide when public subsidies are justified, what they should cover, and which obligations they trigger. Public funding should focus on public-value components: integration with public transport, coverage of underserved areas, accessibility for vulnerable users, data reporting, interoperability and service continuity.

The transition from pilots to stable services is another governance challenge. Many supply-side innovations begin as pilots because technologies, markets and user responses are uncertain. Pilots are useful for learning, but they become problematic when they remain isolated, underfunded or disconnected from long-term planning. Cities should define clear gates from the beginning: what counts as success, what evidence is required, who validates results, and whether the next step is scaling, redesign, integration into contracts, or termination. This is important for DRT, shared mobility, MaaS, CCAM-related services and logistics tools, where pilots can demonstrate potential but not guarantee institutional readiness.

Monitoring should be operational and public-value oriented. Relevant indicators include service availability, reliability, coverage, accessibility, integration with public transport, user satisfaction, emissions, vehicle kilometres travelled, safety incidents, compliance with public-space rules, data quality and equity of access. Data should be comparable across providers and available to the relevant public authority or auditor. Without monitoring, public authorities cannot distinguish between services that genuinely improve the mobility system and services that mainly shift costs or capture profitable market segments.

Overall, supply-side measures are necessary to make sustainable mobility a credible alternative to private car dependence. They provide the services, platforms and tools that allow users and firms to act differently. Their governance must prevent fragmentation, market capture and dependency on proprietary systems, while preserving space for innovation and operational efficiency. For GOLIA cities, the strongest approach is to treat supply-side innovation as part of a publicly steered ecosystem: public transport as backbone, shared and on-demand services as complements, marketplaces as regulated interfaces, logistics tools as coordination instruments, and data as a condition for accountability. This allows mobility innovation to become more than a collection of services. It becomes an integrated offer aligned with accessibility, sustainability and social value.

5.3.2 Conclusion

The infographic below summarises the additional inputs provided by the Impact Creation Board. These inputs helped refine the governance analysis by adding practical insights on actors to involve, coordination gaps, funding needs and examples of transferable practices. The synthesis shows that governance challenges differ across mobility solution groups, but recurring needs emerge: clearer mandates, stronger coordination across levels, better data-sharing rules, stable funding and early stakeholder involvement.



GOLIA

ICB CONTRIBUTIONS: GOVERNANCE INSIGHTS BY ANALYTICAL GROUP

This matrix synthesises the additional governance inputs provided by the Impact Creation Board (ICB) for the five analytical groups of mobility solutions analysed in **Chapter 5**. It highlights key actors, main governance gaps, and enabling mechanisms and good practices to support integrated, multi-level and future-ready mobility governance.

ANALYTICAL GROUP	GOVERNANCE FOCUS	KEY ACTORS TO INVOLVE	MAIN GOVERNANCE GAPS AND CHALLENGES	ENABLING MECHANISMS AND GOOD PRACTICES
1. PHYSICAL INFRASTRUCTURE	**Cross-modal corridor** governance, infrastructure coordination, and long-term investment planning.	National governments Infrastructure managers Ports, rail / waterway actors Municipalities Environmental authorities	Fragmented mandates across levels and sectors Cross-border and national interest conflicts Environmental permitting delays and constraints Lack of harmonised standards and planning approaches	Alignment of EU, national and regional funding Multimodal coordination platforms Shared corridor planning and governance Integrated infrastructure strategies and prioritisation
2. URBAN SPACE MEASURES	**Public-space allocation,** active mobility governance, local participation, and operator regulation.	Municipalities Neighbourhood associations and communities Local businesses Shared mobility operators Citizens and user groups	Public resistance to space reallocation Regional fragmentation and inconsistent rules Weak coordination between municipalities Lack of common standards for public space quality	Co-creation and participation processes Capped operator tenders and fleet regulation Stakeholder consultation and co-design Shared design standards and integrated hub planning
3. DIGITAL SPACE AND DATA-ENABLED INFRASTRUCTURES	**Data governance,** interoperability, MaaS integration, and digital oversight.	Public authorities MaaS providers and platforms ICT and telecom operators Public transport operators Payment and ticketing actors	Weak public digital capacity and monitoring Lack of interoperability and standards Unclear data governance and access rules Platform dependency and market concentration	Open-data standards and interoperable systems Integrated digital ticketing and payment solutions EU digital funding (Horizon Europe, CEF, etc.) Public oversight and data governance protocols
4. DEMAND-SIDE MEASURES	**Regulation of access** and behaviour, public legitimacy, and incentive alignment.	Municipalities Regional authorities Businesses and employers Logistics operators Citizens and travellers	Uneven public acceptance across territories Fragmented authority and jurisdiction Weak enforcement coordination and data chains Political resistance and equity concerns	UVAR governance packages (LEZ, ZEZ, access rules) Regional coordination and SUMP-level integration Integrated communication and incentive schemes Coherent enforcement and data-sharing systems
5. SUPPLY-SIDE MEASURES	**Integrated service governance,** multimodal coordination, and operational interoperability.	Public transport operators MaaS providers Logistics and delivery actors Municipalities Regional transport authorities	Fragmented ticketing and payment systems Weak oversight and coordination bodies Poor timetable and service alignment Pilots not scaled to stable long-term operations	Integrated ticketing and fare systems Timetable alignment and service coordination MaaS governance and interoperability Cross-operator bodies and long-term operational frameworks

Figure 13 Governance insights from ICB across the five analytical groups of GOLIA mobility solutions

The analysis of the five governance groups confirms that mobility solutions cannot be assessed only through their technical function or expected impact. Their effectiveness depends on the institutional conditions that allow them to be implemented, coordinated, funded, monitored and adapted over time. Physical infrastructure requires clear mandates, long-term investment logic and alignment between nodes, corridors and services. Urban space measures require legal clarity, public legitimacy, enforcement capacity and safeguards against exclusion or capture. Digital and data-enabled infrastructures require interoperability, data governance, cybersecurity and public oversight. Demand-side measures require a balanced combination of regulation, incentives, engagement and behavioural evidence. Supply-side measures require service integration, market orchestration and contractual arrangements that protect public value.

Across all groups, several common governance principles emerge. First, public authorities need to define the public purpose of each solution before selecting the governance model. Second, responsibilities must be explicit across governance levels, departments and public-private interfaces. Third, funding schemes must cover not only implementation, but also operation, maintenance, enforcement and monitoring. Fourth, data and feedback loops are necessary to adjust measures when real-world impacts diverge from expectations. Finally, stakeholder involvement must be structured in a way that improves legitimacy without allowing stronger actors to dominate decision-making.

These findings provide the governance layer of the GOLIA 3D Mobility Ecosystem Map. They show how mobility innovation can support adaptive, inclusive and socially oriented mobility planning when it is embedded in clear rules, accountable institutions and shared public objectives. The detailed Annex E complements this synthesis by presenting the full solution-level analysis and the inputs validated and enriched through the ICB consultation process. The governance conditions identified for digital space and

data-enabled infrastructures - particularly around data spaces and open data platforms - will be taken forward through the project's dedicated digital modules of data integration, as outlined in WP2.

6 Conclusions

Deliverable D1.1 establishes the **Three-Dimensional Mobility Ecosystem Map**, which serves as the knowledge foundation upon which the GOLIA project's governance model and digital assets are built. By leaving behind traditional siloed planning, this work provides a unified framework that balances the **human dimension** (personas), **the technical and spatial dimension** (solutions), and the **institutional dimension** (governance).

The integration of these three analyses leads to several critical insights for urban mobility transitions.

Regarding the **human layer**, the mapping of 23 distinct user personas across Antwerp, Florence, and Pilsen confirms that mobility behaviour is not a monolith. Our analysis identifies specific social tipping points and nudges that allow cities to move beyond generic information campaigns. By understanding the unique barriers, such as digital exclusion or perceived safety risks, GOLIA provides the behavioural genome required to personalise pathways to sustainable transitions.

In terms of the **technical and spatial layer**, the mapping of mobility solutions reveals that technical innovation (M-type policies) and spatial redesign (P-type policies) are most effective when deployed as a synchronised portfolio rather than isolated pilots. Evidence from European leaders, such as Barcelona's Superblocks or Copenhagen's Cycle Highways, show that a high return on investment in health and emissions is achievable when physical interventions directly address the needs of specific user segments.

Finally, the **institutional layer** demonstrates that governance is the glue of the ecosystem. Our review of multilevel governance structures proves that even the most innovative solutions fail without regulatory readiness, stable funding, and cross-departmental alignment. The shift from managing movement to creating social value requires governance models that are resilient to political instability and capable of orchestrating public and private data sharing.

The true value of D1.1 lies in the intersection of these dimensions. Because the written format cannot fully capture the complexity of these three-dimensional connections, this **knowledge base will be transitioned into an interactive online tool hosted on the GOLIA website**. This will allow practitioners to navigate the ecosystem map dynamically, filtering solutions by city objective, persona type, or governance readiness.

D1.1 provides the initial evidence and a qualitative framework for the following stages of the project. Specifically, the behavioural indicators and solution impacts identified here serve as the primary inputs for the Social Optimum Mobility Index (Task 1.4). Furthermore, the persona attributes and tipping points define the parameters for the agent-based modelling simulations (Task 2.5). Lastly, the governance and data-sharing requirements mapped in this deliverable set the technical specifications for the GOLIA digital modules within Work Package 2.

In conclusion, D1.1 confirms that a socially optimised mobility system is achieved not through technical deployment alone, but through an adaptive governance model that prioritises social cohesion and human behaviour as highly as transport efficiency.

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ANNEX A

CONCEPTS AND SOLUTIONS FOR SOCIALLY OPTIMISED MOBILITY SYSTEMS

Project deliverable D1.1

Version number: **V2.0 - Final**

Date for release: **31/05/2026**

Author(s):

Fit Consulting C Ramos, T van der Sande



ANNEX B

CONCEPTS AND SOLUTIONS FOR SOCIALLY OPTIMISED MOBILITY SYSTEMS

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ANNEX B – ICB validation of the user's personas

Introduction and approach

The survey was developed to validate identified enablers per persona, using the Impact Creation Board (ICB) and its extended network. Initially, the survey was designed to collect input across all transport modes and personas, asking each respondent to answer all combinations. This approach would help to validate broadly with a relatively small number of responses.

Following feedback from the ICB, the survey was adjusted to allow respondents to select only the transport modes relevant to their expertise, resulting in more targeted input. Following an additional round of feedback from the IPC and more adjustments, respondents were asked to answer only for the persona groups they identify with. This ensured that responses reflect direct experience, while also leading to less validation data for certain personas.

Survey results

Responses per organisation

The responses come from a mix of organisation types (n = 127), with the largest share affiliated with government bodies and agencies (44 responses, 35%), including municipalities and public transport companies or publicly owned parking operators. A similar share comes from industry associations and networks (41 responses, 32%). Contributions from research and academic institutions account for 17 responses (13%), while the private sector represents 13 responses (10%). A smaller number of responses come from NGOs and non-profit organisations (9 responses, 7%) and other respondents (3 responses, 2%).

Overall, the sample is weighted towards public and network-based organisations, with more limited representation from purely commercial actors.

Distribution per persona

The distribution of respondents across personas provides a basis for validating the identified enablers (n = 152 responses, respondents could fill in multiple persona's leading to n > 127). The largest share of responses comes from city centre residents (62 responses, 40.8%) and suburban commuters (50 responses, 32.9%), meaning the findings are more grounded in these groups. Additional input comes from older residents (13 responses, 8.6%), young urban families (12 responses, 7.9%), and logistic service providers (6 responses, 3.9%), adding perspectives from groups with more specific needs.

Some personas are less represented, including tourists (4 responses, 2.6%), residents with reduced mobility (4 responses, 2.6%), and students (1 response, 0.7%), while port/industrial shift workers are not represented. This distribution allows for validation of enablers for the most represented personas.

Modes per persona

The table below features an overview of the validation per mode per persona. Visualising how the validation is complete for the city centre resident and suburban commuter. Whereas it is limited for the older resident, young urban family, resident with reduced mobility, tourist, logistic service provider. The student and port shift worker persona's received the least validations.

Table 1 – Answer rates per mode and persona

Persona	Car & Parking	Cycling	Public Transport	Logistics	Walking	Total
City Centre Resident	29 (19.5%)	27 (18.1%)	41 (27.5%)	14 (9.4%)	38 (25.5%)	**149**
Suburban Commuter	35 (27.1%)	25 (19.4%)	30 (23.3%)	-	28 (21.7%)	**129**
Older/Senior Resident	10 (33.3%)	2 (6.7%)	9 (30.0%)	1 (3.3%)	8 (26.7%)	**30**
Young Urban Family	5 (16.1%)	9 (29.0%)	9 (29.0%)	2 (6.5%)	6 (19.4%)	**31**
Resident with Reduced Mobility	3 (25.0%)	-	4 (33.3%)	1 (8.3%)	4 (33.3%)	**12**
Tourist	2 (18.2%)	3 (27,3%)	3 (27,3%)	-	3 (27,3%)	**11**
Logistic Service Provider (LSP)	3 (42.9%)	1 (14,3%)	-	3 (42,9%)	-	**7**
Student	1 (25.0%)	1 (25.0%)	1 (25.0%)	0 (0.0%)	1 (25.0%)	**4**
Port/(Industrial) Shift Workers	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**0**

Comment: Cells marked with "–" indicate that no question was included in the survey for that specific mode and persona combination.

Analysis of results

Data collection resulted in varying response levels across personas, which affects the extent to which enablers can be validated. The highest number of responses was received for the city centre residents and suburban commuter, allowing for a more complete validation for these groups. A full oversight of the results for these two personas can be found in Annex I. Regarding the remaining personas, lower response numbers limit the robustness of validation. To address this, the analysis will make use of the qualitative inputs provided under "Other(s)" for each mode, using these insights to further enrich and refine the understanding of persona-specific needs at the city level.

Maximising qualitative input

The refinements to the survey led respondents to answer based on their own persona and area of expertise. This ensures that the inputs provided under "Other(s)" are relevant and offer meaningful qualitative insights. These insights can be used to enhance and support the validation of the city personas.

Inputs provided under "Other(s)" require respondents to specify additional enablers or further detail existing ones by adding context, conditions, or influencing factors. This allows respondents to complement the predefined options with more nuanced, experience-based insights. The next section presents the main findings per mode, highlighting key themes and illustrative examples of enablers. For a full oversight of the different responses in full sentences, see Annex II.

Walking

The inputs under "Other(s)" for walking show clear and recurring themes. Safety and accessibility are important. Respondents mention safe crossings, less conflict with other modes, and inclusive infrastructure. The quality of public space also matters. This includes clean streets, well-maintained sidewalks, and greenery. Short distances and access to daily services support walking. Comfort plays a role as well. Respondents highlight seating, lighting, and clear wayfinding. Walking is also part of daily routines. It is often linked to short trips and access to public transport.

Cycling and micromobility

The inputs under “Other(s)” for cycling and micromobility show clear themes around infrastructure, integration, and usability. Safe and high-quality cycling infrastructure is essential, including protected lanes and safe connections. Integration with public transport and mobility hubs supports longer and multimodal trips. Respondents also highlight the need for secure parking and supporting facilities. Access to affordable bikes and clear services further enables use. Overall, cycling is supported by comfortable conditions, short travel times, and its role as a practical option for everyday trips.

Car and parking

The responses for car and parking use show that it is mainly considered when alternatives are limited or do not meet user needs. Availability and management of parking play an important role, especially at destinations and for specific user groups. Integration with public transport and access to real-time information can support more efficient use. Cost, regulation, and workplace incentives also influence decisions. Overall, car use is linked to comfort, flexibility, and the ability to combine multiple activities in one trip.

Public transport

The responses for public transport highlight the importance of reliable and frequent services with short and predictable travel times. Accessibility is key, including well-located stops and infrastructure that meets the needs of different user groups. Comfort and safety during the journey and at stops also play an important role. Integration with other modes supports complete journeys, especially for first- and last-mile connections. Clear information, simple ticketing, and affordable pricing further enable use.

Logistics

The responses for logistics show that use is driven by practical needs, such as transporting bulky goods or accessing products not available locally. Infrastructure plays an important role, including the availability of parcel lockers and urban logistics hubs. Flexibility in delivery options, such as out-of-home delivery and off-peak times, supports wider use. Integration with urban systems and public infrastructure can improve efficiency. Cost and environmental considerations also influence choices, especially for specific user groups.

Annex I

The following contains the results for the two most validated persona's (city centre resident and suburban commuter). The enablers are ranked and listed using tables per mode for groups. Additionally, a list of additional response per question is supplied.

City centre resident

Table 2 - As a city centre resident, what would encourage you to choose cycling or micro mobility (such as e-scooters or shared bikes) for your trips to the supermarket / your work / the gym? (You may select multiple answers.)

Answer	Count	Percentage
Proximity to daily services (15-minute city concept)	34	30.9%
Pedestrian-priority streets and traffic calming	32	29.1%
Public realm improvements (shade, benches, lighting)	26	23.6%
Clear wayfinding between landmarks	4	3.6%
Multilingual signage	3	2.7%
Other(s) please add	*11*	*10.0%*
Total (valid responses)	**110**	**100%**

Most responses indicate that walking is encouraged most by proximity to daily services, pedestrian-friendly street design, and improvements to the public realm, while more specific or contextual factors were mentioned less frequently.

Additional enablers mentioned under "Other":

- Good weather and having sufficient time for the journey
- Safer streets (e.g. reducing bike use on pavements, safer crossings, enforcement of traffic rules)
- Walking as part of daily routines or short-distance trips (<1 km)
- Traffic light priority for pedestrians
- Security and cleanliness of public spaces
- Wide, obstacle-free, and well-maintained sidewalks
- Attractive neighbourhoods with greenery
- Clean streets and well-designed, human-scale infrastructure
- More green public spaces (parks, tree-lined streets)
- Accessible and well-maintained pedestrian infrastructure

Table 3 - As a city centre resident, what would encourage you to choose cycling or micro mobility (such as e-scooters or shared bikes) for your trips to the supermarket / your work / the gym? (You may select multiple answers.)

Answer	Count	Percentage
Proximity to daily services (15-minute city concept)	34	30.9%
Pedestrian-priority streets and traffic calming	32	29.1%

Public realm improvements (shade, benches, lighting)	26	23.6%
Clear wayfinding between landmarks	4	3.6%
Multilingual signage	3	2.7%
Other(s) please add	*11*	*10.0%*
Total	**110**	**100%**

Most responses indicate that cycling and micromobility are encouraged by safe and well-designed infrastructure, proximity to destinations, and integration with broader mobility systems, with these factors accounting for the majority of preferences among city centre residents.

Additional enablers mentioned under "Other":

- Cycling as a faster alternative when time is limited
- Integration with secure parking facilities and clear infrastructure planning
- Availability of shared (cargo) bikes at neighbourhood mobility hubs
- Concerns about safety of e-scooters
- Dedicated, segregated bike lanes and secure, covered bike parking
- Safety considerations, including for women
- Consistent implementation of safe cycling streets (not temporary pilots)
- Proximity to destinations supported by cycling-friendly urban design (e.g. 15–20-minute reach)

Table 4 - Count of As a city centre resident, what would encourage you to use public transport for your trips? (You may select multiple answers.)

Answer	Count	Percentage
Free Public Transport trial days	30	33.0%
Clear and simple main line corridors	21	23.1%
Parking discounts linked to park-and-ride use	13	14.3%
Mobility credits redeemable for PT or shared modes	11	12.1%
Other(s) please add	*16*	*17.6%*
Total (valid responses)	**91**	**100%**

Responses indicate that trial access to public transport and clear, simple network structures are the most frequently mentioned enablers for city centre residents. These are followed by more targeted measures such as park-and-ride incentives and mobility credits, while a notable share of respondents provided additional input highlighting operational and service-related improvements.

Additional enablers mentioned under "Other":

- Frequent, reliable, and high-quality service (on time, consistent frequency)
- Affordable and integrated fares across modes (bus, tram, metro, rail)
- Extended service hours (including evenings, weekends, and 24/7 metro)
- Improved safety and security at stations and on vehicles
- Better comfort (e.g. less crowding, air conditioning, clean environments)

- Stronger integration with parking and multimodal solutions (e.g. park-and-ride, real-time info)
- Reduced need for transfers and more direct routes
- Clear communication at stops (including disruptions and detours)
- Good accessibility of stops and stations, including proximity to origins/destinations
- Better first- and last-mile connections (walking and cycling integration)
- Increased frequency and shorter intervals between services
- Overall efficiency, reliability, and ease of use of the system

Table 5 - Count of As a city centre resident, what would encourage you to use a car for your trips occasionally? (You may select multiple answers.)

Answer	Count	Percentage
Car-sharing incentives	33	37.9%
Short-term loading permits for residents	19	21.8%
Neighbourhood-based shared fleets	14	16.1%
Transparent LTZ rules	7	8.0%
Resident parking permits (reduced fees compared to non-residents)	6	6.9%
Other(s) please add	*8*	*9.2%*
Total (valid responses)	**87**	**100%**

Responses indicate that car-sharing incentives and flexible access options are the most relevant enablers for occasional car use among city centre residents. Measures that support practical use cases, such as short-term loading permits and access to shared fleets, are also frequently mentioned. More regulatory or cost-related measures, such as parking permits and LTZ rules, appear less prominent, while a smaller share of respondents provided additional context-specific factors.

Additional enablers mentioned under “Other”:

- Lack of viable alternatives (e.g. public transport not meeting needs in terms of availability, comfort, or price)
- Use of cars for specific purposes such as transporting heavy groceries or work-related trips
- Better management and availability of parking, including real-time digital information on spaces and pricing
- Fewer parking restrictions and easier access to destinations in the city centre
- Increased availability of resident-only parking spaces, including underground or shared facilities supported by users

Table 6 - Count of In case you chose “Other(s)” Please describe any other factors that would encourage you to use logistics services as a city centre resident.

Answer	Count	Percentage
Home delivery availability	8	38.1%
Parcel lockers in residential buildings	7	33.3%

Support for walkable local retail	3	14.3%
Other(s) please add	*3*	*14.3%*
Total (valid responses)	**21**	**100%**

Responses indicate that logistics services are encouraged by convenience-related factors, such as home delivery availability and access to parcel lockers, with additional support for integrating logistics into walkable urban environments. A smaller share of respondents highlighted more specific motivations and contextual considerations.

Additional enablers mentioned under "Other":

- Willingness to use pick-up points if this contributes to reducing pollution
- Importance of environmental considerations (e.g. pollution reduction) in choosing logistics services
- Use of a mix of delivery options, including mandatory out-of-home delivery in some contexts
- Need for logistics services to access niche or unavailable products not sold in local stores

Suburban commuter

Table 7 - Please select the modes of transportation you would like to help validate. Which transport modes are relevant to your expertise or interest? (Please select all that apply. You will only receive follow-up questions for the modes you select)

Answer option	Count	Percentage
Home delivery availability	8	38.1%
Parcel lockers in residential buildings	7	33.3%
Support for walkable local retail	3	14.3%
Other(s) please add	*3*	*14.3%*
Total (valid responses)	**21**	**100%**

Responses indicate that walking as part of a suburban commute is influenced by the quality and accessibility of walking infrastructure and its connection to public transport, with walking often functioning as a key first- and last-mile solution. More specific, context-related factors were also mentioned by a smaller group of respondents.

Additional enablers mentioned under "Other":

- Accessible and comfortable streets
- Good availability and frequency of public transport
- Comfortable and well-maintained sidewalks, particularly towards stations
- Walking as an essential connection to public transport networks (e.g. linking regional and urban modes)
- Regular and reliable train connections (e.g. every 20 minutes)
- Short walking distances
- Clean and comfortable infrastructure
- Availability of local shops for convenient, small-scale trips

- Possibility to work locally, reducing the need for longer trips

Table 8 - As a suburban commuter, what would encourage you to choose cycling for your commute or part of your commute (to the supermarket / your work / the gym)? (You may select multiple answers.)

Answer option	Count	Percentage
Bike-to-train integration	25	39.7%
E-bike support for longer first-mile trips	16	25.4%
Secure station bike parking	7	11.1%
Other(s) please add	*15*	*23.8%*
Total (valid responses)	**63**	**100%**

Responses indicate that cycling uptake among suburban commuters is linked to integration with public transport, support for longer first-mile distances, and the availability of supporting infrastructure such as secure parking. A notable share of respondents also provided additional input highlighting more specific infrastructure, comfort, and behavioural factors.

Additional enablers mentioned under “Other”:

- Safe paths and protected cycling infrastructure
- Safe connections between suburban areas and urban mobility hubs, including multimodal integration
- Availability of showers at the workplace and favourable weather conditions
- Attractive and usable cycling infrastructure throughout the year
- Clear rules and ease of bringing bikes on public transport (including affordability and access)
- Positive social norms and encouragement
- Existing habit of commuting by bike

Table 9 - As a suburban commuter, what would encourage you to use public transport for your commute? (You may select multiple answers.)

Answer	Count	Percentage
Predictable timetables	30	42.9%
Integrated regional and urban ticketing	18	25.7%
Employer-supported PT passes	11	15.7%
Other(s) please add	*27*	*38.6%*
Total (valid responses)	**70**	**100%**

Responses indicate that the use of public transport among suburban commuters is associated with reliable and frequent services, predictable timetables, and better integration across transport modes. Ticketing and employer-supported measures also play a role, while a substantial share of respondents highlighted additional operational, comfort, and accessibility factors.

Additional enablers mentioned under “Other”:

- Accessible infrastructure and vehicles (e.g. level boarding)
- High frequency and sufficient service levels
- Improved park-and-ride infrastructure and coordination with public transport
- Safety and comfort at stops and during the journey, including lighting and user-friendly design
- Reliable, clean, and comfortable vehicles with good connectivity to other modes
- Faster and more direct connections to main transport hubs (e.g. metro access within 15–20 minutes)
- Policy measures such as urban access restrictions and fuel pricing
- On-board conditions that enable working, reading, or relaxing (e.g. space, seating, Wi-Fi)
- Effective first- and last-mile solutions
- Expansion of public transport networks and connections
- Availability of seating and a sense of social safety
- Increased service offer and coverage

Table 10 - Availability of affordable park-and-ride parking with easy access to public transport

Answer	Count	Percentage
Availability of affordable park-and-ride parking with easy access to PT	19	29.7%
Affordable park-and-ride facilities	14	21.9%
Real-time P+R occupancy information	4	6.3%
Other(s) please add	*27*	*42.2%*
Total (valid responses)	**64**	**100%**

Responses indicate that the use of cars for commuting among suburban commuters is linked to the availability and affordability of park-and-ride options and their integration with public transport, alongside access to information on parking availability. A substantial share of respondents also provided additional perspectives, including both enabling conditions and critical views on car use for commuting.

Additional enablers mentioned under “Other”:

- Lack of park-and-ride facilities and limited availability of efficient transport alternatives
- Integrated parking and public transport solutions with clear pricing and availability information
- Real-time information on parking availability, including in city centres (not limited to P+R)
- Reservation systems for park-and-ride facilities
- Comfort and flexibility of car use for daily activities, despite inefficiencies such as congestion
- Structural factors encouraging car use, such as workplace parking availability, fiscal incentives, and flexibility for multi-purpose trips
- Situations where no viable public transport alternatives exist
- Preference for alternative solutions, such as community-based shared vehicle fleets

- Views opposing the encouragement of car use for commuting

Annex II

Annex 2 presents the responses provided under "Other(s)" for each mode, structured in a table format. Note that responses have been analysed and refined into complete English sentences, as (some) inputs originally consisted of separate terms or keywords.

Walking

Walking	
Safety and accessibility	• Safe crossings, traffic calming, and enforcement • Reduced conflicts with cyclists/micromobility • Accessible infrastructure (incl. reduced mobility, audio signals) • Social safety and well-lit environments
Infrastructure quality and public spaces	• Wide, obstacle-free, well-maintained sidewalks • Smooth surfaces and high-quality design • Clean streets and well-maintained greenery
Distance and urban planning	• Short distances (<500m–1 km) • Access to daily services (shops, schools, work) • Compact, walkable neighbourhoods
Comfort and ease-of-use	• Seating, lighting, wayfinding • Ability to walk at a comfortable pace • Pleasant and calm walking environment
Integration in daily activities	• Walking as part of routines (exercise, short trips) • Connection to public transport • Support from local amenities

Cycling and micromobility

Cycling and micromobility	
Safety and infrastructure quality	• Safe, protected, and segregated bike lanes (not shared with cars) • Safe routes and connections, including in challenging areas (e.g. hilly districts) • Reduced conflicts with traffic and improved road safety (incl. for children and vulnerable users) • Consistent, high-quality cycling infrastructure (not temporary solutions)
Integration and connectivity (i.e. multi modal systems)	• Strong links to public transport and mobility hubs • Integration with parking facilities and multimodal systems • Ability to bring bikes on public transport with clear and simple rules • Proximity to destinations (e.g. 15-20minute cycling distance)
Parking, security and other facilities	• Secure and convenient bike parking near destinations • Covered and theft-resistant parking solutions • Traceability, insurance, and protection against theft • Supporting facilities such as showers at workplaces
Availability, affordability and services	• Access to shared bikes and cargo bikes (incl. low-cost options) • Availability of second-hand bikes and alternative ownership models • Clear, multilingual digital services and easy ticketing/payment options • Integration of pricing across bike-sharing and public transport

Usability, comfort and behavioural factors	• Attractive, calm, and comfortable cycling environments • Infrastructure that works year-round • Cycling as a time-efficient alternative for short trips • Positive social norms and existing cycling habits • Consideration of safety concerns related to micromobility (e.g. e-scooters)

Car and parking

Car and parking	
Availability of alternatives and necessity	• Car use when no viable public transport alternatives exist • Use for specific needs (e.g. heavy groceries, remote destinations, shift work) • Situations where distance or accessibility limits other modes • Some respondents explicitly questioning or opposing the encouragement of car use
Parking availability and management	• Availability of parking at destination (incl. residential and workplace parking) • Affordable or free parking, including dedicated resident spaces • Accessible parking for people with reduced mobility (adequate size and design) • Reservation systems for parking and park-and-ride
Integration and information	• Integration between parking and public transport (e.g. park-and-ride systems) • Real-time information on parking availability and pricing • Better coordination of parking with urban logistics and curb space management • Digital systems supporting efficient and informed car use
Cost, regulation and policy context	• Impact of parking restrictions, LTZ rules, and access regulations • Role of pricing (parking costs, fuel, fiscal incentives) • Workplace-related incentives (e.g. free parking, leasing schemes) • Requests for easier access or reduced restrictions in some contexts
Comfort, flexibility and convenience	• Perceived comfort and flexibility of car use for multi-purpose trips • Ability to combine activities (e.g. childcare, shopping, work) • Weather conditions influencing modal choice • Convenience compared to public transport in terms of time, reliability, and effort

Public transport

Public transport	
Reliability, frequency and travel time	• Frequent and reliable services with consistent schedules • Reduced travel times and more direct/express connections • Extended operating hours (including evenings and weekends) • Reduced need for transfers
Accessibility and inclusion	• Accessible vehicles and infrastructure (e.g. level boarding, functioning lifts) • Stops located close to origins and destinations • Consideration of diverse user needs (families, older users, reduced mobility) • Clear and inclusive access conditions (e.g. seating availability, not overcrowded)
Comfort, safety and user experience	• Clean, comfortable vehicles and waiting environments • Safe and well-lit stops and stations • Space for passengers and belongings • Positive interactions with staff and drivers

Integration and connectivity	• Strong first- and last-mile connections (walking, cycling, park-and-ride) • Better integration with parking and multimodal systems • Routes aligned with user travel patterns (e.g. commuting, education, leisure) • Expansion of network coverage and new connections
Information, ticketing and affordability	• Real-time and clear travel information (digital and non-digital) • Simple, integrated ticketing across modes and regions • Flexible payment options (card, phone, subscriptions) • Affordable pricing, including family-friendly fares

Logistics

Logistics	
Availability and use cases	• Use of delivery services for bulky or hard-to-carry goods • Demand driven by access to niche products not available locally • Use when alternatives (e.g. local retail or self-transport) are not feasible
Infrastructure and service access	• Availability of parcel lockers in residential areas, stations, and community locations (e.g. retirement homes, universities) • Development of urban logistics hubs and locker networks • Broad and neutral (agnostic) locker coverage across providers
Flexibility and delivery options	• Availability of out-of-home delivery options and mixed delivery models • Off-peak and flexible delivery times (e.g. evenings) • Use of combined or multimodal logistics solutions
Integration and system organisation	• White-label or publicly supported locker systems • Integration of logistics services within urban environments and public infrastructure • Coordination of logistics facilities within cities
Cost, sustainability and user considerations	• Price sensitivity (particularly among students) • Willingness to use pick-up points if this reduces pollution • Environmental considerations influencing delivery choices • Local availability of services and facilities



ANNEX C

CONCEPTS AND SOLUTIONS FOR SOCIALLY OPTIMISED MOBILITY SYSTEMS

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Author(s):

Bax Innovation J Bohlen

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ANNEX C – ICB contribution to (social cohesion) impacts of mobility solutions and practices

UITP

Urban space and street design, promoting sustainable modes

Positive effects (on social cohesion)

Enhanced Physical Connectivity

- Improved access to services and opportunities: Safer walking/cycling routes and better public transport make it easier for people—especially non-drivers (youth, elderly, low-income groups)—to reach jobs, education, healthcare, and social activities.
- Bridging fragmented neighbourhoods: Reclaiming streets from car dominance can reconnect areas previously divided by high-traffic roads.
- First/last mile improvements: Active mobility infrastructure strengthens links to transit, making the whole system more inclusive.

→ Overall effect: More equal participation in urban life and reduced isolation of vulnerable groups.

Reduced Socio-Spatial Segregation

- More equitable allocation of public space: Prioritizing people over cars redistributes space toward modes used more by diverse socio-economic groups.
- Improved mobility for low-income populations: Affordable transport options (walking, cycling, transit) reduce dependency on car ownership.
- Access to mixed neighbourhoods: Better connectivity can reduce mobility barriers between affluent and disadvantaged areas.

→ Overall effect: Greater mixing of populations and reduced spatial inequality.

Increased Social Interaction and Public Life

- More attractive public spaces: Wider sidewalks, bike lanes, and traffic calming create environments where people linger rather than just pass through.
- Rise in informal encounters: Streets become places for meeting, and community life rather than just transit corridors.
- Support for local activities: Street redesign can enable markets, events, and community initiatives.

→ Overall effect: Stronger neighbourhood ties and sense of belonging.

Strengthening Local Economies and Community Identity

- Boost to local businesses: Pedestrian- and cycle-friendly streets often increase footfall and local spending.
- Support for small, local enterprises: Reduced car dominance favours local shops over large, car-oriented retail.
- Place-making opportunities: Streets can reflect local culture and identity through design and use.

→ Overall effect: Reinforced local networks and shared community identity.

Improved Safety and Perceived Security

- Reduced traffic speeds and volumes: Leads to fewer accidents and safer environments.
- "Eyes on the street" effect: More people in public spaces increases natural surveillance.
- Inclusive design: Safer infrastructure encourages use by children, elderly, and marginalized groups.

→ Overall effect: Increased trust in public space and willingness to engage socially.

Health and Well-being Benefits

- Encouragement of active lifestyles: Walking and cycling improve physical health.
- Mental well-being: Greener, quieter streets reduce stress and enhance quality of life.
- Reduced air and noise pollution: Benefits are often greatest in disadvantaged areas.

→ Overall effect: Healthier populations are more likely to participate in community life.

Sources

- https://www.tandfonline.com/doi/full/10.1080/23748834.2025.2550872
- https://www.itf-oecd.org/sites/default/files/docs/streets-fit-allocating-space-better-cities.pdf
- WHO Public Space Toolkit: https://unhabitat.org/sites/default/files/2019/05/global_public_space_toolkit.pdf
- UITP Better Urban Mobility Playbook: https://www.uitp.org/wp-content/uploads/sites/7/2025/04/Report-BETTER-URBAN-MOBILITY-PLAYBOOK.pdf

Risks or negative impacts

- Challenge with engaging marginalised groups to understand and design for their needs e.g migrants, persons with specific disabilities. Redesigning spaces can perceive to leave people behind e.g person with reduced mobility, if not designed with them

Sources

- https://www.brusselstimes.com/2029429/skilfully-excluded-are-brussels-pedestrian-zones-leaving-some-residents-behind
- https://www.uitp.org/publications/net-zero-mobility-social-considerations-limiting-private-vehicle-access/

Measures to maximise positive social cohesion outcomes and mitigate risks

- Co-creative design approaches and mixture of engagement measures with different actors and stakeholders.

Infrastructure for active modes

Positive effects (on social cohesion)

- Having services designed for your needs e.g tricycles, step-through frames and bikes with children seats, can help foster trust with local institutions, a feeling of being valued and identification with the community. This can boost civic participation and engagement in local networks. It imporves access across neighbourhoods, reduces spatial segregation and connects previously isolated neighbourhoods. Boosts healthier lifestyles, more liveable cities and advocated for further prioritisation of cycling infrastructure when more people are involved (postive cycle).

Sources

- https://www.interregnorthsea.eu/small/news/creating-new-shared-mobility-services-with-the-elderly-and-people-with-reduced-mobility

Risks or negative impacts

- High cost and often these projects remain within the pilot phase or short-term approach - no sustainable business model. From a resident perspective, it is difficult to trust anything that is only there for a short period of time, rather than long-term permanent feature in cities just like traditional shared bikes.

Infrastructure for public transport

Positive effects (on social cohesion)

- PT is faster & reliable when it is separated from traffoc - connects people to jobs, education and services. Benefits lower-income group who rely on pt. Reduces phyiscal barriers, connects neighbourhoods and reduces congestion.

Sources

- UITP regions thrive with congestion-free bus networks paper: https://www.uitp.org/wp-content/uploads/sites/7/2025/08/20250820_Congestion-free-Bus-Network_Action-Points_WEB.pdf

Risks or negative impacts

- Planning of lanes can mean distribution of benefits is not equal - requires integration of equitable transport planning and land-use planning. Risk of displacement (gentification) around improvements to travel corridors.

Measures to maximise positive social cohesion outcomes and mitigate risks

- Inclusion lens within policy framework

Passenger transport services focusing on sustainability

Positive effects (on social cohesion)

- By offering flexible, on-demand services that can reach areas underserved by conventional public transport, DRT helps to reduce isolation among vulnerable groups such as older people, those with disabilities, and residents of rural or peri-urban areas. This enhanced mobility enables individuals to participate more fully in social, economic and cultural activities, fostering a greater sense of belonging and community engagement.
- Moreover, DRT can strengthen links between neighbourhoods by connecting people to essential services, employment opportunities and social networks, thereby reducing inequalities in access. Its user-centred approach, often supported by digital platforms but adaptable to those with limited technological access, can also encourage a more responsive and equitable transport system. In turn, this can build trust in public services and promote interaction among diverse population groups, contributing to more cohesive and resilient communities.

Sources

- https://www.uitp.org/publications/transport-on-demand-operators-perspective/

Measures to maximise positive social cohesion outcomes and mitigate risks

- Inclusivity should be embedded by design, ensuring services are accessible to all users, including those without smartphones or bank accounts, through options such as telephone booking and cash or alternative payment methods. Physical accessibility, including wheelchair-friendly vehicles and assistance for passengers with reduced mobility, is also essential.
- Second, equitable service coverage should be prioritised to avoid reinforcing existing inequalities; this may involve setting minimum service levels in low-demand or disadvantaged areas rather than focusing solely on efficiency or profitability.
- Third, community engagement plays a key role: involving local residents and stakeholders in the co-design of services can help tailor DRT to actual needs, build trust, and encourage uptake across diverse groups.
- Fourth, integration with the wider public transport network—through coordinated timetables, ticketing, and mobility hubs—can enhance connectivity and prevent fragmentation of the system.
- Additionally, digital inclusion measures, such as user-friendly interfaces and support for those with limited digital literacy, can broaden access.
- To mitigate risks such as social exclusion or service bias, transparent data governance and monitoring should be implemented to ensure fair allocation of services and to detect any unintended disparities in access.
- Finally, training for drivers and staff in customer service and social awareness can foster positive interactions among passengers, contributing to a more inclusive and cohesive travel experience.

MaaS

Positive effects (on social cohesion)

- By providing integrated ticketing across multiple transport modes, MaaS simplifies journey planning and reduces barriers to use, enabling more seamless and equitable access to mobility services. This integration can help bridge gaps between different transport providers and geographic areas, fostering greater connectivity between communities and reducing social fragmentation.
- Furthermore, at higher levels of development, MaaS platforms can be adapted to support policy measures, such as targeted subsidies, fare capping, or discounted access for specific user groups, including low-income households, young people or older adults. This flexibility allows public authorities to use MaaS as a tool to promote social inclusion and ensure that mobility services contribute to wider societal goals. By aligning transport provision with social policy, MaaS can help reduce inequalities in access to opportunities, strengthen links between diverse population groups, and support more cohesive and inclusive communities.

Risks or negative impacts on social cohesion

- One key concern is digital exclusion, as MaaS platforms often rely heavily on smartphones, internet access and digital literacy, potentially marginalising older people, low-income groups or those with limited technological skills. Additionally, if pricing structures are not regulated, MaaS could prioritise convenience and premium services, leading to a two-tier system where more

affluent users benefit from higher-quality, seamless mobility while others face limited or fragmented options.
- There is also a risk that strong reliance on private operators within MaaS ecosystems could shift focus away from public service obligations, potentially reducing coverage in less profitable areas and exacerbating spatial inequalities.
- Algorithmic decision-making within MaaS platforms could unintentionally reinforce biases, for example by optimising services for high-demand users at the expense of marginal communities.
- Finally, over-integration of services under a single platform could reduce user choice or create

Sources

- https://www.uitp.org/publications/using-business-models-for-better-integrated-mobility/

Measures to maximise positive social cohesion outcomes and mitigate risks

- Ensuring multimodal access is essential, including non-digital channels such as smartcards, telephone booking and physical points of sale, so that users without smartphones or digital skills are not excluded. Affordability and equity can be strengthened through integrated fare policies, such as fare capping, concessions and targeted subsidies for vulnerable or low-income groups, enabled by the flexibility of MaaS platforms to align with public policy objectives.
- Strong public governance is also critical to ensure that MaaS supports public service goals rather than purely commercial interests; this includes setting service obligations, maintaining coverage in low-demand areas and preventing the emergence of a two-tier mobility system. Transparent and ethical data management frameworks should be implemented to protect user privacy, build trust and monitor potential biases in algorithms or service allocation. In addition, interoperability and open standards can prevent dependency on single providers and preserve user choice within the ecosystem.
- User-centred design and continuous community engagement can help tailor services to diverse needs, ensuring that MaaS reflects the realities of different population groups. Finally, integrating MaaS with wider transport and social policies—such as land use planning, accessibility strategies and social inclusion programmes—can reinforce its role as a tool for fostering equitable access, strengthening connections between communities and supporting more cohesive societies.

Data spaces and open data platforms

Positive effects (on social cohesion)

- it enables more transparent, inclusive and responsive digital planning and simulation tools for sustainable mobility. By facilitating better data sharing across public authorities, operators and technology providers, these platforms can support more coordinated and equitable service design, ensuring that mobility solutions better reflect the needs of diverse communities. Enhanced access to high-quality, interoperable data can also improve route planning tools, allowing them to be tailored to specific user groups such as people with reduced mobility, low-income users or those living in underserved areas, thereby reducing barriers to access and participation.

Sources

- https://www.uitp.org/publications/sharing-of-data-in-public-transport-value-governance-and-sustainability/

Risks or negative impacts

- a risk that data-driven planning and simulation tools may inadvertently overlook or misrepresent certain population groups, particularly if data is incomplete, biased or lacks sufficient granularity. This could result in services that are optimised for efficiency rather than equity, leaving vulnerable or low-demand communities underserved. Concerns around data governance, privacy and security may also undermine trust in the system, especially if individuals feel their personal data is being shared or used without adequate safeguards or transparency.

Measures to maximise positive social cohesion outcomes and mitigate risks

- clear standards, open interfaces and capacity-building support for smaller operators, local authorities and community organisations, enabling a level playing field within the mobility ecosystem.
- Strong data governance frameworks are essential, including clear rules on data ownership, privacy, security and ethical use. Transparent data-sharing agreements and accountability mechanisms can help build trust among users and stakeholders, while ensuring that personal and sensitive data is adequately protected.
- Third, efforts should be made to improve data quality and representativeness, for example by incorporating diverse data sources and actively addressing gaps that may exclude certain population groups.

TOD

Positive effects (on social cohesion)

- In traditional car-centric areas, large portions of urban space are dedicated to roads, parking and traffic infrastructure, often at the expense of public life and social interaction. TOD reverses this dynamic by concentrating development around public transport hubs and promoting walking, cycling and shared mobility, thereby reducing the need for extensive car use.
- This shift allows for the redesign of streets as “people-first” spaces, where wider pavements, pedestrian zones, cycle lanes and traffic calming measures create safer and more attractive environments for everyday activities. Space previously used for parking or road expansion can be repurposed into public squares, green areas, community facilities or mixed-use developments, encouraging social interaction and community engagement.
- By prioritising accessibility over mobility speed, TOD supports shorter distances between homes, services and amenities, making it easier for people to meet, interact and participate in local life. This human-scale urban form fosters a sense of place and belonging, transforming streets from transit corridors into social spaces. In doing so, TOD not only reduces car dependency but also creates more inclusive, liveable environments that better support social cohesion and everyday social encounters.

Sources

- https://tod.itdp.org/tod-standard.html
- UITP & WHO TOD paper will be published soon

Risks or negative impacts

- One significant concern is gentrification: improved accessibility and attractive urban environments around transport hubs can lead to rising property values and living costs, potentially displacing lower-income residents and weakening existing community networks. This can result in more homogeneous populations and reduced social diversity, undermining cohesion rather than strengthening it.
- There is also a risk that TOD developments prioritise higher-income groups or market-driven interests, particularly if affordable housing and inclusive services are not adequately integrated. This may create enclaves of privilege around well-connected areas, while more disadvantaged populations remain in less accessible locations. Additionally, if public spaces are overly commercialised or privatised, they may become less inclusive, discouraging use by certain groups and limiting opportunities for genuine social interaction.
- Furthermore, inadequate community engagement in the planning process can lead to developments that do not reflect local needs or cultural contexts, potentially generating resistance or social tension. Increased density, if poorly designed, may also place pressure on local infrastructure and services, affecting quality of life and community relations. Without deliberate policies to ensure inclusivity and affordability, TOD risks reinforcing existing inequalities and fragmenting communities rather than fostering stronger social cohesion.

Measures to maximise positive social cohesion outcomes and mitigate risks

- a range of inclusive planning and design measures should be integrated from the outset. Ensuring a strong provision of affordable and diverse housing is essential to prevent displacement and maintain a mix of income groups; this can include inclusionary zoning, rent controls or dedicated quotas for social and affordable housing within TOD areas.
- Equally important is the creation of genuinely inclusive and accessible public spaces. Streets, plazas and green areas should be designed to accommodate a wide range of users across ages, abilities and cultural backgrounds, encouraging everyday social interaction and community life. Avoiding over-commercialisation and ensuring that spaces remain open and welcoming to all.
- Meaningful community engagement throughout the planning and implementation process is also critical. Involving local residents and stakeholders in co-design can ensure that developments reflect local needs, strengthen a sense of ownership and reduce the risk of social tension. In addition, integrating essential services such as schools, healthcare, community centres and local shops within TOD areas can support daily life and foster stronger neighbourhood ties.
- From a mobility perspective, prioritising safe, accessible and affordable public transport, walking and cycling infrastructure ensures that all groups can benefit from improved accessibility. Finally, strong public governance and long-term monitoring are needed to align TOD with social objectives, track impacts on different population groups, and adapt policies where necessary.

ALICE

Logistics and last mile services

Positive effects (on social cohesion)

- to encourage use of parcel lockers, reduce number of home delivery, also encourage active transport modes (walking or cycling), overall enhance connectivity, reduce isolation as well.

Sources

- Finding the Right Space for Urban Logistics: An Accessibility Analysis for Walking and Cycling to Parcel Lockers, by Víctor Ferran & Lorena Axine; https://link.springer.com/chapter/10.1007/978-3-032-08387-6_14

Risks or negative impacts

- 1) it may not work for people with reduced mobility; it will also not suitable for medicine delivery when people are sick.
- 2) there may be too many lockers at one location, or in one neighbourhood, resulting in waste space.

Measures to maximise positive social cohesion outcomes and mitigate risks

- 1) setting use of parcel lockers as default is optional for different users and different goods;
- 2) parcel lockers in public space should be open (white lable)

Flexible use of urban space

Positive effects (on social cohesion)

- giving space to freight is vital to improve quality of life and enhance cities' economic growth. There are two parts:
  - 1) allow micro-hubs,
  - 2) loading zone in cities

Sources

- Yanying Li, https://www.intertraffic.com/news/how-to-make-freight-transport-sustainable

Risks or negative impacts

- planning micro-hubs in city centres is essential for use smaller delivery vehicles; however, micro-hubs may generate noise to local residence and congestion to local traffic. Loading zones will compete with other users. How to balance it is important.

Measures to maximise positive social cohesion outcomes and mitigate risks

- integrate freight and people transport together; plan together with local business, and LSPs.

Cargo-bikes for delivery

Positive effects (on social cohesion)

- Cargo-bike delivery roles offer a practical, inclusive pathway into the labor market because they require relatively low formal qualifications while still providing meaningful, structured work. Operating a cargo bike does not demand specialized technical skills beyond basic road safety awareness and short on-the-job training, making these positions accessible to a wide range of people, including newcomers and individuals with limited prior work experience.
- From a social cohesion perspective, this type of employment can play an important role in integrating immigrants. It enables immediate participation in the local economy, daily interaction with residents and businesses, and gradual language acquisition in a real-world context. The

visibility of cargo-bike couriers within neighborhoods also helps normalize diversity and foster everyday social contact.

Sources

- https://www.so-de.it/

Risks or negative impacts

- Safety is an issue, training is essential to ensure safety of workers. Cargo bikes would also require infrastructure to ensure safety to drivers but also all road users.

Sources

- https://www.sciencedirect.com/science/article/pii/S1366554526000967

Measures to maximise positive social cohesion outcomes and mitigate risks

- evaluation of readiness of using cargo-bikes (where, how, what kind of delivery); training materials/guidelines; protection for drivers; regular evaluation of operation's safety levels (any incident reports etc).

Collective action and awareness, promoting sustainable mobility

Positive effects (on social cohesion)

- Online shopping has become part of everyday life. It is fast, convenient, and always available. But e-commerce has negative impacts on transport, emissions, packaging, returns and how our cities function. Sustainable e-commerce is about making smarter choices—not just about how we deliver goods, but also about how much and how often we consume. Negative impacts of various e-commerce behaviours are not well know so raising awareness is important to enable sustainable e-commerce. Research shows that most e-commerce providers still see faster delivery as a unique selling point. Not every order needs to arrive instantly. Choosing slower delivery options helps reduce transport pressure and allows logistics companies to optimize routes. This means fewer vehicles on the road, lower emissions, and less congestion in urban areas. The transition to zero-emission delivery vehicles—such as electric vans or bikes—can further reduce air pollution and noise, making cities healthier and more liveable.
- Effective awareness campaigns can play a key role in shaping how people understand and participate in sustainable e-commerce. To maximise positive social cohesion outcomes, campaigns should go beyond environmental messaging and also highlight fairness, inclusion, and shared responsibility.

Sources

- https://link.springer.com/chapter/10.1007/978-3-032-08387-6_9

Risks or negative impacts

- Engaging with citizens & business is essential; identify different needs (for example, elder people) of different personas.

Sources

- https://link.springer.com/chapter/10.1007/978-3-032-08387-6_10

Measures to maximise positive social cohesion outcomes and mitigate risks

- Campaigns should emphasise that sustainable e-commerce is a collective effort, not just an individual choice. People are more likely to change behaviour when impacts are concrete. To strengthen social cohesion, campaigns should link e-commerce choices to local quality of life, such as safer streets with less delivery traffic; quieter neighbourhoods. inclusive messaging for all income and cultural groups: multilingual communication in diverse cities;
- avoiding framing sustainable behaviour as “elite” or difficult; highlighting affordability and accessibility of options.

Service integration and convenience

Positive effects (on social cohesion)

- Online shopping has become part of everyday life. It is fast, convenient, and always available. But e-commerce has negative impacts on transport, emissions, packaging, returns and how our cities function. Sustainable e-commerce is about making smarter choices—not just about how we deliver goods, but also about how much and how often we consume. Negative impacts of various e-commerce behaviours are not well know so raising awareness is important to enable sustainable e-commerce. Research shows that most e-commerce providers still see faster delivery as a unique selling point. Not every order needs to arrive instantly. Choosing slower delivery options helps reduce transport pressure and allows logistics companies to optimize routes. This means fewer vehicles on the road, lower emissions, and less congestion in urban areas. The transition to zero-emission delivery vehicles—such as electric vans or bikes—can further reduce air pollution and noise, making cities healthier and more liveable.
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Sources

- https://link.springer.com/chapter/10.1007/978-3-032-08387-6_9

Risks or negative impacts on social cohesion

- Engaging with citizens & business is essential; identify different needs (for example, elder people) of different personas.

Sources:

- https://link.springer.com/chapter/10.1007/978-3-032-08387-6_10

Measures or design elements to maximise positive social cohesion and mitigate risks

- Campaigns should emphasise that sustainable e-commerce is a collective effort, not just an individual choice. People are more likely to change behaviour when impacts are concrete. To strengthen social cohesion, campaigns should link e-commerce choices to local quality of life, such as safer streets with less delivery traffic; quieter neighbourhoods. inclusive messaging for all income and cultural groups: multilingual communication in diverse cities;
- avoiding framing sustainable behaviour as “elite” or difficult; highlighting affordability and accessibility of options.

Service integration and convenience

Positive effects (on social cohesion)

- By clustering logistics activities into shared hubs and coordinating them with public transport and urban infrastructure, the integrated mobility hubs reduces traffic congestion and environmental pressure in residential areas. This creates safer, quieter, and more accessible public spaces, which supports stronger everyday social interaction and improves perceived quality of life across different neighbourhoods. In addition, the integrated governance model—where public authorities, logistics operators, and mobility providers collaborate—enhances transparency and fairness in urban transformation. This reduces inequality in access to services and ensures that the benefits of sustainable logistics are distributed across the city rather than concentrated in specific areas.

Sources

- https://move21.eu/latest-developments-in-oslo/

Risks or negative impacts

- such hubs should aim financially sustainable; if its operation would depend on public funding when funding ends, hubs' operation would end. Business models therefore are important.

Measures to maximise positive social cohesion outcomes and mitigate risks

- prevents top-down systems that exclude certain neighbourhoods or groups; strengthens participation and integration into the local economy; increases everyday interaction in shared spaces and reduces invisible, fragmented logistics flows in neighbourhoods; prevents pressure from ultra-fast delivery models that create inequality and poor working conditions;

Digital planning and simulation tools

Positive effects (on social cohesion)

- Integrating traffic data to identify locations for logistics hubs in order to reduce congestion, increase efficiency, enable best use of urban space. There is a need for a data-driven framework to support cities in identifying potential micro-hub locations. The framework is based on key performance indicators (KPIs), including proximity to motorways and main roads, short distances to residential and commercial areas, and accessibility for freight operators. Use of integrated traffic data for enabling the identification of candidate sites with high logistical potential.

Sources

- https://www.eiturbanmobility.eu/projects/loge-hubs/

Risks or negative impacts

- Logistics service providers do not interested in setting up logistics hubs at at the potential locations.

Measures to maximise positive social cohesion outcomes and mitigate risks

- public and private partnership is essential; planning of logistics hubs should not overlook impacts on various neighbourhoods and residents.

MPACT

Voluntary DRT Systems

Positive effects (on social cohesion)

- A lot of the transport for less mobile citizens is done through networks of volunteers. An example of this, is the Mobitwin-service developed by Mpact: a network of +3.000 volunteer drivers bringing +35.000 less mobile citizens to supermarkets, doctor's appointments, family visits, etc. The service works on a door-to-door basis.
- Positive effects include:
    - preventing loneliness: often, the Mobitwin volunteers are among the few people that our users see on a weekly basis;
    - access to basic amenities: many of our users cannot use public transport for various reasons, or cannot rely on a network to bring them to their destinations. Our Mobitwin-volunteers guarantee the transport for a group that might otherwise be living in mobility poverty
    - reducing socio-economic gaps: our users only pay the cost per kilometer and a small yearly membership fee. This is crucial, as this vulnerable group does not have the means to make use of very expensive taxis.

Sources

- See the Mobitwin information page: https://www.mpact.be/en/service/mobitwin/
- We can also recommend the PhD written by Egger, exploring the (voluntary) DRT-context for Switzerland: https://zenodo.org/records/10814269

Risks or negative impacts

- Digitalisation is a risk. A part of the volunteer drivers is pushing for more digital approaches, like payments through QR-codes and contact with the users using an app. Yet, quantitative and qualitative data among our users suggest that their level of digital skills is fairly low. Therefore, 'forcing' a digital way of working might exclude a substantial part of our (potential) users from actually using the service. Therefore, we stick (for the time being) to in-person communication via a call center.

Sources

- Internal research.

Measures to maximise positive social cohesion outcomes and mitigate risks

- If we would like to increase app usage, the app would have to be co-designed with our users before launching it. At all times, analogue alternatives would have to remain available.

Mobility Hubs

Positive effects (on social cohesion)

- Mobility hubs can enhance the connectivity of a neighbourhood by bunding the offer, hence making it more visible. This is a powerful tool in the 'carrot and stick' strategy. While policies

often focus on 'sticks' (LEZ, less parking), mobility hubs are the 'carrots' from a policy perspective: they are a tangible example of something that politics gives in return.

- Social cohesion can be enforced through design: a good hub does not just offer mobility services, but also includes facilities that can bring the neighbourhood closer together. Examples are benches, picnic tables, playground, coffee bar, and weekly farmer's market in the vicinity of the hub.

Sources

- Still relevant is the SmartHubs final report, which includes 10 recommendations to develop hubs that are inclusive through digital, democratic and physical integration: https://www.smartmobilityhubs.eu/_files/ugd/c54b12_eec2ced132d04c158f16c04daa6b8c48.pdf

Risks or negative impacts

- I see two potential risks that might undermine the concept of mobility hubs:
    - 1) Digitalisation: increasingly, shared and public mobility providers pursue an app-only strategy. If you want to find information about departures, timetables, how to book a shared car etc., you are lost when you do not have a smartphone. This is problematic as a considerable part of the population has limited digital skills only (see: https://www.cedefop.europa.eu/en/tools/skills-intelligence/digital-skills-level?year=2023#1)
    - 2) Security: when there is no investment in social cohesion, greenery, playgrounds, security cameras or physical presence of PT staff / coffee bar, people might feel insecure, especially in the evening or at night. Unregular emptying of litter bins or the lack of removal of grafiti tags increases this (perceived) insecurity.

Sources

- Study on the requirements of vulnerable users at mobility hubs: https://www.sciencedirect.com/science/article/abs/pii/S1361920924004048?via%3Dihub
- Study on how to co-design a hub with local residents: https://www.smartmobilityhubs.eu/_files/ugd/c54b12_1d3db67817ca4a04b766ccb280b73848.pdf.
- Guidelines for the design of mobility hubs in Flanders, focusing on mobility and non-mobility components of a hub: https://wegenenverkeer.be/sites/default/files/uploads/documenten/Ontwerpwijzer-Hoppinpunten_v1.1.pdf

Measures to maximise positive social cohesion outcomes and mitigate risks

- Digitalisation: physical presence of staff that can provide information, co-design of transport apps, trainings on how to retrieve information using the apps of public/ shared mobility providers.
- Security: co-designing the hub with residents, 'explorative walks / marches exploratoire' where women identify spots / corners where they feel unsafe (https://maligneh.transilien.com/2025/07/09/marche-exploratoire-a-ermont-eaubonne-un-outil-participatif-pour-des-mobilites-plus-sures/)

Bike library network for children

Positive effects (on social cohesion)

- Op Wielekes is a bicycle library where you can borrow children's bikes. Parents don't have to worry about their kids quickly outgrowing their bikes; when they do, the bike can simply be exchanged for a larger model. This also keeps costs down for parents, as there is no need to constantly buy a new bicycle. The 'depots' where you can borrow a bike, are staffed by volunteers.
- Positive effects include:
    - 1) Increased access to bikes, also for people with limited financial means. A yearly subscription to Op Wielekes costs around 25 € / year (varies between cities)
    - 2) Feeling of community between the volunteers thanks to events that are organised at the local 'depots'; being a volunteer creates a "sense of belonging"
    - 3) Op Wielekes depots are developed in a partnership between (1) Mpact, (2) local volunteers, and (3) a municipality / neighbourhood organisations / non-profit that provides infrastructure. This builds 'bridges' between local residents and the municipal administration, and can enforce the local administration's anchoring in a neighbourhood.

Sources

- See the Op Wielekes 'upscaling report': https://www.opwielekes.be/wp-content/uploads/2025/12/BBBC-Op-Wielekes-Eindrapport.pdf
- There is a small docu as well: https://vimeo.com/1140493247

Risks or negative impacts

- Although Op Wielekes aims to be there for all children, member surveys show that it is primarily middle-class families with a Dutch-speaking background who find their way to the service. Only a small portion of members make use of the social rate or have a migration background.

Sources

- See the analysis done by the Artevelde College (Ghent) about the impact of Op Wielekes (in Dutch): https://opwielekes.be/wp-content/uploads/2025/12/BBBC-Op-Wielekes-Verdiepend-onderzoek.pdf

Measures to maximise positive social cohesion outcomes and mitigate risks

- As stated above, reaching a diversified audience remains challenging. In depots that do succeed in reaching vulnerable families, they do so through partnerships with social welfare organizations, multilingual communication, and special arrangements such as free memberships.

PAVE

CCAM/Autonomous Vehicles

Positive effects (on social cohesion)

- Congestion reduction, and the liberation of urban/peri-urban space, environmental benefits, increased accessibility for segregated communities
- Enhanced accessibility and inclusivity, regaining urban space, enhance sustainable mobility, improved public transport and shared mobility services

Sources

- https://pavecampaign.org/pave-europe-publishes-white-paper-safer-cleaner-more-equitable-seizing-the-opportunities-of-highly-automated-vehicles/
- https://pavecampaign.org/safer-cleaner-more-equitable-seizing-the-opportunities-of-highly-automated-vehicles/
- https://pavecampaign.org/the-future-of-public-transportation-embracing-autonomous-mobility/

Risks or negative impacts

- Risk of reinforcing current mobility challenges if not done correctly, or with co-designing in mind from the outset e.g., continued exclusion of these vulnerable groups, digital divide must also be considered, no clear roadmap for upskilling/re-skilling in Europe could also be a challenge
- digital divide, affordability

Sources

- https://pavecampaign.org/pave-europes-new-white-paper-the-future-of-public-transportation-embracing-autonomous-mobility/
- consider a logistics perspective also: https://pavecampaign.org/unlocking-the-future-of-goods-transportation-pave-europe-publishes-white-paper-on-autonomous-vehicle-av-application-in-goods-transportation-and-logistics-2/

Measures to maximise positive social cohesion outcomes and mitigate risks

- Co-creation and co-design, integrating different levels of government i.e., local governments or councils, engaging with communities such as first responders or 'people who make the city', ensuring that the technology caters to different types of people, in different situations, creates better services for people, which in turn maximises positive social cohesion. People-first innovation rather than a solely technological perspective will make a difference for AVs/CCAM.
- https://pavecampaign.org/understanding-citizens-needs-common-guidelines-for-ccam-user-surveys-in-europe/

Traffic and mobility management benefitting sustainable modes

Positive effects (on social cohesion)

- Congestion reduction, and the liberation of urban/peri-urban space, environmental benefits, increased accessibility for segregated communities

Sources:

Sources

- https://pavecampaign.org/pave-europe-publishes-white-paper-safer-cleaner-more-equitable-seizing-the-opportunities-of-highly-automated-vehicles/

Risks or negative impacts

- Risk of reinforcing current mobility challenges if not done correctly, or with co-designing in mind from the outset e.g., continued exclusion of these vulnerable groups, digital divide must also be considered, no clear roadmap for upskilling/re-skilling in Europe could also be a challenge

Sources

- https://pavecampaign.org/pave-europes-new-white-paper-the-future-of-public-transportation-embracing-autonomous-mobility/
- consider a logistics perspective also: https://pavecampaign.org/unlocking-the-future-of-goods-transportation-pave-europe-publishes-white-paper-on-autonomous-vehicle-av-application-in-goods-transportation-and-logistics-2/

Measures to maximise positive social cohesion outcomes and mitigate risks

- Co-creation and co-design, integrating different levels of government i.e., local governments or councils, engaging with communities such as first responders or 'people who make the city', ensuring that the technology caters to different types of people, in different situations, creates better services for people, which in turn maximises positive social cohesion. People-first innovation rather than a solely technological perspective will make a difference for AVs/CCAM.

POLIS

Shared micromobility

Positive effects (on social cohesion)

- Shared micromobility enhances connectivity by improving first- and last-mile access to public transport, jobs, education, and essential services, particularly for underserved neighbourhoods. It can contribute to reducing socio-spatial segregation when services are deployed beyond city centres and include peripheral or lower-income areas.
- Shared micromobility increases transport affordability by offering a lower-cost alternative to private car use for short trips. It supports greater accessibility and inclusion by providing flexible mobility options for people without access to a car, including younger and lower-income users. It can help activate public space and foster social interaction by increasing the presence of people in streets and shared urban environments.
- Although UVARs have the reputation to accelerate or increase social imbalance, the opposite is true.
    - UVARs can bring balance between modes, decrease the burden of external costs of motorised traffic (congestion, air pollution, noise).
    - If well designed, the accompanying measures can support those who see their mobility impacted due to the fact that older vehicles are not allowed to access certain parts of the city, or that permits are linked to specific user categories.

Sources

- https://www.polisnetwork.eu/wp-content/uploads/2023/11/SHARED-MICROMOBILITY-REPORT.pdf
- www.civitas-reveal.eu (project)
- https://transport.ec.europa.eu/news-events/news/urban-vehicle-access-regulations-uvars-recommendations-expert-group-urban-mobility-2024-04-22_en

Risks or negative impacts

- Shared micromobility can exacerbate the digital divide, as access typically requires a smartphone, digital payment methods, and a certain level of digital literacy, potentially excluding older adults, low-income groups, and other vulnerable users.
- It may lead to unequal spatial distribution of services, with operators prioritising high-demand and affluent areas, thereby reinforcing existing socio-spatial inequalities.
- Shared micromobility can contribute to the exclusion of vulnerable groups if pricing structures, vehicle design, or operational models do not consider the needs of people with disabilities or low-income users.
- It may create public space conflicts, particularly on sidewalks, which can disproportionately affect pedestrians, including elderly people and persons with reduced mobility.
- Without proper regulation, it can reinforce transport inequality, as benefits may be concentrated among already well-served and more mobile populations.
- As mentioned above, forced car ownership or lack of access to alternatives can decrease the mobility to useful locations for specific target audiences.

Sources

- https://www.polisnetwork.eu/wp-content/uploads/2025/03/Shared-Micromobility-Regulations-Report.pdf

Measures to maximise positive social cohesion outcomes and mitigate risks

- Ensure equitable spatial deployment with minimum coverage in underserved and peripheral areas.
- Introduce reduced fares or subsidies for low-income and vulnerable users.
- Provide non-digital access options (e.g. SMS, cards) to reduce the digital divide.
- Strengthen integration with public transport and MaaS for seamless mobility.
- Define clear parking and street rules with designated parking areas to reduce public space conflicts.
- Require inclusive design standards for better accessibility (e.g. adapted vehicles).
- Use community engagement/co-design to reflect diverse user needs.
- Implement data monitoring and sharing to track equity impacts and adjust policies.

TTS

Commoning of urban mobility (mobility as a commons)

Positive effects (on social cohesion)

- Treating urban mobility as a commons (governed by the community of users instead of as a public service or a private market) generates several social cohesion effects:
    - (a) Co-stewardship: residents shift from "users" of a service to active co-stewards of a shared resource, with direct agency over a decision that would otherwise be top-down.
    - (b) Bonding capital inside the neighbourhood: co-defining rules, contributing time and accepting reciprocal obligations strengthens ties among residents.
    - (c) Bridging capital between residents and the local authority: structured negotiation with the municipality builds trust across the citizen–institution boundary.

    - (d) Redistributive fairness: access to the mobility resource does not depend on individual purchasing power, broadening inclusion of lower-income groups.
    - (e) Ongoing deliberation: governance happens through repeated decision moments, so the social contract behind the service remains visible and contestable, rather than hidden in a private contract or in a market price.
- A current European reference is the Horizon Europe project GEMINI (GA 101103801, in which TTS Italia is a beneficiary and MLL leader for Turin). GEMINI is piloting a Mobility-as-a-Commons (MaaC) arrangement in its Amsterdam Mobility Living Lab — neighbourhood car-sharing cooperatives supported by a city-level "umbrella commons" structure. GEMINI D3.1 (Nov 2024) reports one new MaaC cooperative operational in the Spaarndammerbuurt district (20 members, 2 shared cars) plus two pre-existing cooperatives being monitored (Tuindorp Oostzaan, Centrumeiland), with five additional locations under development. The GEMINI evaluation framework (D2.1) and the interim progress report (D3.1) explicitly list "Improved social cohesion in the neighbourhood" and "Improved social inclusion" as MaaC impact indicators, measured through interviews with cooperative members, focus groups with stakeholders, and value/knowledge-network mapping. The Turin MLL (led by TTS Italia) tests a complementary MaaS-based model in which a co-designed B2B business community of mobility and tourism operators shapes the service offering.

Sources

- GEMINI — CORDIS fact sheet: https://cordis.europa.eu/project/id/101103801
- GEMINI project website: https://geminiproject.eu
- GEMINI D1.1 — Market Analysis and Innovation Drivers,
    - §3.2.8 "Social inclusion"
    - Appendix Q "MaaC" (Amsterdam + The Hague case studies)
- GEMINI D3.1 — Interim progress report of MLLs implementation (Nov 2024)
    - Chapter 2 "MLL1 - Amsterdam: Mobility as a Commons (MaaC)",
    - §2.1-2.3 with impact indicators "Improved social cohesion" and "Improved social inclusion"
- Elinor Ostrom, Governing the Commons (1990)
- Robert D. Putnam, Bowling Alone (2000).

Risks or negative impacts

- Commoning arrangements in mobility carry some recurrent risks that need to be addressed by design:
    - (a) Free-rider dynamics: the commons can be over-used or under-maintained if the rules are not visibly enforced.
    - (b) Capture by the most vocal residents: louder or better-resourced participants may dominate the deliberation, leaving silent groups (elderly, migrants, lower-income households) under-represented.
    - (c) Fragility around individual facilitators: arrangements that depend on a single charismatic facilitator collapse when that person leaves.
    - (d) Accountability gaps: informal governance can drift outside the municipal legal framework, creating ambiguity on liability, safety, data protection and public-money use.
    - (e) Social-media distortion of the deliberation: online platforms can skew commoning in three ways —

- (i) amplifying a small vocal minority out of proportion to its real weight in the neighbourhood;
- (ii) enabling coordinated campaigns that simulate broad opposition (or consensus);
- (iii) letting out-of-neighbourhood users influence a decision that should be locally bounded. Algorithmic ranking further tilts the conversation toward emotionally charged content, at the expense of reasoned deliberation.
  A first-hand Italian case is the GRAB — Grande Raccordo Anulare delle Biciclette in Rome (a ~45 km urban cycling ring co-promoted since 2017 by civic associations, Comune di Roma): the public debate on Facebook was dominated by vocal opponents framing the project around loss of on-street parking and alleged waste of public money, contributing to political stalling of several segments despite the project's technical maturity and its alignment with Roma's SUMP. Similar patterns have been documented internationally for Low-Traffic Neighbourhoods in London and the "15-minute city" framing in Oxford.

Sources

- Elinor Ostrom, Governing the Commons (1990) — free-riding and rule-enforcement risks
- GEMINI D3.1 (Nov 2024),
  - §2.3.3 Table 14 and
  - §2.5 (barriers to MaaC implementation: upfront investment cost, participant recruitment, lack of legal/financial expertise, municipal coordination difficulty, scaling constraints)
- GEMINI D1.1 Appendix Q — Townmaking obstacles (dependency on individual facilitators, scalability of the "Townmaker" role)
- Cass R. Sunstein, #Republic: Divided Democracy in the Age of Social Media (2017) — echo chambers and polarisation of deliberation
- Rachel Aldred et al., Transport Policy (2019) — opposition dynamics to cycling infrastructure and Low Traffic Neighbourhoods
- GRAB Roma (Grande Raccordo Anulare delle Biciclette) — press coverage 2018-2023 (Il Messaggero, la Repubblica) on social-media-driven opposition to the project (parking loss, alleged waste of public funds).

Measures to maximise positive social cohesion outcomes and mitigate risks

- The risks above can be mitigated through a small set of complementary design choices:
  - (a) Pair commoning with formal participatory mechanisms (participatory budgeting, citizen assemblies) so the deliberative space is institutionalised and less dependent on single individuals.
  - (b) Recurring municipal facilitation grants: small but stable public funding to cover facilitation, mediation and onboarding of new participants, reducing fragility.
  - (c) Equity-of-access KPIs: monitor and publish disaggregated indicators (gender, income, age, disability, migration background) on who actually uses the commoned mobility resource, to surface and correct silent exclusions.
  - (d) Formal convention with the municipality: anchor the commoning arrangement to a written agreement with the local authority, giving it legal standing, accountability and resilience to political turnover.
  - (e) Documented rules and rotation of roles: write down operating rules and rotate facilitator / steward roles on a defined cycle, to avoid concentration of authority.

- (f) Structured hybrid deliberation: combine face-to-face workshops in the affected neighbourhood with moderated online channels that verify residence / stakeholder status, and publish the demographics of participants at each deliberation step, so online dynamics do not swamp a locally-bounded decision.

Participatory budgeting on mobility

Positive effects (on social cohesion)

- Participatory budgeting (PB) operationalises the principle that citizens decide together on a tangible, divisible resource — public money. When the resource is mobility, the cohesion gains compound: residents experience direct agency over their daily environment, and the resulting interventions are physically visible to everyone in the neighbourhood, reinforcing the perceived legitimacy of the deliberation.
- Italy has a mature PB tradition with explicit mobility threads:
  - Milano runs Bilancio Partecipativo since 2015 with multiple editions including pedestrian-priority and cycling proposals;
  - Reggio Emilia funds neighbourhood mobility works through "Quartiere Bene Comune";
  - Bologna uses PB inside the "Piani di Quartiere";
  - Emilia-Romagna Region has a regional PB law (LR 15/2018, Legge regionale sulla partecipazione).
- At European scale, Paris Budget Participatif (≈ €100M/year, several mobility-themed projects) and Lisbon Orçamento Participativo are the most-cited large-city precedents. Italian SUMP guidance (Decreto MIMS n. 397/2017) explicitly recommends participatory tools, and the open-source platform DECIDIM Italia is increasingly used to host the digital deliberation layer.
- Three concrete cohesion levers:
  - (i) shared agency over a previously top-down budget allocation;
  - (ii) cross-neighbourhood bargaining that surfaces previously invisible mobility needs (peripheries vs. centre);
  - (iii) ex-post visibility of delivered works, which builds long-run trust in the institutional process.

Sources

- Bilancio Partecipativo Milano: https://partecipazione.comune.milano.it
- Quartiere Bene Comune Reggio Emilia: https://partecipazione.comune.re.it
- Bologna Piani di Quartiere — Comune di Bologna
- LR Emilia-Romagna 15/2018 (partecipazione)
- Decreto MIMS 397/2017 — Linee guida PUMS
- DECIDIM Italia: https://decidim.org
- Paris Budget Participatif: https://budgetparticipatif.paris.fr
- Lisboa Orçamento Participativo: https://www.lisboaparticipa.pt
- Sintomer, Herzberg, Röcke (2008) "Participatory Budgeting in Europe"
- Y. Cabannes (UN-Habitat, 2004) "Participatory Budgeting: A Significant Contribution to Participatory Democracy".

Risks or negative impacts

- Three recurrent risks documented in the PB literature:

- (a) Tokenism: when the budget envelope put on the table is symbolic relative to the overall municipal budget, residents perceive the process as participation theatre and trust erodes faster than if the process had not been run at all.
- (b) Self-selection bias: PB participants are systematically skewed toward already-engaged demographics (higher education, mid-to-upper income, mid-life age brackets, native speakers). Without active outreach, the deliberation reproduces existing inequalities rather than rebalancing them.
- (c) Mobility crowding-out: in non-segmented PB rounds, mobility proposals (which often need cross-neighbourhood scope and slow delivery) lose to higher-visibility, lower-cost quick-wins (playgrounds, urban furniture, single-block interventions). The result is that mobility ends up under-represented even when residents would have prioritised it given the choice.
- (d) Implementation gap: when proposals win the vote but are then delivered late, partially, or not at all, the process produces *negative* cohesion effects — frustrated participants disengage from future municipal initiatives. The trust-building moment in PB is in the delivery phase, not the vote phase.

Sources

- Sintomer, Herzberg, Röcke (2008) "Participatory Budgeting in Europe" — tokenism risk and segmentation recommendations
- C. Pateman (2012) "Participatory Democracy Revisited", Perspectives on Politics 10(1) — self-selection bias
- G. Allegretti et al. "Participatory Budgeting in Europe and Beyond" (RIPS/OIDP) — Italian PB critiques
- Y. Cabannes (UN-Habitat, 2004) — conditions for meaningful PB (envelope size, ex-post monitoring)
- Hagelskamp et al. (2018) Public Agenda, PB in NYC — participation gap and outreach evidence
- Il Mulino / RIPS academic reviews on limits of Italian Bilancio Partecipativo.

Measures to maximise positive social cohesion outcomes and mitigate risks

- Four design elements address the risks above:
  - (1) Reserve a dedicated "mobility envelope" inside the PB so that mobility proposals do not compete head-to-head with quick-win micro-projects. Italian SUMP guidance (Decreto MIMS 397/2017) is a natural anchor for this carve-out.
  - (2) Pair the digital deliberation platform (e.g. DECIDIM Italia) with face-to-face workshops in under-represented neighbourhoods (peripheries, social housing, immigrant-dense areas), and use stipends or childcare to lower the participation cost.
  - (3) Mandate ex-post implementation monitoring with public dashboards: percentage of winning projects delivered, time-to-delivery, residual budget. Trust in PB collapses fastest when the vote-to-delivery gap is opaque.
  - (4) Pre-commit a multi-year cycle (≥3 editions) before evaluating PB outcomes — single-shot pilots systematically under-perform because participants need to see the loop close at least once.



ANNEX D

CONCEPTS AND SOLUTIONS FOR SOCIALLY OPTIMISED MOBILITY SYSTEMS

Project deliverable D1.1

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Author(s):

Fit Consulting M Meta, F Mauro

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ANNEX D – Full analysis of the governance models for the different groups of mobility practices and solutions

Governance models for Urban Space & Urban rules

Regulatory frameworks

1. **Rights-based legal principles (access, inclusivity, accountability)**

Overview:

A regulatory framework for street and public space should be grounded in rights-based legislation: it protects equitable access, reduces discrimination risks, and makes participation, transparency, and accountability legally meaningful (not optional "good practice"). A clear distinction between streets and public space is necessary as street occupancy requires official traffic management plans for managing road space, reducing congestion and ensuring safety.

Relevance for urban space & urban rules:

- Equitable access:

rules protect access for underprivileged groups and set expectations for inclusive public space outcomes

- Legitimate participation:

consultation and participatory budgeting are strengthened when required by law and supported by transparency/oversight mechanisms

- Clear accountability:

public reporting and oversight reduce discretionary decision-making and increase trust in rule changes

Additional comments:

A recurring gap is "participation without protection": if equal access and anti-capture safeguards are not specified, participation can be dominated by stronger interests.

Freight transport and people's mobility should be equal, and planning should be integrated for both. Often, urban freight has been ignored and there is no space for logistics activities (traditionally, such activities are in outside the city). Local businesses often have no voice in urban vehicle access regulations; urban vehicle access regulations often fragmented.

2. **Binding planning and zoning standards (space allocation + minimum quality)**

Overview:

Rules are more enforceable when they are embedded into planning law and zoning: minimum allocations for streets, sidewalks and public space, plus minimum quality standards (accessibility, safety, environmental performance, maintenance).

Relevance for urban space & urban rules:

- Consistent delivery:

minimum standards reduce “patchwork” implementation across neighbourhoods and projects

- Clear design expectations:

quality requirements make public space usable and robust over time (not just “left over” land)

- Space is formally protected:

zoning can reserve land for parks, plazas, pedestrian zones, and prevent overcrowded development

Additional comments:

A recurring gap is non-binding guidance: in many contexts, street/sidewalk/public-space design is left to discretion because standards are missing, too low, or ambiguous

Giving space to freight is essential. Freight transport includes B2B, B2C, consisting of big items, or small parcels. Micro-hubs or logistics hubs are essential to enable use of smaller vehicles; loading zones are essential to keep local business in cities (not move away from city centres due to restriction of motorised traffic).

3. Land allocation and acquisition rules (developer duties, value capture, safeguards)

Overview:

A strong framework clarifies how land is secured for streets and public space: allocation obligations in new developments, tools for acquisition (purchase, swaps/incentives, expropriation as last resort), and value-capture logic with safeguards for vulnerable groups.

Relevance for urban space & urban rules:

- Predictable space supply:

planning law can require a minimum share of land to be dedicated to streets and public spaces in new developments

Planning law can provide a guideline of planning logistics hubs in cities (not in industry zone only),

Loading zone/bays for business and residences should be provided in the planning.

Parking spaces (traditionally is essential for residences) may be replaced by shared mobility, and delivery zones, and parcel lockers (picking-up points).

- Fair cost sharing:

developer obligations and value-capture tools link private gains to public infrastructure needs

Needs of freight sector should be considered.

- Social protection:

clear legal safeguards reduce displacement and backlash, especially where expropriation is used

Worker’s right should be protected; space for delivery workers to take breaks & rests should be planned together with infrastructure; planning a community space (indoor) for delivery or uber drivers would improve well-being.

Additional comments:

A recurring gap is over-reliance on expropriation: it is politically explosive and can hit the poorest hardest unless protections and fair processes are strong

4. Mandates and coordination across levels (who decides what, across boundaries)

Overview:

Urban rules require a "competence map": who sets standards, who implements, who enforces, and how coordination happens across municipal borders (metropolitan or multi-jurisdiction platforms).

Relevance for urban space & urban rules:

- Role clarity:

reduces conflicts between agencies/levels and prevents implementation from stalling

Often logistics is a 'homeless topic'. A dedicated logistics coordinator at public authority is recommended.

- Cross-boundary coherence:

metropolitan platforms help when travel patterns and impacts go beyond one municipality

Coordinated urban vehicle access rules should be harmonised at regional level at least (not city level), or national level; avoiding registration to various systems for vehicle owners.

- Faster execution:

clear mandates reduce "permission ping-pong" between institutions

Additional comments:

A recurring gap is fragmented mandates + weak inter-jurisdiction coordination, especially when local governments have limited autonomy and tools

5. Funding and fiscal rules (stable budgets + local revenue tools + transparency)

Overview:

Street/public space change needs long-term funding for implementation and maintenance. Regulation matters because it determines local fiscal autonomy, eligible revenue tools, and what can be ring-fenced for public space outcomes.

Relevance for urban space & urban rules:

- Long-term maintenance:

rules should recognize that public space is not "one-off capex" and needs predictable O&M funding

- Local fiscal autonomy:

own-source revenues and decentralization enable cities to fund sustained change instead of relying only on unstable transfers

- Transparent use of funds:

rights-based frameworks support public reporting and oversight, reducing legitimacy risks

Additional comments:

A recurring gap is weak local revenue control: cities carry responsibility for delivery but lack the fiscal tools to finance it effectively.

6. Monitoring, data governance, and "feedback-driven" adjustment

Overview:

Modern urban rulemaking increasingly relies on real-time monitoring and structured feedback loops (sensors, mobile data, community reporting). Regulation should define data responsibilities and ethical safeguards so data-driven management stays legitimate and inclusive.

Relevance for urban space & urban rules:

- Faster problem detection:

data signals and community reporting help identify issues early and adjust interventions

Reporting issues via apps has been approved as an efficient way to detect problems

- More responsive governance:

rules and measures can be updated based on evidence rather than political cycles alone

- Fairness and trust in digital tools:

ethical, participatory data governance reduces exclusion and legitimacy risks

Protecting local business and help economic growth should be at the centre, but often voices from certain groups (e.g. cyclists) are higher than others, leading to unbalanced governance.

Additional comments:

A recurring gap is "smart without safeguards": without clear ethical and participatory data rules, monitoring systems can widen inequalities and reduce trust.

7. Safety and security-by-design requirements (procedures, tools, cross-border complexity)

Overview:

Safety can be embedded into regulation through mandated procedures: vulnerability/risk assessment, scenario testing, and co-design of mitigation strategies involving relevant authorities and stakeholders. This is especially important where multiple regulatory systems intersect (e.g., cross-border spaces).

Relevance for urban space & urban rules:

- Safety considered early:

risk assessment becomes part of planning and design workflows, not an end-stage add-on

- Shared operational readiness:

multi-actor involvement (municipalities, police, first responders, civil society) aligns emergency protocols and responsibilities

- Avoiding over-securitisation:

tools support proportionate measures and help protect openness and democratic use of space

Additional comments:

A recurring gap is missing procedural mandates: if early risk assessment and coordination steps are not required, safety becomes inconsistent.

8. Avoiding "sterilisation" through rigid standards (managing plural uses)

Overview:

Regulation can unintentionally "sterilise" public space when it over-standardizes use through formulaic requirements (e.g., parking/road width rules, use classification of roads…) that remove local meaning and flexibility. A stronger framework acknowledges plural uses and supports negotiated solutions rather than nullifying diversity.

Relevance for urban space & urban rules:

- Better place quality:

rules can preserve social value and everyday usability, not only technical compliance

- Conflict is managed, not erased:

recognising commoning practices can help balance different users and needs

- More adaptable street management:
  - temporary uses and negotiated arrangements can reduce the need for "one-size-fits-all" rules
  - temporary road uses need to be formally authorised as there is a question of legal responsibility of the directors of the traffic departments and consequences related to insurance consequences

Additional comments:

A recurring gap is that standards focus on physical metrics while under-specifying how to manage competing uses and power imbalances in practice.

Governance models (overview)

Municipality regulatory governance (public-led)

Description

This model frames speed and street-use regulation as part of a broader municipal public-space and street governance system: the municipality is the central actor that defines the rules, translates them into enforceable local instruments and aligns street design and space allocation with those rules so they are practical and consistently applied.

In practice, the city acts through a package of regulatory levers:

- Urban legislation and bylaws that set behaviour rules (e.g., what is allowed where), define rights/obligations
- Binding standards for streets and public space (minimum requirements, accessibility, safety, environmental quality and maintenance provisions), so the physical street environment supports the intended use

- Enforcement capacity (inspections, compliance monitoring, accountability), because rules without enforcement become optional

A key variant is a "rights-based municipal approach", where regulation explicitly protects equitable access to public space (including universal design and safeguards so participation is not dominated by “capital-driven interests”)

Governance approach

A municipality-led setup where the city defines the rules and targets, coordinates implementation across municipal departments and local partners, funds core measures through the public budget (optionally complemented by peculiar fees) and monitors and enforces compliance

Advantages

- Implementation power:

the city can move from intent to enforcement because it controls local rules, permits, inspections and standards

- Consistency and scale:

planning law can impose minimum requirements across neighbourhoods and new developments, reducing “patchwork” delivery

- Equity by design:

rights-based frameworks can mandate inclusive, accessible public spaces and create transparency mechanisms

- Ability to secure space:

legal tools for allocation/acquisition reduce reliance on ad-hoc negotiations project by project

Challenges

- Public resistance and low acceptance:

can slow down implementation, especially when changes are perceived as restrictive or disruptive to daily routines

- Legal ambiguity and complexity:

can lead to inconsistent enforcement and “creative interpretations” (often with negative equity impacts)

- Capacity gaps:

municipalities may lack legislative expertise and resources to draft, implement and enforce effectively

- Outdated frameworks

can be rigid and slow to adapt to new needs (innovation gets stuck in bureaucracy)

- Political interference:

may prioritise short-term wins over long-term street/public space outcomes

Examples (mapping)

Closest analogues of municipal regulatory governance are:

- Kigali: master plan + zoning laws enforced by the City of Kigali through inspections and public consultations.

- Mexico City: constitution and urban development laws embedding rights to public space, participation, transparency, accountability and oversight mechanisms; includes public-space initiatives and pedestrian-friendly zones mentioned as outcomes.
- Christchurch (Linwood Master Plan): city council master planning aimed at a compact/walkable centre and subsequent streetscaping/cycleway interventions (shows municipal planning instruments shaping street/public space).
- The London Freight Quality Partnerships (LFQP) is a collaborative effort among the freight industry, local government, local businesses, the local community, environmental groups, and others with an interest in freight. The LFQP aims to raise awareness of freight's importance within Transport for London (TfL).

Regulatory/legal gaps

- No binding standards (or standards too weak) for streets/sidewalks/public-space design → outcomes depend on discretion of planners/developers; guidelines may be non-binding
- Overlaps between national and local rules and general legal ambiguity → inconsistent enforcement and room for abuse
- Outdated legal frameworks not reflecting current urban challenges → slow, restrictive and misaligned with innovation
- Weak tools to secure land for public use (or over-reliance on expropriation) → delays and inequitable impacts
- Insufficient municipal resources/expertise to draft and enforce effectively → good rules fail at execution
- Outcomes of innovation that have been piloted often does not have no influence on policy or regulation making

Multi-level "dynamic" governance (anticipatory, adaptive, agile - feedback driven)

Description

A governance model where multiple levels of government (national, regional/metropolitan, local) and non-government actors jointly steer urban change, with a strong focus on being future-ready and able to adjust quickly when conditions or evidence change.

What makes it “dynamic” is that it combines, in the same system:

- Anticipation: institutions use foresight tools (e.g., horizon scanning, scenarios, simulation tools) to plan instead of reacting late
- Adaptation: policies and interventions are updated over time based on learning and new information
- Agility: faster coordination and iterative policy/action cycles, often enabled by institutional reforms and more flexible decision-making
- Feedback loops: continuous monitoring (real-time data + community reporting) to track impacts and adjust actions

It is also explicitly about how to plan, finance and manage urban areas through coordinated decisions and shared responsibilities, not just “participation”.

Governance approach

National/regional bodies set enabling frameworks and standards, metropolitan or inter-jurisdiction platforms coordinate across boundaries, and municipalities implement and enforce on the ground. Funding comes from a mix of local own-source revenues and fiscal tools (where enabled), national programs/transfers, and blended public-private (and sometimes public-private-people) finance, with performance monitored through institutionalised feedback systems that trigger periodic adjustments.

Advantages

- Coherent action across levels: better alignment between national priorities and local implementation, with two-way learning (local experience informs higher-level policy)
- Better coordination across sectors reduces siloed decisions (e.g., transport rules/design aligned with planning, environment, public works)
- More resilient delivery: anticipatory planning + monitoring helps detect issues early and respond faster
- More robust financing options encourages diversified funding (e.g., local fiscal tools, innovation/climate finance facilities, blended finance)

Challenges

- Fragmented mandates and weak coordination between institutions and levels can block implementation
- Limited local capacity (skills, staff, systems) makes it hard to run data-driven feedback loops and adaptive planning
- Cross-boundary problems are hard: urban issues often exceed municipal borders; without metropolitan arrangements, solutions stay partial
- Digital divide and data governance risks: if data systems are not inclusive/ethical, governance becomes less legitimate and less equitable; public authorities lack expertises/resources to manage large of datasets, making data sharing between public and private sector is impossible.

Examples (mapping)

- Iloilo River Esplanade (Philippines):

dedicated council coordinating national agencies, city government, local units, academia, private partners; web-based monitoring; legal backing; national funding programs aligned to the council's direction

- Ahmedabad Smart City initiative (India):

multi-level coordination, institutional innovation (SPV), phased pilots-to-scale, citizen feedback channels, diversified financing (grants + PPPs + municipal bonds + own revenues)

- Medellín (Colombia) – Integrated Urban Projects (PUIs):

multilevel governance + PPP funding + participatory budgeting and community-managed spaces

- Creative District of Porto Alegre / Oslo waterfront revitalization:

examples of public participation and collaborative governance in a multilevel logic, described at high level

Regulatory/legal gaps

- Unclear or misaligned competences across levels (who decides what) → coordination becomes informal and fragile
- Missing enabling frameworks for agile collaboration (cross-sector and cross-jurisdiction) → slow, siloed implementation
- Limited fiscal decentralization / weak local revenue tools → cities lack autonomy to fund long-term change and must rely on unstable transfers
- Lack of ethical/participatory data governance rules for AI/IoT/digital platforms → risks on transparency, accountability and inclusion

Commons-based co-governance (co-management of public space)

Description

This model manages streets and public spaces as a shared resource ("urban commons"). The municipality does not act alone: it shares day-to-day management choices with community organizations and local users, and it supports "commoning" practices that emerge on the ground. The goal is to reduce conflict over use and make public space more socially meaningful, not just well-designed.

Commoning can take different forms and each form has different governance implications:

- Taking over(co-option risk): some groups may try to capture the space for their own purposes
- Commons-management (co-management): users and community groups cooperate to run and maintain the space
- Activation (supported use): the space is kept lively through events and temporary activities, sometimes supported with public resources
- Decommoning (sterilisation/exclusion): rules or design choices can unintentionally strip away local meaning and exclude certain uses

This model is especially relevant where formal consultation does not resolve tensions among different users, or where trust between residents and authorities is weak.

Governance approach

The municipality enables and funds the basic framework (permissions, safety rules, small grants), while community organizations and local users co-decide how the space is used and take responsibility for daily management and upkeep, often supported by volunteer work and/or local partnerships.

Advantages

- Higher local ownership: people feel the space is "theirs", so they protect it and keep it active
- Better conflict handling: negotiation happens close to the street level, not only through formal consultations
- More diverse and meaningful use: spaces can host multiple social functions (community hubs, gardens, low-cost services)
- Low-cost activation capacity: temporary use and events can deliver quick benefits with limited infrastructure

Challenges

- Risk of capture ("common-deering"): stronger groups can dominate the space and push out weaker users
- Unequal participation: co-management works only if access is fair and voices are balanced
- Sustainability of effort: volunteer-driven management can be fragile without stable support and clear roles
- Blurred responsibility and liability: it can be unclear who is accountable when issues arise in shared-managed spaces

Examples (mapping)

- Christchurch (Linwood Village / "Tiny Shops"):

collaboration between a community organization (Te Whare Roimata), the city council, another community group, and a private landowner to convert a vacant lot into a community hub; the city supported the approach with funding

- Medellín (community-managed spaces + participatory budgeting):

residents influence spending priorities and local organizations manage certain spaces, fostering ownership and accountability

Regulatory/legal gaps

- Weak formal recognition of "commons" arrangements: the role of commoning in official governance is often not clearly defined
- Rules focus on design more than governance: equity, trust, and "who decides" can get sidelined by a purely managerial/design lens
- Missing safeguards for fair participation: without explicit conditions (equal access, anti-capture measures), co-management can reproduce inequalities

Public-private governance with blended financing

Description

A model where the municipality shares delivery and operational responsibilities with private actors through structured agreements (e.g., PPP-type contracts), and where the project is financed through a mix of public and private sources rather than relying only on the city budget.

It typically works as a "package":

- Clear public objectives and access rules: the city defines what must be delivered and what cannot be compromised (e.g., public access, inclusivity, quality standards)
- Private delivery and/or operations: a private operator may build, run, and maintain assets/services, often in exchange for revenues (fees, advertising rights) or contract payments
- Blended finance: public funds (grants/budget) are combined with instruments like PPP revenues, municipal bonds, own-source revenues and land-based tools (fees, levies, developer contributions)

In the UN-Habitat framing, this logic can also evolve toward "4Ps" (Public–Private–People Partnerships), but the core PPP idea remains shared delivery and shared financial burden.

Governance approach

The municipality sets standards and contracts the private partner(s); private actors deliver and/or operate services/assets under performance rules; public funding covers the "public value" part while private funding and revenues (user fees, advertising, leases, developer contributions, bonds) cover scalable delivery, tracked through contract monitoring and accountability mechanisms.

Advantages

- Lower pressure on city budgets: costs are distributed and the city can avoid funding everything upfront
- Access to private expertise and efficiency: private operators can bring operational capability, innovation, and faster execution
- More funding options (scalability): municipal bonds, PPP revenues, own-source revenues, and land-based tools can expand what the city can implement
- Shared accountability (when well-designed): structured agreements with legal backing can improve oversight compared to informal arrangements

Challenges

- Public-interest risk: private involvement can push toward privatization or commercialization unless rules protect public access and inclusivity
- Complex contracts and administration: tools like tax-increment financing, levies, and developer fees can be administratively heavy and politically sensitive
- Revenue volatility: models depending on property markets, user demand, or advertising can underperform and create funding gaps
- City readiness constraints: weak regulatory and institutional environments and limited technical capacity make PPPs hard to structure well

Examples (mapping)

- Ahmedabad Smart City (India):

PPP delivery for services such as smart public toilets (private maintenance in exchange for advertising rights and user fees) and PPP-driven bike-sharing; plus, municipal bonds and diversified revenues alongside public grants

- Medellín (Colombia) – Integrated Urban Projects (PUIs):

public-space projects funded and managed via PPPs; example: Parque Biblioteca España funded with a mix of public funds and private donations

Regulatory/legal gaps

- Fragmented or weak PPP legal and regulatory frameworks: unclear rules and lack of standard tools for risk allocation undermine bankable partnerships
- Weak legal basis for ring-fenced revenues: earmarking revenues (e.g., fees) for public-space or street management often needs stronger statutory support
- Contract terms not aligned with public interest: leases and management contracts can create conflicts if access, pricing, and service levels are not protected
- Unclear ownership and handover in donor or philanthropy funding: if agreements do not formalize transfer to local government, long-term governance becomes messy

Security by design governance for public space (integrating safety requirement into rules and design)

Description

A model where safety is treated as a core requirement of public space and mobility planning, not as an afterthought.

Governance links three elements into one system:

1. Rules and responsibilities: safety goals are translated into clear responsibilities (who must assess risks, who approves designs, who manages operations, who controls and monitors)
2. Design and planning choices: physical design is used to prevent problems (visibility, permeability, layout, access control where needed), while avoiding “fortress” solutions that harm openness and inclusion
3. Ongoing management and learning: safety is monitored over time and governance adapts based on evidence and stakeholder feedback

Governance approach

Public authorities set safety objectives and approval procedures, planners and designers integrate risk assessment into projects from the start, operators manage day-to-day safety, and costs are covered through public budgets and project delivery budgets. Structured tools (e.g., risk and vulnerability assessments and shared guidelines) are used to align all actors across planning, design, implementation and management.

Advantages

- Safer spaces by default: risks are addressed early through planning and design, not only through policing or reactive fixes
- Clearer accountability: roles and procedures reduce "nobody owns the problem" situations
- Better balance between safety and openness: security measures can be designed to support inclusion and everyday use, not to block it
- Shared working language across stakeholders: common tools and frameworks help align planners, authorities and communities

Challenges

- Risk of over-securitisation: measures can reduce openness, increase control and exclude certain groups if not carefully governed
- Coordination burden: linking policy, design and operations requires strong cross-department collaboration and clear processes
- Hard to measure "success": safety perceptions and real incidents do not always move together; monitoring must be continuous
- Cost and capability constraints: risk assessments and long-term management require resources and skills

Examples (mapping)

- Gorizia – Nova Gorica (Italy/Slovenia border area): pilot site used to test the "security-by-design" governance approach and related tools (risk and vulnerability assessment and an "Atlas" to support planning)

Regulatory/legal gaps

- No formal requirement to integrate safety early: if law or procedure does not mandate risk assessment in planning and design, safety is addressed too late
- Unclear responsibilities across actors: without clear mandates, planning, policing and operations may work in silos
- Lack of governance safeguards against exclusion: rules may not explicitly protect openness and inclusivity when security measures are introduced

Market dynamics and competition assessment

1. Commercialisation and privatisation pressures (access rights become "market power")

Public space can turn into an economic asset through leases, concessions, and delegated management, which creates competition over who controls access and revenues. If safeguards are weak, private incentives can reshape space use and limit inclusivity.

- Concessions / leases:

operators may gain quasi-exclusive control over parts of public space

- Public value vs revenue logic:

risk that “publicness” is reduced when the public sector sheds responsibility

2. Real-estate/value-driven funding and volatility (who benefits, who carries the downside)

Many public-space interventions are linked to property value expectations and market-based funding tools. This can accelerate investment, but it also creates dependency on real-estate cycles and raises distributional questions.

- Market-linked tools:

tax-increment logic, bonds, land sales, value capture mechanisms

- Unequal benefit distribution:

owners/developers may capture most of the upside unless rules capture value for the public

- Downside risk:

if expected revenues do not materialise, cities still face maintenance obligations

3. Developer bargaining and capacity asymmetry (complex tools favour large players)

When cities use impact fees, incentive zoning, land readjustment, development approvals become part of a negotiated market. This can fund public space, but it often advantages actors with legal/financial capacity.

- Transaction complexity:

smaller actors may struggle to comply or negotiate effectively

- Negotiation power:

large developers can shape outcomes more strongly if public capacity is weak

4. PPP and concession markets (concentration risk + contract power)

Public–private delivery can shift the competitive landscape toward a smaller set of firms that can handle finance, long contracts, and operational risk. Without strong public capacity, this can lead to poor deals or public-interest dilution.

- Limited bidder pool:

capital-intensive, complex contracts reduce contestability

- Incentive misalignment:

private operators may optimise revenue (fees/advertising/leases) unless access and service obligations are explicit

- Governance readiness:

weak legal/institutional environments increase procurement and performance risks

5. Digital systems and data advantage (vendor dependency and uneven playing fields)

Urban management increasingly relies on digital tools (monitoring systems, platforms, reporting channels). This can improve coordination, but it also creates data asymmetry and lock-in if interoperability and governance rules are weak.

- Data advantage:
actors controlling key systems can influence priorities and decisions faster
- Procurement lock-in:
integrated solutions can reduce competition if cities cannot switch providers easily
- Inclusion risks:
digital divides can distort whose needs are visible in "data-driven" governance

6. Security "solution markets" and liability-driven bias (over-securitisation risk)

Security concerns can create demand for physical and technological security measures. Market offerings may push visible "hard" solutions, while governance must protect openness and avoid exclusionary outcomes.

- Bias toward hard measures:
barriers/surveillance can be chosen for visibility and liability avoidance
- Trade-off management:
security-by-design tools aim to keep measures proportionate and socially compatible

7. Competition between user groups for space and influence (capture vs "decommoning")

Public space is contested even without formal market transactions. Different groups compete for use, visibility, and control; outcomes can range from shared management to capture or sterilisation.

- Taking over (capture):
stronger groups may appropriate shared space for their own purposes
- "Decommoning" (sterilisation):
rules/design can unintentionally erase local meaning and exclude informal uses
- Capacity imbalance:
co-management works only if roles and fairness safeguards are clear

Political influence

1. Short-termism and "visible wins" bias (electoral cycle effect)

- Observation:
Urban rule changes compete with many priorities, and political leaders may prefer actions that show quick, visible results
- Cause:
Traditional governance models can be reactive and rigid, and policy choices may tilt toward short-term economic gains rather than long-term, people-centred mobility and space outcomes
- Implication:

Measures that require behaviour change and sustained enforcement risk being delayed, softened, or reversed when political leadership changes

2. **Departmental fragmentation means "no political owner"**

- Observation:

Public space and street rules are often split across departments and levels of government. However, there is always a public official who "signs" an official street occupancy management decision for road use.

- Cause:

Fragmented responsibilities and limited metropolitan coordination make it hard to identify a single accountable champion

- Implication:

Decisions get postponed, implementation becomes inconsistent, and accountability becomes blurry ("everyone involved, nobody responsible")

3. **Lobbying and capture by powerful interests (developers, concessionaires, organised groups)**

- Observation:

Where public space involves concessions, leases, or developer-linked tools, strong actors can gain influence over outcomes

- Cause:

Complex arrangements and financing tools increase dependency on actors with money, legal capacity, and negotiating power

- Implication:

Rules can drift toward commercial priorities, increasing the risk of reduced access, inequity, or "privatisation by contract"

4. **Public trust and legitimacy gaps (strained authority–resident relations)**

- Observation:

Formal consultation does not always resolve conflict, especially where relationships between residents and authorities are strained or missing

- Cause:

Governance debates (rights, equity, trust) are often overshadowed by technical design and management discussions

- Implication:

Rule changes can become politically fragile: low trust increases resistance, conflict, and the likelihood of policy backtracking

5. **Securitisation politics (fear-driven decisions and restrictions)**

- Observation:

Security threats can be politically instrumentalised, producing restrictive measures that limit public space use and civil liberties

- Cause:

Risk-averse politics can favour visible “hard security” solutions (barriers, surveillance) and permit-based access control

- Implication:

Urban space becomes less open and inclusive, and citizens may perceive a “climate of fear,” which can reduce participation and social cohesion

6. Corruption and discretionary enforcement (political interference in implementation)

- Observation:

Weak accountability and corruption can worsen inequities and distort service delivery

- Cause:

Top-down governance, underfunding, and vague or subjective restrictions create room for discretion and unequal treatment

- Implication:

Even well-designed rules can fail politically because enforcement looks arbitrary, undermining legitimacy and compliance

7. “Sterilisation” as a political compromise (pleases nobody, but avoids conflict)

- Observation:

When interests cannot be balanced, authorities may fall back on generic, formulaic rules that suppress plural uses (“decommoning/sterilisation”)

- Cause:

It is politically easier to standardise than to negotiate contested uses and power dynamics

- Implication:

Outcomes can be socially weaker and less legitimate: space becomes blander, less useful, and conflicts return in other forms

Funding schemes

General overview of available funding instruments

- Overview:

Funding for street and public-space measures typically comes from a mix of public budgets, land-based revenues, debt instruments, and partnership-based financing. The key point is that public space is not a “one-off” investment: it needs both CAPEX and long-term OPEX (maintenance and management).

- Core instruments:
  - Local government budgets (baseline funding): annual allocations from the city budget, sometimes supported by earmarking specific revenue streams
  - Earmarked local charges (ring-fencing): revenues such as parking fees, fines and congestion charges can be earmarked for public space (where legislation allows it)

- Land/property-based revenues (value capture family): property and land value tax, tax increment financing (TIF), betterment levies, development impact fees, incentive zoning, land readjustment
- Asset-based revenues: sale of public land; transfer taxes and stamp duties; recurring lease payments linked to access and management contracts
- Debt and bonds: local government borrowing and bond issuance to finance large projects (requires creditworthiness and strong financial management)
- Public–Private Partnerships (PPP) and concession models: private operators finance or operate services and assets, usually recovering costs through user fees or advertising rights (PPP examples shown in the case studies)
- Community-based and philanthropic funding: crowdsourcing and community contributions and donor or philanthropy grants (useful but fragile without stable governance and formal handover)
- Blended and green financing (where accessible): blended finance and risk-sharing tools, and green bonds as emerging options for climate-aligned investments (uptake constrained by local capacity and frameworks)

Relevance for urban space and urban rules

- Stable implementation capacity: budget-based funding gives control and predictability, but competes with other priorities
- Scalability beyond the municipal budget: land-based tools, bonds, and PPPs can expand what can be delivered, if the city has the legal and technical capacity to use them
- Fairness and distribution of costs and benefits: value-capture tools (impact fees, TIF, betterment levies) can shift part of the cost to beneficiaries of urban development, but can increase development costs and require careful planning
- OPEX and maintenance matter: community and donor funding can help, but long-term upkeep usually still needs a stable public financing backbone

Additional comments (recurring gaps and design lessons)

- Market dependency risk (especially TIF and transfer-related tools): these instruments can underperform where property markets and economic activity are weak
- Weak ring-fencing legislation: even when cities collect relevant revenues, laws may not allow stable earmarking for public space and street management
- Creditworthiness and financial management constraints: limited transparency and weak public financial management reduce access to debt, bonds, and climate-aligned finance
- PPP enabling environment gaps: fragmented legal frameworks and lack of standard risk-allocation tools reduce competition and increase the chance of poor contracts
- Privatisation and access safeguards: involving private funding (leases and concessions) requires governance clauses that protect public access and community priorities
- Donor and philanthropy handover risk: funding agreements often fail to formalize long-term ownership and management by local government, creating future governance problems

How to co-define the best governance scheme

Cities should not force a single governance model on all streets and public spaces. Different areas have different users, risks, and management needs, so the best approach is often a portfolio of governance arrangements that share the same legal baseline but vary in who manages, who pays, and how decisions are made.

1. Set “non-negotiables” in the legal baseline

- What to co-define: the minimum public conditions that must always hold.
- Rights and access rules: public space remains open, inclusive, and rights-based, with transparency and accountability protections
- Minimum quality standards: clear requirements for accessibility, safety, and maintenance (not “optional guidance”)
- Why it matters: these safeguards prevent governance choices (PPP, co-management, etc.) from drifting into exclusion or informal capture

2. Map the territory and classify space types (function + context)

- What to co-define: what type of space you are regulating and what it is for.
- Street and public space typology: main corridors vs local streets vs residual spaces vs high-footfall civic areas whilst considering alternative solutions for consolidated uses such as vehicle parking.
- Functional priorities: movement, social use, accessibility, local economy, environmental quality
- Evidence-based prioritisation: use spatial analysis and field assessment to identify where interventions create the highest public value
- Why it matters: the same rule can require very different governance intensity depending on spatial function and local conditions

3. Identify stakeholders by role, capacity, and incentives

- What to co-define: who has decision power, who operates, who maintains, who is accountable, who monitors.
- Public actors: municipality (planning, mobility, public works), metropolitan or regional bodies (where relevant)
- Community actors: neighbourhood groups, local organisations, users of the space
- Private actors: service providers, contractors, concessionaires, developers (where funding tools depend on development)
- Why it matters: a governance scheme should match real capacity; if the city cannot enforce, or the community cannot maintain, the model will fail

4. Define “who does what, when” through a simple delivery chain

- What to co-define: a clear sequence from planning to operations.
- Rule-setting and planning: who defines objectives, standards, and design requirements
- Implementation: who delivers works and behavioural measures, and how responsibilities are coordinated across departments
- Operations and maintenance: who keeps the space functioning day-to-day, and with which budget
- Enforcement and accountability: who monitors compliance, who can act, and what reporting is public
- Why it matters: this avoids the classic failure mode of fragmented mandates and blurred accountability

5. Choose the funding logic (CAPEX + OPEX), then fit governance to it

- What to co-define: the money flow and the long-term maintenance plan.

- Public budget backbone: ensure stable funding for core public responsibilities and ongoing maintenance
- Land and value-related tools (where appropriate): developer contributions, levies, and other land-based instruments, only if capacity is strong
- PPP and concessions (where needed): use private finance and operations for scalable delivery, but with strict public-interest clauses
- Community and philanthropic contributions (supporting role): useful for activation and stewardship, but fragile without formal support
- Why it matters: a governance model that cannot pay for operations and maintenance will degrade fast, even if implementation succeeds

6. Integrate safety as a design-and-governance requirement (not only a technical add-on)

- What to co-define: safety responsibilities, assessment tools, and proportionality safeguards.
- Early risk assessment: embed vulnerability and risk assessment in planning and design workflows
- Multi-actor coordination: align municipality, operators, and relevant safety actors on procedures
- Protect openness and inclusion: avoid "fortress" outcomes and exclusionary control practices
- Why it matters: safety choices can become politically and socially toxic if they reduce access and public life

7. Build feedback loops and revision points ("dynamic" governance)

- What to co-define: how learning changes the scheme over time.
- Monitoring and community reporting: track outcomes and user experience, not just technical compliance
- Periodic review: define when rules, design, and operations are reassessed and updated
- Adaptive adjustments: change measures when evidence shows unintended effects
- Why it matters: urban space rules often trigger behavioural shifts and conflicts; without feedback, the city either overreacts or freezes

Additional comments (recurring gaps to address upfront)

- Mandate fragmentation: without a clear competence map and coordination platform, decisions stall and accountability dissolves
- Participation without safeguards: co-management can reproduce inequality if anti-capture conditions and fair access rules are not explicit
- Privatisation by contract: PPPs and concessions can undermine inclusivity if contracts do not hard-code public access and service obligations
- Sterilisation risk ("decommoning"): over-standardised rules and design can erase local meaning and informal uses, creating new conflicts
- Maintenance gap: projects get funded for delivery but not for long-term management and upkeep

Governance models for Sharing Mobility

Regulatory frameworks

1. Overview: what "the regulatory framework" looks like in practice

Across countries and cities, shared mobility services often arrive before regulation, so governments build rules in layers over time. Interesting example is Brussels, which went from a 'micromobility Wild West' to a neatly regulated (and hence more profitable) micro mobility ecosystem. A useful cross-cutting framing is a spectrum of regulatory scopes: baseline (umbrella) requirements, local operational permits/contracts, non-binding codes/partnerships, and explicit bans.

2. Multi-level governance: who has which powers

A recurring issue is the mismatch between local impacts and national legal frameworks: cities face safety/parking/public-space problems locally, but their ability to regulate and enforce can be constrained when national rules are unclear or incomplete. This leads to "workarounds" (e.g., locally developed permit systems) and legal uncertainty.

Some contexts require national or regional enabling action to make local governance possible (e.g., creating/clarifying a legal category for these vehicles/services so cities can tender, contract, and regulate).

3. Core regulatory focus: public space management (not just "mobility")

The framework is strongly shaped by the fact that shared micromobility is a public-space-intensive service. Typical regulatory content focuses on:

- parking compliance (designated parking zones (with geofencing); reduction of clutter and sidewalk obstruction)
    - For Example, the city of Milan deployed a tow away service with a specific traffic order to remove all the two wheeled sharing vehicles that were not "parked" in proximity of the parking racks or the subway stations. The concessionaire was informed and had to pay roughly €70.00 per penalty and retrieve the vehicle. In the years 2024 and 2025 the number of vehicles removed amounted to around 5-6000/year. The last user of the vehicle was charged the fee by the concession holder of the service. The result is a radical reduction in clutter. In the initial years of the service the ATM mobility and parking company generated over €600.000,00.
- fleet control (caps, allocation rules)
- cost-shifting mechanisms (e.g., relocation fees when vehicles are mis-parked)

These elements are repeatedly highlighted as central because parking misuse and clutter are persistent and politically visible

4. Safety, accessibility, and "who gets protected"

Safety and pedestrian protection are dominant drivers of regulation, especially when accident rates and conflicts rise. Accessibility can become a formal pressure point as well (e.g., when disability organisations challenge deployments linked to obstructed public space). This pushes regulators to treat accessibility and pedestrian priority as core requirements, not "nice-to-have"

5. Data governance and integration with the wider mobility system

Modern frameworks increasingly include a data layer to support monitoring and integration:

- requirements for precise tracking technologies
- tools like geofencing and designated parking areas
- data-sharing agreements and, in some contexts, a unified micromobility data framework
- integration into MaaS platforms to support multimodal trips[1]

A key limitation is that oversight can depend heavily on operator-provided data, which constrains public control and auditing (this can be mitigated by listing data requirements explicitly in the tender).

6. Policy goals: regulation is "goal-driven," not neutral

The regulatory frameworks are typically justified by a small set of dominant public goals, such as:

- better use of public space and protection of pedestrians
- air quality / reduced pollution and providing more mobility options
- innovation (in some contexts), public control/power, equity, and road safety

This matters because the framework you design will look different depending on which goals are prioritised.

This is also why SUMPs are relevant in this context: they provide the strategic planning framework through which cities can position shared mobility within broader goals for multimodality, accessibility, public-space management, and sustainability, rather than regulating it through a purely reactive or sector-specific lens. This is becoming even more important for urban nodes on the TEN-T network, where the role of SUMPs is being further strengthened within the broader EU mobility framework.

7. Regulatory gaps and recurring weak points (across models)

- National framework gap: lack of clear national regulation limits local enforcement powers and long-term certainty
- Legal basis ambiguity: some local systems rely on indirect legal instruments (e.g., permits issued under a police ordinance rather than the municipality), which can constrain flexibility
- "Regulatory vacuum" risk: where no framework exists, governments may end up declaring services illegal and focusing on order/enforcement rather than structured integration (shown in the ride hailing case; mechanism is transferable as a warning)
- Data dependence: monitoring and "data-driven" governance can be limited by reliance on operator data

Governance models (overview)

Prohibition (Ban model)

Description

In this model, the public authority explicitly bans the deployment of a shared mobility service (e.g., shared e-scooters), meaning operators must remove fleets and cannot legally operate in the city/area. In the shared mobility taxonomy, this is labelled as a distinct regulatory scope: "Banned: Regulations that explicitly ban the deployment of these services".

[1] https://www.interregnorthsea.eu/sharedimobihub/news/new-publication-data-and-dashboards-dos-and-donts

In practice, bans often emerge after a period of increasing problems that authorities struggle to control through incremental rules - typically:

- rising accidents and safety concerns
- parking misuse and street clutter
- strong public opposition

The Paris case shows a trajectory from progressive tightening of rules to a citywide ban following a 2023 referendum, after years of accidents, parking misuse and public frustration

Governance approach

The authority governs primarily by denying market access and public-space use for that service. The core actions are:

- a formal decision to ban (political/administrative; in Paris, via a referendum outcome)
- enforcement to ensure fleet removal and prevent re-deployment

After a ban, governance does not disappear, it shifts to managing the remaining micromobility ecosystem, for example through:

- designated parking zones
- strengthened enforcement
- public space occupation agreement

Advantages

- Immediate visible impact:

removal of shared fleets leads to an immediate reduction in street clutter and fewer conflicts linked to footway obstruction

- Simpler compliance landscape:

fewer operator-related parking violations to monitor, which can ease enforcement pressures for the city

- Political clarity:

it provides a clear and strong response when safety/public space concerns dominate and incremental tools are seen as insufficient

Challenges

- Mode shift rather than problem elimination:

in Paris, travel behaviour adjusted rather than disappearing, with demand shifting towards other shared modes (especially shared bicycles)

- Does not solve ‘private device’ issues:

even after fleet removal, private e-scooter ownership remains high, so safety and public-space issues may persist beyond what operator regulation can address

- Loss of flexible mobility option:

banning a shared service can reduce short-trip options that otherwise complement public transport and multimodal travel (e.g. for night shift workers or people working in ill-connected industrial zones).

Examples (mapping)

Paris - shared e-scooters: citywide ban after a 2023 referendum; reported outcomes include immediate clutter reduction and demand shifting to other shared modes; post-ban focus on parking zones, enforcement, and public space occupation agreements

Scooters are banned in smaller cities like Leuven as well.

The taxonomy paper lists other 'banned' cases (e.g., Quito, Managua, Luxembourg), but it does not provide detailed implementation narratives for them

Regulatory/legal gaps

- Framework gap (multi-level governance):

cities often face unclear or incomplete national regulatory frameworks, limiting the ability to adapt rules and enforce standards quickly; this is presented as a cross-cutting issue in shared e-scooter governance and helps explain why some contexts end up at the 'restrictive' end of the spectrum.

- Scope gap (shared fleets vs. private devices):

banning a shared service does not automatically address the ongoing prevalence of privately owned devices, which reinforces the need for public-space management and enforcement tools beyond shared-operator regulation.

- 'Legal vacuum' pressure (in other shared mobility sectors):

where no framework exists, authorities may be pushed to declare services illegal to pursue order and law enforcement - showing how bans/illegality can be a default response to regulatory absence. (This example is discussed for ride hailing in Colombia/Bogotá, not micromobility)

Umbrella regulation (baseline requirements model)

Description

In this model, government sets baseline rules that define what a shared mobility service must comply with, mostly technical and safety-related requirements (e.g., insurance, safety rules, identifiable vehicle characteristics). If an operator complies with these requirements, it can operate without a city-by-city permit. This approach is typically adopted at national or state/region level

Governance approach

Public authorities set the baseline rules upfront and monitor/enforce them as needed, while private operators pay for and run the service end-to-end (fleet, operations, compliance), and the public side mainly pays for administration and enforcement when issues arise

Advantages

- Fast market clarity:

operators know the rules upfront and can enter if they comply

- Administrative simplicity:

authorities avoid running complex local permit programmes for every operator

- Consistency:

a wider-area framework can reduce fragmentation across cities within the same country/region

Challenges

- Limited ability to manage local impacts:

baseline rules may not be enough to address parking compliance, street clutter, and public space conflicts, which are highly local issues

- Weak levers on operator behaviour:

without permits, it is harder to require operator-specific obligations such as data sharing, equity objectives, or operational constraints

- Enforcement constraints:

when the overarching legal framework is unclear or incomplete, cities can struggle to enforce standards or respond quickly

Regulatory/legal gaps

- Local control gap:

baseline requirements can leave cities without strong tools to manage public space use, especially parking behaviour and clutter, which remain persistent challenges

- Power/competence gap:

if the higher-level framework does not clearly assign powers, cities may face legal and enforcement limitations when local ambitions go beyond national rules

- Coverage gap:

umbrella rules focus on minimum compliance, but may not address topics that become politically salient, such as accessibility concerns and conflicts with pedestrians

Operational permits / contractual concessions (licensing & tendering model)

Description

In this model, a city (or a transport authority) allows shared micromobility services to operate only if the operator gets a permit or wins a contract/concession. Unlike baseline rules that apply to everyone, permits and concessions set operator-specific conditions and can be used to actively manage impacts in public space. Typical conditions mentioned include:

- operational requirements (how/where vehicles can operate)
- data-sharing obligations
- equity objectives
- fleet controls (e.g., caps) and parking rules
- financial mechanisms that shift costs back to operators (e.g., relocation fees for mis-parked vehicles)

This model is mainly local, and it is often used when cities want stronger control after 'uncontrolled' market entry or rising public-space and safety issues

Governance approach

The public authority sets permit/contract conditions before operation and monitors compliance, while private operators pay for and run the service end-to-end (fleet + operations + compliance) and may also pay permit-related costs or penalties (e.g., relocation fees) when rules are broken

Advantages

- Control and predictability:

clear responsibilities for operators and clearer expectations for the city (more predictable operations)

- Ability to manage externalities:

permits can include parking rules, designated zones, and mechanisms to reduce clutter and protect pedestrians

- Policy targeting:

permits can be designed to pursue specific goals like equity, safety, and public-space management through enforceable requirements

Challenges

- High administrative burden:

designing, issuing, and monitoring permits requires capacity and continuous enforcement

- Persistent compliance problems:

even with parking zones and fee systems, parking violations can remain a recurring issue

- Legal and institutional constraints:

when higher-level rules are unclear, local powers and enforcement can be constrained, reducing flexibility over time

Examples (mapping)

- Stockholm (shared e-scooters):

a bi-annual permit system with a citywide fleet cap, defined parking rules, and a relocation-fee mechanism for incorrectly parked scooters

- Paris (shared micromobility operators):

after an initial 'boom' of private deployments, the city moved to a public tender leading to a direct contract with three scooter operators (2020); earlier shared systems (bike sharing and car sharing) were also set up via public tendering with a city–operator contract

- Los Angeles (dockless scooter sharing):

the city moved from allowing a pilot to creating a large-scale permitted scooter-sharing operation (permit programme referenced as the operational-permit case)

- Flanders (regional governance)

In Flanders, micromobility (as well as car sharing in some regions) is tendered per transport region. Flanders is divided in 15 Transport Regions, which tendered for shared mobility. Via this system, less densely populated parts of the country also have a shared mobility offer.

Regulatory/legal gaps

- Authority gap (multi-level governance):

when national rules are weak or unclear, cities may struggle to enforce standards or adapt permit conditions quickly, even if local needs are changing

- Legal basis gap:

permits may rely on indirect legal instruments (e.g., issued under a police ordinance rather than directly by the municipality), which can limit flexibility and create uncertainty.

- Data dependence gap:

permit systems that require data-sharing still depend on operator-provided data, which can be a limitation for monitoring and management

Soft Co-regulation (codes of conduct model)

Description

In this model, the city and operators agree on a code of conduct / code of practice (or a partnership) that sets expectations for how the service should operate. The rules are non-binding, so they are not legally enforceable, but they can guide behaviour quickly when a city wants to improve order and coordination without launching a full permit or tender process

Governance approach

The city convenes operators to define non-binding rules upfront and during rollout, operators fund and run the service end-to-end and voluntarily commit to the code, and the public side mainly pays for coordination and monitoring, not for fleet operations

Advantages

- Fast and flexible:

can be introduced quickly when a service appears suddenly, without waiting for new legislation

- Collaborative problem-solving:

creates a structured channel for dialogue to reduce conflicts (e.g., public space, pedestrian issues)

- Step before “hard” regulation:

can stabilise the situation and help the city prepare stronger instruments later if needed

Challenges

- Not enforceable:

because it is non-binding, there are no direct legal tools to sanction non-compliance

- Depends on operator cooperation:

outcomes rely heavily on voluntary compliance and ongoing engagement

- May be insufficient under pressure:

when safety incidents and public-space conflicts escalate, cities may still need binding tools (permits, contracts, or bans)

Examples (mapping)

- Paris:

moped, bicycle, and scooter sharing codes of conduct are explicitly identified as the non-binding agreement case; the city first adopted a code of good conduct with operators before later moving to a tender/contract approach

- Paris (process detail):

the city used public-private working groups with a mandate to define goals and non-binding regulatory agreements to guide deployment

- Berlin (cooperation element, not framed as a code):

governance measures include operator cooperation and data-sharing agreements, showing how collaboration can support oversight and integration

Regulatory/legal gaps

- Enforcement gap:

non-binding rules are not legally enforceable, so the city has limited ability to compel compliance beyond persuasion and coordination

- Authority/competence gap:

where national frameworks are unclear or incomplete, local governments can struggle to move from voluntary cooperation to strong, enforceable standards

- Accountability gap:

responsibilities can remain ambiguous (who must act, when, and how) unless the city later translates the code into binding permit/contract conditions

Market dynamics and competition assessment

1. **"Boom first, rules later" market entry**

Shared micromobility often starts with rapid operator entry and fast scaling. This can create:

- intense short-term competition (many fleets in the same areas)
- visible negative externalities (parking clutter, safety incidents)
- political pressure to "do something fast" (which later reshapes the market)

2. **Regulation as a market filter (from open entry to controlled entry)**

When cities move to permits or tenders, competition shifts:

- from "who enters first and scales fastest"
- to "who meets conditions and wins access" (compliance + governance fit becomes a competitive advantage).

This tends to reduce the number of operators and can create a more stable structure, but also a more selective one.

3. **Public space is a competitive asset (and a bottleneck)**

Competition is not only about price and app design. It is also about access to scarce public space, especially:

- parking locations / designated zones
- high-demand corridors and central areas

Because parking compliance is a recurring issue, cities use space rules to shape market outcomes (who can operate smoothly and where).

4. **Barriers to entry rise with "serious" governance**

Stronger governance typically increases barriers to entry through:

- permit/tender requirements
- operational constraints (fleet caps, parking rules, enforcement mechanisms)
- data-sharing expectations and monitoring needs

These elements can professionalise the sector, but they can also favour operators with stronger operational capacity and legal/compliance resources

5. Competition is shaped by policy goals (not just market efficiency)

Cities regulate shared mobility to pursue a small set of dominant goals, such as:

- public space protection and pedestrian safety
- providing mobility options and (in some contexts) air-quality goals
- public control/power, equity, and safety

This means market "success" is partly defined by goal alignment, not only by profitability or user growth

6. Data asymmetry and "governance through operator data"

Data is increasingly central to oversight (e.g., geofencing, monitoring, integration initiatives). But a structural issue remains:

- public authorities often depend on operator-provided data (depending on what is required by the tender or permit. Delivery data in a specific format can be part of the market access conditions)
- this can limit independent auditing and weaken enforcement credibility

Data therefore becomes both a governance tool and a competitive lever

7. Reputation spillovers: one market's behaviour can trigger a hard reset

When parking and safety issues remain visible, public acceptance can collapse. This can lead to:

- rapid tightening of rules
- or even removal of the service

From a competition perspective, this is a "system risk": the entire market can be reshaped by sustained negative impacts

8. Cities as market shapers (not only referees)

Municipalities influence competition directly through:

- fleet caps and allocation rules
- permit conditions, fees, and penalties (e.g., relocation fees)
- tendering and contracting (selecting a limited set of operators)
- enforcement intensity

So, the city is effectively a market designer, not just a regulator

Political influence

a) High political sensitivity to visible "street-level" impacts

Shared micromobility becomes politically charged when problems are highly visible and directly affect daily life, especially:

- crashes and perceived safety risks
- parking misuse and sidewalk obstruction
- public frustration about disorder in public space

These issues can quickly dominate the political narrative and push decision-makers toward restrictive action.

b) Political leadership shapes goals more than technical departments

Policy goals are often defined at the political level and then handed down to practitioners for implementation. This can create two recurring dynamics:

- political leaders set the "headline goals" (e.g., safety, control, innovation)
- public administrations then need internal alignment to translate them into operational rules

When alignment is weak, implementation becomes inconsistent or reactive.

c) "Innovation branding" can bias governance choices

In some contexts, political leaders treat shared mobility as part of a city's identity as "innovative." This can:

- encourage experimentation and early pilots
- reduce early caution about unknown impacts
- frame regulation as "not blocking innovation," even when risks are not fully understood

d) Lobbying and pressure from private actors

Because shared mobility affects winners and losers, political decision-makers can be exposed to external pressure such as:

- direct lobbying of elected officials
- attempts to bypass local government by pushing regulation at higher levels (state/national) to pre-empt city action

This can distort goal setting and timing of regulation.

e) Incumbent industries can be decisive political actors

Where new services threaten established, regulated markets, incumbents can shape political outcomes through:

- organised interest groups
- mobilisation capacity (e.g., strikes)
- election-related pressure

This can lead governments to avoid disruptive reforms, keep newcomers in legal uncertainty, or protect the status quo.

f) Participation and public legitimacy can redefine governance

Political influence is not only lobbying. In some cases, legitimacy is built through:

- structured public–private working groups
- citizen-facing processes that influence whether a service remains acceptable

This can shift governance from "expert-only" goal setting to broader shared decision-making.

g) Advocacy groups can trigger governance change (accessibility focus)

Disability organisations and similar groups can influence governance through legal and political channels, pushing issues like accessibility and pedestrian priority higher on the agenda—even if they were not central at first.

h) Fragmented authority makes politics more complex

Shared mobility governance is shaped by the fragmentation of competences across levels of government. When national rules are unclear or incomplete:

- cities carry the political cost of local impacts
- but may lack full legal tools to regulate or enforce
- conflicts across levels of government become political friction points

Funding schemes

General overview: who typically pays for what

Across the cases, shared micromobility services are usually operator-funded for fleets and day-to-day operations, while public authorities mainly pay for policy design, coordination, and enforcement capacity (and, in some cities, supporting infrastructure like parking zones and monitoring tools).

1. Operator self-financing (fleet + operations)

Most shared micromobility services are run as private business models, where operators finance:

- vehicles and fleet renewal
- charging/redistribution logistics
- customer service and app systems
- compliance costs (meeting local requirements, reporting, etc.)

2. City/region-funded governance costs (administration + enforcement)

Even when fleets are privately financed, cities/regions face recurring public costs linked to:

- enforcement and street management (especially around parking misuse and safety)
- staff time for coordination with operators and rule updates
- monitoring activities (often tied to data systems and reporting)
- communication campaigns to promote shared and sustainable mobility

3. Cost-recovery and "polluter pays" mechanisms (fees and charges)

To avoid the city paying for "negative externalities," some frameworks introduce mechanisms that shift costs back to operators, such as:

- relocation-fee mechanisms when vehicles are incorrectly parked (designed to fund/trigger removals and reinforce accountability)
- public space occupation agreements (used to manage remaining micromobility services and public-space use)
- discussions about introducing a charge/license fee for free-floating shared bicycles (indicating the idea of charging for public-space impacts)
- Charging directly and/or indirectly is certainly an influential lever to condition behaviour. For incorrect vehicle parking when subjected to penalties of some sort (fines, tow-aways, clamping) has proved successful and lucrative.

4. Procurement / concession-style delivery (contracts as a funding channel)

In some cities, shared mobility services are organised through public tendering and contracts with private operators. In these cases:

- the city selects operators via tender
- the operator runs the service under contract conditions (safety, fares, design, operations)

5. Public investment in enabling infrastructure and coordination systems

Some approaches rely on public-side investments that support orderly operation, for example:

- mandatory parking zones and coordinated rules across municipalities
- a unified data framework to manage services across a region
  These imply public spending on governance infrastructure, even if fleets remain privately funded. At the same time, a public administration might vary concession or licensing fees to compensate for costs generated by the incorrect or unmanaged use of shared mobility services, such as public-space occupation, enforcement activities, or operational externalities linked to provider activities

How to co-define the best governance scheme

Cities should not treat governance as a one-off choice between fixed models. In practice, governance is a sequenced design: start with a clear set of public goals, test tools that match local capacity, and escalate (or relax) measures based on observed impacts and public acceptance.

1. Start from a short list of "dominant goals" (avoid goal overload)

A recurring lesson is that, even if many objectives are mentioned, only 3–4 goals usually drive most governance actions. Co-definition works better when the city makes those priorities explicit early. Safety is the only goal consistently shared across contexts; other goals are highly context-specific (e.g., public space, equity, innovation/control).

Practical approach:

- Define 3–4 primary goals (e.g., safety, public space order, equity, multimodal integration)
- Translate each goal into "what success looks like" (simple indicators)
- Make trade-offs explicit (e.g., more vehicles vs. more clutter)

2. Map stakeholders by "who controls what" (and who gets blamed)

Co-definition should identify actors by their real levers, not by formal titles. These stakeholder types matter most:

- Political leadership (mayor/council): sets goals and provides political clarity; this drives alignment of lower-level implementation
- Transport authority / city administration translates goals into operational rules and monitors outcomes
- Operators: finance fleets and operations, control day-to-day compliance, and provide most operational data
- Enforcement bodies (incl. Police/inspectors and parking wardens[2]): determine whether rules are real or just "paper law."
- Accessibility and pedestrian stakeholders (e.g., disability organisations): can reshape the agenda through legal challenges and public legitimacy debates
- Regional/municipal network actors (in multi-jurisdiction areas): critical where coordination across municipalities is needed
- Public transport / MaaS platform actors: relevant when integration into multimodal journeys is a goal

3. Diagnose local constraints before choosing instruments

Co-definition should explicitly check "what the city can realistically do," because governance options depend on context:

- National legal clarity: lack of national frameworks can limit enforcement powers and long-term certainty
- Institutional channel for permits: some cities issue permits through indirect legal instruments (e.g., under a police ordinance), which can limit flexibility
- Spatial pressure: dense urban areas make parking and clutter more politically explosive
- Governance fragmentation: powers are split across levels of government, which can constrain what local actors can legally regulate

4. Use a governance "ladder": start lighter, then escalate if needed

[2] In this case parking wardens. would need and extension of power to do so, but they are public officials when operating [EPA]

A practical way to co-define the best scheme is to agree on an escalation path upfront:

a) Soft coordination (codes/working groups): fast stabilisation, shared expectations, early learning.
b) Operational permits / contracts: stronger controls when impacts persist (parking rules, fleet caps, equity objectives, data requirements).
c) Regional coordination + shared data standards (where needed): when multiple municipalities are involved, align rules and monitoring.
d) Moratorium / ban (backstop): if sustained public dissatisfaction and safety/space conflicts collapse legitimacy.

This ladder turns governance from a binary debate ("permit or ban?") into a staged agreement ("we start here, and we escalate if X happens").

5. Co-design operational rules together with "cost allocation"

A recurring pattern is that operators pay for fleets and operations, while cities pay for governance capacity unless they create cost-recovery tools. Co-definition should make this explicit:

Typical co-designed elements:

- Parking solutions: designated parking areas/zones; clear user rules
- Accountability tools: relocation-fee mechanisms for incorrectly parked devices (shifting part of the public-space burden back to operators)
- Data-sharing + monitoring: required tracking technologies, geofencing, and reporting; acknowledge limits of operator-provided data
- Integration objective: if multimodality is a goal, define how services appear in MaaS and how cooperation is structured

6. Build a feedback loop (data-informed, but not data-naïve)

The cases point to a simple truth: governance improves when cities use data and structured monitoring, but they must also recognise that:

- enforcement and user behaviour remain hard problems (parking compliance persists even with strong rules)
- regional "data-driven" models can still be limited by reliance on operator-provided data

So, co-definition should include:

- a small set of indicators tied to the dominant goals
- regular review moments (e.g., semi-annual permit cycles)
- a clear mechanism to adjust rules when outcomes diverge from goals

7. Treat legitimacy as a governance variable (not a PR problem)

Public acceptance is not optional: if safety incidents and public-space conflicts remain visible, legitimacy can collapse and drive extreme outcomes. Accessibility stakeholders can also materially reshape governance debates through legal challenges. Co-definition should therefore include:

- early inclusion of pedestrian and accessibility perspectives
- visible public-space protections (not just operator-facing rules)

- neighbourhood organisations

Governance models for Public Transport Infrastructures

Regulatory frameworks

Before analysing each regulatory framework in detail, it is useful to note that governance models for transport infrastructure can range from fully public and vertically integrated systems to separated models, concession or PPP arrangements.

1. **Multi-level allocation of responsibilities (avoid fragmentation)**

Overview:

Public transport lane and infrastructure decisions are often split across government tiers and across sectors (transport, urban planning, land use). Infrastructure includes road space used by PT lanes, stops and stations, hubs, depots, charging infrastructure and related digital or enforcement systems. If responsibilities are not clearly allocated, delivery becomes a fragmented "patchwork": overlaps, gaps, slow decisions, and unclear roles and accountability.

Relevance:

- Clear "who decides what" is essential for road-space reallocation and day-to-day management
- Dynamic allocation needs a clear chain of command (engagement/testing/development → decision → implementation → evaluation), otherwise it stays a pilot forever

Additional comments:

A workable framework needs formal coordination mechanisms (shared plans, joint decision routines, and explicit boundaries of authority across levels)

2. **Legal authority for road-space management (including enforcement)**

Overview:

A corridor is not just concrete and asphalt: it also rules for how space is used (priority, access, restrictions) and how those rules are applied across a road hierarchy (national/arterial/local).

Relevance:

- Dedicated lanes require clear authority to assign priority and to protect the lane from misuse
- Dynamic allocation adds the need to legally define when rules can change, who triggers the change, and how users are informed

3. **Public service obligations and contracting rules**

Overview:

Public transport services are often governed through contracts: the public authority defines service requirements and quality standards, and an operator delivers them under a direct award or competitive tender. Examples include the Netherlands, where provincial authorities tender many bus services while rail services combine national and regional arrangements, and Geneva, where the legal framework sets accessibility, reliability, service and reserved-corridor requirements and under the law, the network must be fully integrated, connecting urban, regional and cross-border areas.

Relevance:

Corridor measures only matter if the service improves; contracts can lock in targets like reliability, travel time, and service quality

- Contracts can also define who pays for operational changes needed to exploit new lanes (timetables, fleet deployment, supervision)

Additional comments:

This layer should connect service obligations with corridor management powers; otherwise, infrastructure changes and service incentives pull in different directions

4. Investment programming and funding rules (multi-year budgets shape what gets built)

Overview:

Corridor upgrades are often decided through multi-year investment programmes and funding cycles. These programmes influence priorities, timing, and what is “bankable” and deliverable.

Relevance:

- Dedicated lanes may require capital works (redesign, signage, separation, stops), which need a budget line in an approved programme
- Dynamic allocation can also require investment (systems, monitoring, control tools), which often does not happen without programme support

Additional comments:

Investment patterns can remain road-dominant and stable over time; shifting priorities typically needs sustained long-term policy and funding alignment

5. Fiscal constraints and financing instruments (who pays, and under what limits)

Overview:

Public infrastructure funding is constrained by fiscal rules and debt/deficit pressures. Financing can come from public budgets, transfers, borrowing, and sometimes PPP/PFI-style schemes or co-financing.

Relevance:

- If funding is fragmented (one level decides, another level pays), delivery slows and incentives get distorted
- Dynamic systems often create recurring costs (operations, maintenance, monitoring), which need stable funding, not only one-off capex

Additional comments:

A practical framework should separate clearly: capex funding (build/upgrade) vs opex funding (operate/maintain/enforce), with explicit cost ownership

6. Competition, market rules, and "public funding legitimacy" (state aid/PSO boundaries)

Overview:

Transport governance in Europe includes strong market-making pressures (liberalisation, competition, procurement discipline). Public support for services and infrastructure can be contested unless it fits recognised public service logic and rules.

Relevance:

- PT priority measures often imply public spending and advantages for certain services; authorities need a defensible public-interest basis and consistent procurement/contracting logic
- For corridors involving multiple operators, neutrality and fairness become more important (especially when infrastructure decisions affect competitive conditions)

Additional comments:

This is less about "one lane design" and more about protecting the policy from legal/political backlash by making the rationale, funding, and contracting structure robust.

7. Planning integration with urban policy (make corridor rules consistent with city goals)

Overview:

Transport corridor governance is tied to wider urban governance: spatial development, land use, accessibility goals and long-term city strategies. Plans and strategy tools shape priorities even when they are not directly enforceable. It should also align with wider climate and interoperability frameworks, including the Green Deal, TEN-T, AFIR where charging infrastructure is relevant, and technical standards for systems operating across regions and operators.

Relevance:

- These measures are politically easier to justify and sustain when linked to explicit goals (accessibility, reliability, equity, decarbonisation)
- Dynamic allocation especially needs a clear policy logic: what outcome is being optimised, for whom and where, for example bus speed, safety or access in inner-city, peri-urban or suburban contexts

Additional comments:

If plans are not connected to enforceable tools (budget, contracts, corridor operations powers), they remain intention rather than implementation.

Technical and interoperability standards ensuring that systems are functioning seamlessly across regions and operators such as signalling systems, safety standards etc.

Governance models (overview)

Integrated Corridor Authority / Empowered Urban Transport Authority

Description

In this model, a dedicated transport authority (a "Type 2" institution in the UTG framework) has a strong role in governing a transport system/corridor by coordinating or directly managing key functions across infrastructure and operations. The idea is to reduce fragmentation between who plans/builds infrastructure and who runs services.

For innovations like dedicated PT lanes or dynamic PT lane allocation, this model matters because it puts road-space decisions (infrastructure/management) closer to service goals (operations) and integration with land use. The model emphasises centralised decision-making, system-wide optimisation and a long-term vision.

Governance approach

A single transport authority sets corridor priorities, plans and budgets the measures, secures the money (own revenues + earmarked local/regional/national transfers/grants), procures/delivers the infrastructure, and then manages operations either directly or via contracted operators. So, the authority decides what/where/when, coordinates implementation, and pays using its consolidated funding streams.

Advantages

- Less fragmentation, clearer accountability: fewer "grey zones" between infrastructure and operations decisions; high network integration across fares, services and infrastructure; faster implementation of strategic projects
- More coherent corridor management: easier to align road-space use, service planning, and delivery responsibilities along a corridor
- Better integration with spatial planning (when the authority has an explicit integration role)

Challenges

- Power and mandate conflicts: even with a strong authority, multiple actors and levels may still overlap, especially when plans require cross-entity implementation; the model can also create over-centralisation risks, reduced flexibility, high institutional-capacity requirements and stronger political exposure
- Fiscal autonomy limits: strong responsibilities without matching funding control can weaken delivery capacity
- Complex stakeholder landscape: integration (transport–land use–urban planning) can still involve many stakeholders and consultation mechanisms

Examples (mapping)

- London (UTG pilot mapping):

The survey example lists Transport for London (TfL) as a high-influence public agency for planning/strategy/prioritisation and shows the Mayor of London + TfL as coordinating actors for transport–land use integration. The road/street infrastructure example shows a clear hierarchy (National Highways → TfL for major roads → London Boroughs for local roads) with coordination mechanisms across levels.

- Vienna / VOR authority is also relevant examples of integrated or coordinated governance arrangements

Regulatory/legal gaps

The analysis does not list "gaps" as a separate legal analysis, but it clearly points to governance weaknesses that typically show up as legal/mandate gaps:

- Unclear or misaligned responsibilities between infrastructure, services, and urban planning (a core fragmentation issue)
- Jurisdiction boundary ambiguity: the UTG jurisdiction may not match formal boundaries, which can create unclear authority over corridor decisions unless formally defined
- Formal mandate vs real influence mismatch: the framework notes that an actor's effective influence may not reflect the formal responsibilities framework

Multi-level & Cross-sector Coordinated Governance (anti-fragmentation)

Description

In this model, corridor and road-space decisions are shared across multiple government tiers (national / regional / municipal / district) and across multiple sectors (transport, land use, urban planning). Because responsibilities overlap, the system relies on coordination mechanisms to bring planning and investment decisions together and avoid conflicts.

This is relevant for dedicated PT lanes and dynamic PT lane allocation because these measures sit at the intersection of street infrastructure, operations priorities, enforcement, and city-planning goals—so "one actor alone" often cannot deliver them end-to-end.

Governance approach

National/regional bodies set high-level priorities and may co-fund; municipal/district road authorities design and implement corridor changes and operate/maintain streets; a coordinating actor (or a plan hierarchy) aligns decisions across tiers and sectors and manages overlaps; funding typically combines local revenues, transfers/grants from higher levels, and sometimes private co-financing/PPPs.

Advantages

- Works across boundaries: useful when the corridor crosses multiple jurisdictions or agencies
- Reduces "vertical" and "horizontal" failures by explicitly managing overlaps (who decides, who pays, who delivers)
- Supports integration with land use planning through joint plans and structured plan-making hierarchies

Challenges

- Slow decisions and blurred accountability when many actors must agree

- Power asymmetries: an actor can have high influence even when the formal responsibilities framework suggests otherwise, creating friction
- Funding complexity: mixed funding sources can delay delivery or create misaligned incentives (e.g., one tier pays while another tier decides)

Examples (mapping)

- London – road/street infrastructure governance:

clear division by road type (national highways vs municipal major roads vs district local roads) plus explicit coordination mechanisms across levels to avoid conflicts

- London / Buenos Aires – transport & land-use integration:

integration responsibility shared among multiple actors at different government levels, using mechanisms like a plan-making hierarchy and infrastructure-led spatial development logic

- Bogotá – transport & land-use integration:

integration mainly concentrated in one local planning organisation (single-actor concentration rather than multi-actor)

- The Swiss coordinated federal-canton system is also relevant examples of cross sector coordinated governance arrangements

Regulatory/legal gaps

- Mandate gaps: unclear or poorly aligned responsibilities between infrastructure, services, and planning create governance "holes"
- Boundary gaps: the functional transport governance area may not match formal administrative borders, making corridor authority unclear unless formally defined
- Coordination gaps: lack of formal mechanisms (or weak ones) to resolve overlapping decisions across tiers and sectors

Programme- and Funding-Cycle Driven Corridor Investment Governance

Description

In this model, transport corridors and infrastructure upgrades are shaped mainly by multi-year investment programmes and funding cycles. Projects are selected and delivered because they fit the programme priorities, budget windows, and eligibility rules, not because a single corridor operator can decide quickly. Investment choices tend to be stable over time and are often "immune" to short-term shocks, because large infrastructure programmes run over many years.

This matters for dedicated PT lanes and dynamic PT lane allocation because these measures often require capital spending (street redesign, signage, ITS, enforcement tools) that must be inserted into a funded programme; otherwise, they remain "nice ideas" with no budget line.

Governance approach

A lead public funder (often national and/or supranational) sets a multi-year programme and allocates grants/loans; implementing authorities and infrastructure managers package projects, procure and deliver them during the funding window; costs are covered by a mix of programme transfers plus local revenues, borrowing, and sometimes PPP/PFI-style co-financing. These arrangements are often coordinated across multiple actors but anchored in funding cycles rather than permanent institutions.

Advantages

- Predictability and scale: multi-year budgets can fund large corridor upgrades and bundled packages of works
- Long-term impact: investment decisions lock in corridor performance and emissions outcomes for many years
- Access to diversified finance: the model can combine grants, borrowing, and private contributions when needed; it can also facilitate cross-border and large-scale investments while encouraging standardisation and accountability

Challenges

- Slow change: programme cycles can delay action, even when operational needs are urgent; they can also create fragmented implementation between funding cycles
- Bias toward road spending: investment can remain road-heavy, which conflicts with decarbonisation objectives
- Fragmented delivery: even with funding, multiple implementers and jurisdictions can complicate corridor execution and maintenance

Examples (mapping)

- Poland completing a major EU funding cycle (2007–13 ERDF + Cohesion Fund), with a large share invested in roads and most funding concentrated in a national operational programme [2]
- Serbia increasing investment (2015–2021) linked to building Pan-European Corridors 10 and 11, supported by grants and loans which should be read in connection with the wider European corridor and TEN-T policy context
- Denmark shifting rail investment share via a long-term policy package and the “Hour Model” strategy
- London using rolling multi-year business/transport plans with mixed funding (fares/commercial revenue, borrowing, central grants, co-financing)

Regulatory/legal gaps

- Programme–operations gap: funding rules often focus on capital projects, while corridor outcomes also depend on operations, enforcement, and ongoing maintenance
- Incentive gap: when funding cycles reward “shovel-ready” projects, priorities can drift toward familiar road projects instead of low-carbon corridor reallocation
- Fiscal constraint gap: deficit/debt pressures can restrict public infrastructure spending or push financing toward PPP-style arrangements without guaranteeing better outcomes

Contract-Based Service Governance (PSO + direct award or competitive tendering)

Description

In this model, public transport on a corridor is governed mainly through public service contracts. A public authority defines what the service must deliver (routes, frequency, quality, safety, data, sometimes maintenance tasks), and then either:

- awards the contract directly, or
- runs a competitive tender and selects an operator

The operator provides the service under the contract, while the authority keeps control through performance requirements and monitoring.

This model is useful for corridor measures (like dedicated or dynamic PT lanes) because the authority can "translate" corridor priorities into clear operational obligations and incentives (e.g., reliability targets, service quality, compliance requirements)

Governance approach

A public authority sets corridor service requirements and contract terms, selects an operator via direct award or tender, and pays PSO compensation and/or keeps fare revenue (taking revenue risk), while the operator runs the service and delivers agreed functions (operations, maintenance, quality/safety tasks, data) under performance monitoring. PSO is also associated with air corridors, which are essential for many isolated communities in the EU.[3]

Advantages

- Clear levers to drive performance: contracts can include quality metrics, safety requirements, and incentive mechanisms; they can also allocate responsibilities and risks and enforce policy goals through tender and contract design
- Flexibility: direct award or tendering can be chosen depending on local context and capacity
- Cost transparency: subsidies can be framed as compensation for PSO delivery, reducing disputes on what public money is paying for

Challenges

- Procurement and governance are politically sensitive: pushes for tendering can trigger resistance and conflict with incumbent models; tendering and monitoring also create transaction costs
- Contract management burden: the authority needs strong capability to specify, monitor, and enforce quality and safety standards
- Risk allocation problems: deciding who carries revenue risk (authority vs operator) can affect incentives and financial stability

Examples (mapping)

- London / Buenos Aires / Bogotá:

examples of PT services procured via third-party contracts, including contract incentives for quality, continuing tendering programs (in some cases), contract lengths, and revenue risk largely held by the contracting agency in London and Buenos Aires.

- EU public transport PSO regime:

PSO Regulation 1370/2007 allows both direct award and competitive tendering (member-state discretion), influenced by the Altmark ruling on PSO compensation and state aid.

- Country policy pressure toward tendering (examples cited):

prescriptions encouraging Romania to continue competitive tendering for PSO contracts, and urging Italy to promote competition via public procurement rather than direct concessions.

- Swedish regional authorities: competitive tendering of regional public transport services

[3] https://transport.ec.europa.eu/transport-modes/air/internal-market/public-service-obligations-psos_en

Regulatory/legal gaps

- Discretion gap: rules allowing both direct awards and tenders can lead to inconsistent approaches and long-running disputes over the "right" model
- Competition vs public service tension: the boundary between PSO compensation and state aid, and the role of competition authorities, can create uncertainty and pressure for market-oriented reforms
- Interface gap with corridor infrastructure: service contracts can govern operations well, but if road-space powers sit elsewhere, corridor measures (like lane allocation rules) may fall outside the contract's direct control unless mandates are aligned

Unbundled Governance with Stronger Independent Regulation (infrastructure–operations separation)

Description

In this model, the system is governed by separating roles: one organisation manages the infrastructure (the corridor assets), while different operators run services on top of it. A stronger and more independent regulator (or similar oversight body) is used to ensure fair access, transparency, and compliance. The aim is to prevent conflicts of interest when the same actor would otherwise control both the infrastructure and the services.

For corridor innovations like dedicated or dynamic PT lanes, the logic is similar: one body controls the "physical/operational right-of-way" rules and assets, while service operators must comply with access and performance rules supervised by an independent authority.

Governance approach

A corridor infrastructure manager plans, maintains, and controls access/use rules for the corridor assets; multiple operators deliver services under access or service agreements; an independent regulator sets/monitors access conditions and compliance, while funding comes from public budgets and/or user charges for infrastructure plus separate funding streams for operations (fares and/or PSO compensation).

Advantages

- Reduced conflict of interest: the actor controlling infrastructure is not the same actor competing in service delivery
- Clearer transparency/accountability: separation makes costs, responsibilities, and performance easier to track
- Supports competition where desired: multiple operators can access the same infrastructure under regulated conditions

Challenges

- Coordination burden: splitting infrastructure and operations creates interfaces that must be managed (planning, timetables, incident response, maintenance windows)
- High transaction and regulatory complexity: strong oversight is needed, and reforms often face political resistance
- Not a guaranteed "better outcome": formal separation alone does not solve investment gaps or fragmented decision-making if governance capacity is weak

Examples (mapping)

- EU rail governance debates and reforms:

- repeated push for separation between infrastructure managers and railway undertakings, stronger regulatory oversight, and ongoing political conflict around vertical integration vs unbundling. Examples include infrastructure managers such as Infrabel in Belgium or ProRail in the Netherlands, alongside operators such as NMBS, NS or Arriva. Freight rail is already largely liberalised.
- EU telecom analogy used:

the "functional separation / Chinese walls" concept is cited as a model for dealing with vertical integration concerns.

Regulatory/legal gaps

- Interface gap: rules can define separation, but practical coordination duties (who decides what, when) can remain unclear unless explicitly specified
- Independence gap: if regulators are not truly independent or do not have strong enforcement capacity, separation does not prevent discriminatory behaviour
- Scope gap for "corridor space" rules: the analysis discusses separation mainly for services/infrastructure; translating this logic to street/corridor allocation requires clear legal authority over access and priority rules across actors

Public-Private partnership / concession-based infrastructure governance

Description

Infrastructure is delivered and/or operated through long-term contracts with private partners, who take on defined risks such as construction, financing and operations. Governance is contract-driven, with public authority focusing on regulation, performance monitoring and strategic oversights.

Advantages

Access to private finance and expertise, risk-sharing, potential for faster delivery of infrastructure & lifecycle cost optimisation

Challenges

Complex contract design and negotiation, long-term fiscal commitments, potentially misaligned incentives, high dependency on contract enforcement.

Examples

Copenhagen model, UK rail concessions such as Elisabeth Line in London

Market dynamics and competition assessment

1. **Public service markets are "designed", not naturally competitive**

Overview:

Public transport along corridors is often a managed market. Competition depends on how authorities choose to organise service delivery (public operator, direct award, or competitive tender) and how contracts are written.

Relevance for dedicated PT lanes & dynamic PT lane allocation:

- Corridor priority measures work only if operators deliver better reliability and speed; contracts and incentives can push this
- If service delivery is locked into long, rigid arrangements, corridor changes may have weak operational follow-through

Additional comments:

Competition here is mainly competition for contracts, not competition "on the street"

2. Liberalisation pressure vs public service logic creates recurring market conflict

Overview:

Transport markets in Europe have faced sustained pressure toward liberalisation and competition, but the sector remains politically sensitive. Reforms often create conflict between market goals and public service goals.

Relevance for dedicated PT lanes & dynamic PT lane allocation:

- Reallocating road space toward PT can be politically easier than changing market structure, but it still interacts with how services are organised
- If corridor measures are seen as "picking winners", conflicts intensify unless the public interest case is explicit

Additional comments:

Resistance can slow reforms and create stop-start policy cycles, which is bad for corridor investments that need continuity

3. Fragmentation creates uneven playing fields and higher entry costs

Overview:

When responsibilities and rules differ across jurisdictions, operators and implementers face different requirements and decision pathways. This increases transaction costs and makes scaling harder.

Relevance for dedicated PT lanes & dynamic PT lane allocation:

- A dynamic lane rule that works in one city/corridor can be hard to replicate if governance, enforcement, and funding rules change across boundaries
- Larger players typically cope better with complexity (legal, procurement, reporting), which can reduce the number of credible entrants

Additional comments:

Coordination mechanisms reduce “who decides what” conflicts and make competition more comparable across areas

4. **Investment choices shape “competition between modes” (and therefore corridor priorities)**

Overview:

Investment patterns strongly influence which modes improve and which stagnate. In many contexts, road spending remains dominant, while shifts toward rail or PT require long-term policy commitment.

Relevance for dedicated PT lanes & dynamic PT lane allocation:

- Dedicated PT lanes compete directly with general traffic capacity; if the system’s investment logic is road-first, PT priority can remain marginal or piecemeal
- Dynamic allocation often needs supporting investment (signage, systems, monitoring); without a budget pathway it stays conceptual

Additional comments:

This is not only a “transport” issue: it is a budget competition across sectors and tiers

5. **Risk allocation (fare revenue, subsidies, performance incentives) changes operator behaviour**

Overview:

Service contracts differ in who carries risk (authority vs operator) and how operators are rewarded (fixed payments vs performance incentives). These choices influence cost discipline, quality, and willingness to innovate.

Relevance for dedicated PT lanes & dynamic PT lane allocation:

- If operators are rewarded for reliability and speed, they have stronger incentives to exploit PT priority measures
- If incentives are weak or risk is misallocated, corridor changes may not translate into better service outcomes

Additional comments:

Risk design is a competition variable: it affects who bids, how many bidders show up, and how aggressive bids are

6. **Separation of infrastructure and operations can support competition, but raises coordination costs**

Overview:

Some governance approaches separate infrastructure management from service operations and rely on oversight to prevent conflicts of interest. This can enable multiple operators to access the same infrastructure under defined conditions.

Relevance for dedicated PT lanes & dynamic PT lane allocation:

- If one actor controls corridor rules (access/priority) and others operate services, clear access and priority conditions are needed to avoid disputes
- However, separation adds interfaces: planning, incident response, maintenance scheduling, and operational rule changes must be coordinated

Additional comments:

Separation can increase transparency, but it does not automatically improve delivery capacity

7. Labour relations and incumbency can strongly shape competitive outcomes

Overview:

Transport reforms often face resistance from incumbent operators and labour organisations. This can slow tendering, change contract forms, or block structural reforms.

Relevance for dedicated PT lanes & dynamic PT lane allocation:

- Even when corridor infrastructure changes are feasible, service-side reforms (contracts, operator restructuring) can be politically hard
- Instability reduces investment confidence and can delay corridor programmes

Additional comments:

Where conflict is high, authorities often prefer incremental steps rather than full market redesign

Political influence

Road-space decisions become "visible politics" (winners and losers)

- Observation:

Corridor measures affect many user groups at the same time (private cars, freight, road-based public transport, cyclists, pedestrians).

- Cause:

Road space is limited; giving priority to PT (dedicated lanes or dynamic allocation) directly changes travel time, access, and convenience for others.

- Implication:

Decisions are politically sensitive and need a clear public-interest justification, plus credible enforcement, otherwise opposition grows fast. Communication should explain the return for users and residents, for example lower pollution, lower noise, better reliability or safer streets

Power struggles across levels and sectors (who is in charge)

- Observation:

Responsibilities are often split vertically (national–regional–local) and horizontally (transport–urban planning–land use), with weak alignment.

- Cause:

Corridors cut across boundaries and institutions, and no single actor fully controls planning, delivery, operations, and enforcement.

- Implication:

Political disputes about competence can slow or block implementation, and rules can become inconsistent across parts of the same corridor.

Marketisation and procurement are recurring political battlegrounds

- Observation:

Public transport is both a service and a political symbol; reforms that push competition (tendering, concessions, restructuring) often trigger controversy.

- Cause:

The more a service is perceived as "public", the more contentious commodification becomes (because it touches jobs, tariffs, service coverage, and control).

- Implication:

Decisions can swing between "competition" and "public control" depending on political coalitions, creating uncertainty for corridor planning and long-term operations.

Organised labour and social movements can directly shape outcomes

- Observation:

Transport unions and allied groups have a documented ability to politicise reforms, including coordinated actions that target decision moments.

- Cause:

Reforms can be framed as threats to working conditions, service quality, or public accountability.

- Implication:

Policymakers may slow down, water down, or re-route reforms; corridor projects linked to controversial reforms can become hostage to wider conflicts.

Budget politics: investment priorities follow programmes, not daily needs

- Observation:

Large infrastructure decisions are typically locked into multi-year programmes and tend to be stable over time.

- Cause:

Funding cycles and big national/supranational programmes create path dependency; road spending often remains dominant unless long-term political commitment shifts priorities.

- Implication:

Corridor reallocation measures that require capex (redesign, systems, monitoring) move forward mainly when they fit an existing programme window.

Political champions matter (or projects drift)

- Observation:

Some cities concentrate political influence in a small set of actors (often mayors and strong transport agencies), while others have more fragmented influence.

- Cause:

Integration across transport and urban policy is hard without a clear sponsor who can cut through coordination problems.

- Implication:

With a strong champion, corridor measures scale faster; without one, they risk becoming "everyone's topic and nobody's job".

External political pressure can bypass domestic deadlocks

- Observation:

Supranational governance can push national reforms (e.g., competition, procurement, regulator independence) through recommendations and conditionality

- Cause:

This route can circumvent slower or more contested domestic transport-policy processes

- Implication:

It can accelerate change, but also trigger backlash or compliance that is more political than operational (formal reform without smooth implementation)

Funding schemes

Typical funding sources (who pays)

- National government grants/subsidies and multi-year programmes: used to fund major infrastructure packages and corridor upgrades, often through long-term cycles
- Local government taxes and local revenues: used for local corridor works and supporting measures; can include revenues linked to transport policy (e.g., parking-related income)
- Fare income and transport authority commercial revenue: can support broader transport plans and investment capacity (especially where a strong transport authority exists)
- Road user charges (e.g., tolls, emissions/congestion charges): can contribute to infrastructure and maintenance funding where politically and legally available
- Borrowing (markets, public investment funds): often used as a second major lever, especially for rail and large projects

- Private sector contributions and special financial instruments (bonds, PPP/PFI, blended finance): used to mobilise capital, sometimes explicitly to reduce public deficit pressure
- TOD / land value capture (where in place): used as an additional source tied to development gains around transport investments

CAPEX vs OPEX (what needs money)

CAPEX (upfront investment)

- Corridor redesign and civil works (lane separation, stops, signage, junction treatments)
- Systems and tools that enable corridor management (relevant for dynamic lane allocation)
- Large network upgrades tied to multi-year programmes

OPEX (ongoing costs)

- Operations and service delivery (especially if improvements require more service, supervision, or monitoring)
- Maintenance of corridor assets; some governance setups require specific funding sources for maintenance and routine strategies

Funding logic across the delivery chain (who does what, when)

- Programming / prioritisation: a lead authority sets multi-year priorities and allocates budgets (often with national or higher-level support)
- Project packaging and delivery: implementing bodies procure and build within the available funding window; decisions can be driven by "where the money is" rather than by administrative level
- Operations and performance: service improvements are financed through fares and/or public payments under service contracts (PSO-style), with possible incentives and defined revenue-risk allocation

Public procurement and "pay-for-performance" funding

When PT service improvements are needed to realise corridor benefits, funding is often channelled via contracts that can include:

- Fixed service payments (authority pays for delivering a defined service level)
- Bonuses/penalties and extensions linked to performance (quality, reliability, safety)
- Explicit revenue-risk allocation (authority holds revenue risk vs shared risk vs operator-held risk)

Fiscal constraints and why PPP/PFI appears

Public funding is shaped by deficit/debt constraints and "do more with less" pressures; this can push governments toward PPP/PFI-style approaches and private capital mobilisation, especially during austerity phases

How to co-define the best governance scheme

Cities should not force corridor and infrastructure governance into one single model. A corridor programme can mix schemes across corridor segments, road types, and maturity stages (quick reallocation vs. long-term investment). The key is to co-define a scheme that matches local objectives, stakeholder power, delivery capacity, and funding reality.

1. **Start from "public purpose", not from the lane tool**

Define what the corridor must achieve, in simple measurable terms:

- Improve PT travel time and reliability
- Improve accessibility (especially for key destinations and underserved areas)
- Support sustainability goals (emissions, space efficiency, liveability)
- Keep safety and network resilience acceptable (including freight access where needed)

2. **Choose the corridor context and the lane concept (dedicated vs dynamic)**

Different contexts require different governance intensity.

- Dedicated PT lane: simpler rules, clearer enforcement, easier communication
- Dynamic allocation: needs clear trigger rules (when it switches), operational control, and stronger coordination with enforcement and operations

Keep the first version narrow: one corridor, clear hours, clear signage, simple exceptions

3. **Map the road hierarchy and ownership first (otherwise you don't know who can act)**

Before designing anything, map:

- Which organisation leads each road type (highways/major roads/local roads)
- Who has powers for planning, design, permitting, construction, operations, maintenance

If the corridor crosses road types, define a coordination routine (who convenes, who signs off, who resolves conflicts)

4. **Map stakeholders and "who has leverage" (not just who shows up)**

For dedicated/dynamic PT lanes, the critical actors usually include:

- Road/street authorities (by road class)
- Transport authority / PT planning body
- PT operators (and sometimes concessionaires)
- Enforcement actors (traffic police, parking enforcement, etc.)
- Urban planning/land-use actors (if corridor changes interact with development)

Also note who can block (politically or operationally), and who is expected to deliver

5. **Make one clear sentence for governance approach: who decides, who delivers, who pays**

A practical co-defined scheme can be expressed as:

- Decision: who sets corridor rules and priorities (and on what timeline)
- Delivery: who designs and builds the changes (procurement and works)
- Operations: who manages day-to-day corridor rules (and service planning)
- Funding: who covers CAPEX and who covers OPEX (including maintenance and enforcement)

6. Use a staged process with "gates" (fast start, then tighten)

Avoid waiting for a perfect final design. Use a staged path:

- Stage 0: corridor selection + objectives + responsibility map
- Stage 1: first implementation (often a dedicated lane or limited dynamic rule)
- Stage 2: expansion to more hours/segments or higher complexity
- Stage 3: stable operations (rules, enforcement, maintenance, monitoring)

For each gate, agree upfront: what evidence is needed (service performance, safety, compliance), who validates it, and what the decision options are (expand, pause, redesign)

7. Align the service layer with the infrastructure layer (or benefits won't show)

If the corridor measure is meant to improve PT outcomes, make sure the service governance supports it:

- Service contracts and incentives should reward reliability and quality improvements
- Decide revenue risk and compensation logic clearly (authority vs operator)
- Ensure operators can adjust operations (timetables, fleet allocation) to capture the corridor benefit

8. Decide "who pays for what" using a simple CAPEX/OPEX split

Keep the money logic boring and explicit:

- CAPEX: corridor redesign, civil works, signage, (and any systems needed for corridor management)
- OPEX: operations management, maintenance, enforcement capacity, monitoring activities

If the scheme relies on multi-year programmes, align timing with programme windows; otherwise delivery will stall

9. Anticipate market and political conflict early (because it will arrive anyway)

Two predictable pressure points:

- Competition/procurement debates (direct award vs tendering; concessions vs contracts)
- Labour and incumbent resistance when reforms are perceived as commodification or loss of control

Co-definition should include a political "stability plan": how decisions are communicated, who owns the narrative, and what compromises are acceptable without killing the corridor outcomes

Governance models for Public Transport Services

Regulatory frameworks

The regulatory framework should clarify the legal mandate of transport authorities, planning and contracting powers, enforcement responsibilities, financial risk allocation, asset ownership and alignment with EU Regulation 1370/2007 on public passenger transport services. Recent reports from UITP with case studies and overview of conditions & pre-requisites help in this effort[4][5]

1. **Multi-level allocation of responsibilities (avoid a "patchwork")**

Overview:

Public transport governance is typically split across levels (national/regional/local) and across functions (land-use and street space vs service planning and operations). If roles are not clear, coordination becomes ad-hoc and inconsistent across territories

Relevance for Public Transport:

- Clear "who decides what", who bears financial risk and who owns what reduces conflict between land-use planning and service planning
- Shared responsibilities across levels support long-term development beyond political cycles

Additional comments:

A practical framework needs explicit coordination routines (early joint planning, structured negotiation, and clear boundaries of authority)

2. **Market organisation and contracting rules (tendering, negotiated contracts, public service contracts, concessions)**

Overview:

Public transport services, including flexible and on-demand services, can be organised through different institutional and market arrangements, such as direct public provision, public service contracts, concession models, or more open-market systems. In some contexts, services are delivered by government-owned operators under negotiated public service obligations, while in others authorities rely on concession-based (Netherlands, UK) or competitive market structures. These institutional setups strongly shape what the authority can determine in terms of service levels, performance requirements, operational control and risk allocation, as well as what it can steer and enforce across the system.

Relevance for Public Transport:

- Clear contracting models help translate policy goals into enforceable service requirements (service levels, integration duties, reporting)

[4] https://www.uitp.org/publications/authorities-strategic-conditions-prerequisites/
[5] https://www.uitp.org/publications/governing-for-quality-and-performance/

- Procurement rules matter for scaling innovations (DRT, integration requirements) without "reinventing the contract" every time

Additional comments:

The value of "readily usable" classifications and lean procedures is stressed for flexible services, so that local authorities can activate services with clear objectives and timing

3. Funding, subsidies, and fare policy (affordability vs quality)

Overview:

Affordability and quality are shaped by how regulation, public financing/subsidies, and state oversight work together. Price controls alone can push operators to cut quality if there is no financial and regulatory support.

Relevance for Public Transport:

- Subsidies can protect affordability while maintaining quality when paired with enforceable obligations
- Cost-sharing across levels (regional taxes, municipal funds, targeted local contributions) is a core governance issue in multi-level settings

Additional comments:

The analysis flags the need to define funding rates and cost-sharing rules for new services (especially flexible services), and to link financial support to objectives and targets.

4. Integration rules: PT as backbone + shared mobility and on-demand as complementary services

Overview:

A regulatory framework should define integration as a public objective: shared and on-demand services should complement PT (first/last mile, off-peak, underserved areas) and should not undermine PT as the backbone. For example, a recently publishes study from Bremen[6] shows that car sharing users travel less by car than average and make more use of PT, walking, cycling. This showcases that carsharing can only work when there is a good PT backbone.

Relevance for Public Transport:

- Clear integration rules avoid uncontrolled competition and protect coverage for vulnerable users
- Planning permissions and public contracting can be used when commercial models are not viable but the public need is high

Additional comments:

[6] https://mobilpunkt-bremen.de/app/uploads/2026/01/Bremen-Carsharing-Evaluation-2025.pdf

It is important the integration into mobility plans (regional/urban/metropolitan) and the need for a fair regulation framework across levels to stabilise the offer and coordination. It is also relevant a business model to support the demand responsive mobility in underserved areas, so that it remains a viable long-term solution.

5. **Data governance and digital integration (standards, access, MDMS/MaaS, monitoring dashboards)**

Overview:

Integration increasingly depends on data: shared information, booking, ticketing, and payment require trusted data-sharing policies and common standards. The framework must also define fair access to interfaces and conditions for resale

Relevance for Public Transport:[7]

- Digital integration reduces fragmentation and makes multimodal travel usable in practice
- Monitoring dashboards and common indicators help control service quality and economic sustainability, especially for flexible services

6. **Public space and infrastructure regulation (kerbside, hubs, priority lanes/parking, rolling stock readiness)**

Overview:

Physical integration needs rules for public space: kerbside allocation, parking/lanes, and mobility hubs are governance tools to implement policy priorities and enable multimodality.

Relevance for Public Transport:

- Kerbside management becomes a "control point" to operationalise public objectives (safety, access, system performance)
- Mobility hubs should be embedded in planning documents (SUMPs, urban development plans) and designed with a long-term, cross-border logic

Additional comments:

Infrastructure policy is treated as a core regulatory layer (space reallocation, stop/hub equipment, micromobility accommodation)

7. **Oversight, accountability, and enforcement capacity (make rules real)**

Overview:

Rules and funding only work if oversight is credible. Weak oversight allows low-quality and informal/loosely monitored operations to persist and can lock systems into poor outcomes.

[7] https://tomp-wg.org/

Relevance for Public Transport:

- Strong oversight supports safety standards, vehicle conditions, labour protections, and service reliability
- Meta-governance also highlights that coordination often relies on trust and shared understanding, but risks increase when there is no strong nodal public actor

Additional comments:

Performance-based indicators and transparency are repeatedly mentioned as a way to demand accountability from providers (especially in integrated mobility ecosystems)

8. Inclusion, accessibility, and safety duties (including the digital divide)

Overview:

A cross-cutting framework should explicitly protect inclusion: infrastructure and services must work for vulnerable users, and digital-first services must address exclusion risks (booking access, accessibility needs).

Relevance for Public Transport:

- Safety requirements extend to micromobility interactions and protected infrastructure for riders and pedestrians
- Participatory planning and co-design are recommended for flexible services to align with local needs and activate local resources

Governance models (overview)

Public Transport Authority (PTA) as "meta-governor" of a multi-actor network

Description

In this model, public transport is governed through multiple networks (some formal, some informal) where no single actor controls the whole system. A PTA acts as a meta-governor, meaning it guides and steers these networks to deliver public goals (mainly system efficiency/effectiveness, and sometimes innovation), while still recognising that many actors remain autonomous and interdependent

Governance approach

The PTA sets shared goals and rules, convenes and manages the key networks, and uses contracts/standards and coordination to align operators and public bodies, while funding typically comes from public authorities (e.g., municipalities/regions) and operations are delivered by operators, with the PTA continuously steering and adjusting through network participation/management plus framing/design tools.

Advantages

- System integration:

helps align many actors and services that otherwise move in different directions

- More governance “levers”:

combines formal tools (contracts, legal arrangements) and informal ones (trust, shared understanding)

- Supports innovation when needed:

PTAs can meta-govern innovation-focused networks (e.g., MaaS-type initiatives) rather than leaving them unmanaged

Challenges

- No single “control tower”:

networks can be fragmented; the PTA may not be able to govern the system as a whole in one place

- Limited statutory powers vs real-world needs:

the PTA may need to steer outcomes in areas where it has weak formal authority

- Balancing steering and autonomy:

too much control can reduce actor motivation; too little leads to coordination failure

Examples (mapping)

- Copenhagen Region case:

PTA (Movia) participating in and managing multiple governance networks; mix of formal and informal arrangements

- West Midlands case:

PTA (Transport for the West Midlands, TfWM) acting as meta-governor of a core bus governance network and also in an innovation-focused network

Regulatory/legal gaps

- Mandate gap:

unclear or insufficient legal authority for the PTA to steer across all topics the network addresses (especially where responsibilities are split)

- Enforcement gap:

voluntary agreements and “soft” arrangements can be hard to enforce consistently

- Accountability gap:

when governance is spread across multiple networks, it becomes harder to identify “who is responsible” for outcomes system-wide

Multi-level co-governance between Region/Metropolitan level and Municipalities

Description

In this model, public transport governance is split across levels of government. The municipality controls land-use planning and local infrastructure (streets, space, stops), while the regional level (often through a regional public transport authority/agency) controls public transport service design and delivery. The system works through continuous coordination, because both levels depend on each other to make a new area “work” for mobility

Governance approach

The municipality plans and builds the local urban layout and PT infrastructure (e.g., stop locations, road design) and funds local works, while the regional authority/PTA decides routes, service levels and operations and funds service provision (typically through regional taxes and municipal contributions); they coordinate early in planning and adjust decisions over time through joint meetings and negotiated trade-offs.

Advantages

- Better alignment of land use and public transport:
planning the district and the service together improves feasibility and long-term outcomes
- Shared problem-solving:
each level brings its competence (local context vs network/operations), which can reduce blind spots
- Earlier PT consideration:
when PT is discussed from the start of a development project, it increases options and reduces later "retrofit" costs

Challenges

- Different priorities and time horizons:
municipalities often plan 10–30 years ahead, while regional PT planning may be shorter-term and more cost-driven
- Money conflicts:
local actors may push for early/high service supply, while the regional level worries about profitability and budget constraints. This is happening in Flanders[8]: the government is reducing budgets for PT operations due to financial constraints
- Slow, negotiation-heavy processes:
collaboration can become time-consuming and outcomes can be uncertain

Examples (mapping)

- Vallastaden (new district development):
municipality leads land-use and local infrastructure decisions; regional public transport agency/PTA leads service decisions; coordination happens through early dialogue and recurring joint planning forums
- Lisbon Metropolitan Area
is a recent case of co-governance between Region/Metropolitan level and Municipalities

Regulatory/legal gaps

- Coordination structure gap:
there may be no formal structure that guarantees coordination between land-use planning and PT planning across levels
- Obligation timing gap:

[8] https://www.vrt.be/vrtnws/nl/2026/03/04/14-van-de-15-vervoerregio-s-tegen-besparingen-bij-de-lijn-maar/

regional actors may have no formal obligation to act until an area is built, even if early involvement is practically necessary

- Planning status gap:

local long-term plans can be non-binding, making it harder to lock in PT-supportive decisions early enough

Public-value governance for integrating Public Transport (PT) with Shared and On-Demand Mobility

Description

In this model, shared and on-demand services are treated as a planned extension of the PT system, not as separate "nice-to-have" add-ons. The public side defines what "good integration" means: shared services should support PT as the backbone, improve first/last mile access, and work across urban and peri-urban areas. Integration is both physical (mobility hubs, kerbside space, safe access to stops) and digital (shared information, booking, ticketing, and payment through integrated platforms).

Governance approach

Local/regional authorities (often via a Public Transport Authority) set public goals and rules (space access, data-sharing, integration requirements), fund/enable hubs and PT infrastructure, and contract or license providers, while shared/on-demand operators run their services and finance fleets/operations through fares (or through public procurement/subsidies where the market is not viable)

Advantages

- True multimodality:

easier transfers and smoother journeys via hubs + integrated information/ticketing/payment

- Better coverage:

hared/on-demand can fill gaps where fixed routes struggle (especially peri-urban/rural)

- Public control of outcomes:

authorities can steer private services toward equity, safety, and sustainability goals

Challenges

- Fast-moving providers vs slow policy cycles:

authorities can struggle to adapt rules quickly enough to keep services complementary to PT

- Data and platform tensions:

integration needs operational data, but providers may resist sharing (commercial sensitivity, timing, quality)

- Space conflicts:

hubs and kerbside allocation create winners/losers; without clear rules, it becomes political and messy

Examples (mapping)

- Mobility hub network integrated with PT services and partners; includes city involvement and funding.
- PT operator/authority-led mobility hub brand and app enabling booking and payment for shared modes

Regulatory/legal gaps

- Data-sharing and standards gap:

without clear, trusted policies and common standards, integrated booking/ticketing/payment is hard

- Public-space governance gap:

unclear or weak rules for kerbside access, parking/lanes, and hub use by private providers

- Fair access / non-discrimination gap (digital + commercial):

rules are needed so all eligible providers can participate under similar conditions, and public sales systems can define access and resale terms

- Safety and inclusion gap:

service and vehicle rules may not fully address micromobility safety, vulnerable users, and the digital divide

Governance of integrated Demand-Responsive Transport (DRT)

Description

In this model, DRT is designed as a functional part of the public transport (PT) network, not as a stand-alone pilot. It is used to improve coverage and efficiency in low-demand areas (often rural, peripheral, evenings/holidays), while staying complementary to fixed routes so it does not "cannibalise" the main network. Integration is typically both:

- Operational: DRT connects people to main PT lines and stations, with clear rules on when DRT is offered vs fixed-route service
- Digital: DRT appears in the PT journey planner/app and uses coordinated booking information, so users see one network

Governance approach

The competent public authority (often regional/municipal) defines the DRT service area, operating rules, and integration requirements and pays the operator via a public service contract/procurement, while the operator (often with a technology partner) runs dispatching and vehicles and collects fares (usually aligned with PT fares), with performance monitored through shared indicators/dashboard

Advantages

- Better accessibility at lower cost than fixed routes in weak-demand areas, by matching supply to real demand
- Network efficiency:

can replace or complement low-performing fixed services in specific time windows

- Higher user acceptance when integrated:

passengers gain easier access to the main PT network, especially when DRT is visible in the same PT tools

Challenges

- Business model fragility:

long-term financially sustainable models are often uncertain; many services struggle or end early

- Risk of poor coordination:

without clear rules, DRT can overlap with fixed routes or compete with other regulated services (e.g., taxis)

- Digital divide:

app-based booking improves efficiency but can exclude traditional users if not managed carefully. Call centres or non-digital booking channels can mitigate this risk

- Data and software barriers:

data quality/access, privacy, and software costs can block integration and scaling

Examples (mapping)

- Sprinti (Hannover Region) DRT designed to stay complementary to existing services, with strong digital integration into the regional PT ecosystem.
- TAD (Île-de-France) region-led platform integrating multiple service designs and territories, enabled by strong regional coordination, strengthening accessibility in suburban and rural areas
- fflecsi (Wales) region-level coordination across many operators and areas, under a single identity

Regulatory/legal gaps

- Category gap:

DRT may sit in an unclear space between "public service" and "market offer," which affects what rules apply and whether subsidies are possible

- Procurement/contract gap:

authorities often lack simple, standardised procedures and "ready-to-use" operating model classifications to procure DRT consistently

- Financing clarity gap:

cost-sharing rules (who pays what between local authorities and other stakeholders) are often not defined upfront

- Data governance gap:

integration needs rules for data access, quality, privacy protection, and fair conditions for participants

Market Dynamics and Competition Assessment

1. Blurred market boundaries ("public transport" as a wider mobility ecosystem)

Overview:

Public transport is no longer only buses/rail. "Public transportation" increasingly includes shared modes, ride-hailing/taxis, and on-demand services. This blurs old categories and creates new competitive overlaps between services that users perceive as substitutes (at least for some trips)

Relevance for Public Transport:

- Competition is not only "operator vs operator", but also mode vs mode (PT vs shared/on-demand) for the same users and trips
- Without clear integration goals, new services can drift into replacing PT rather than complementing it

Additional comments:

Authorities need an explicit "market design stance": what services are expected to be complementary, and which behaviours are not acceptable (e.g., undermining PT as the backbone)

2. Volatile markets and business-model fragility (especially for new/on-demand services)

Overview:

Shared and on-demand services can grow fast but are also volatile: providers enter and exit, and business cases may fail without stable conditions. For DRT, long-term viability depends on clear funding logic, tariffs, and continuous monitoring of economic sustainability

Relevance for Public Transport:

- Market volatility creates service instability for users and makes long-term network planning harder
- For low-demand areas, public contracting may be needed when the market cannot sustain service

Additional comments:

A practical assessment should check: “Is this service expected to survive commercially, or does it need a public-service logic (contract/subsidy)?”

3. Procurement and contract design as a key competition lever

Overview:

Competition in PT is often shaped less by “free market forces” and more by how authorities design procurement, tenders, contracts, and risk allocation. Contracting can also be combined with trust-based partnerships, depending on context

Relevance for Public Transport:

- Contract design determines who can enter (large vs small operators), what is rewarded (quality, integration), and who carries risk
- Smaller tenders can be used to keep markets contestable and allow local/smaller operators to compete (instead of locking-in one dominant provider)

Additional comments:

A useful competition assessment should look at the procurement strategy: “few big lots vs many small lots”, contract duration, and the practical barriers for smaller bidders

4. Market concentration and dominance risks (ownership and scale effects)

Overview:

The analysis treats ownership structures and market dominance as relevant governance issues. A system can drift toward dominance by a few large operators, especially where one incumbent holds most of the service and coordination relies on voluntary arrangements

Relevance for Public Transport:

- Dominance can reduce competitive pressure on service quality and innovation
- Where one operator is much larger than the rest, partnership forums may become de facto shaped by that operator's incentives

Additional comments:

Competition assessment should include simple questions: "How concentrated is operations?" and "Do governance networks counterbalance or reinforce incumbent power?"

5. Informal or loosely monitored operators as "unfair competition" and a quality trap

Overview:

Where regulation and oversight are weak, informal or loosely monitored services can dominate. This creates a two-tier market: low-quality services (often in poorer or peripheral areas) coexisting with higher-quality regulated services

Relevance for Public Transport:

- Informal dominance can lock the system into "bad equilibria" (high fares for poor service, or cheap fares with declining quality)
- Users pay the price through fragmented journeys and unequal access, even within the same metro area

Additional comments:

A competition assessment should treat "weak enforcement" as a market distortion: firms that ignore standards can undercut compliant operators

6. Data-sharing and digital integration as a competition dimension (MaaS / integrated ticketing)

Overview:

Digital integration (real-time info, ticketing/payment, journey planning) can improve multimodality, but it also creates competition around data access and interoperability. A key tension is that operational data is valuable and sensitive, yet needed to make systems complementary and accountable

Relevance for Public Transport:

- If one actor controls the interface or key data flows, it can become a gatekeeper for demand and coordination
- Without fair data rules, smaller providers can be disadvantaged and integration can become selective. Neutral standards such as the TOMP-API can reduce this risk by creating a more level playing field for communication with the end user[9]

[9] https://tomp-wg.org/

Additional comments:

Competition assessment should explicitly ask: “Who owns which data?”, “Who can access the platform/interface?”, and “On what terms?”

7. **Competition for public space (kerbside, hubs, priority lanes) as a “market variable”**

Overview:

Space is scarce. The analysis treats kerbside management, parking/lanes, and mobility hubs as tools to allocate space and enable integration. This creates competition not only for users, but also for privileged access to public infrastructure

Relevance for Public Transport:

- Space allocation can tilt competition toward services with higher utilisation and stronger public value
- If rules are unclear, space becomes a conflict zone (providers compete politically rather than on service performance)

Additional comments:

A practical assessment should link space access to performance and compliance (not to “first come, first served”)

8. **Multi-level financing disputes as a hidden driver of competition outcomes**

Overview:

Conflicts between local and regional levels over funding and planning are common. These disputes influence what services are offered, where, and with what quality—indirectly shaping “who can compete” and where investment goes

Relevance for Public Transport:

- Unclear cost-sharing can delay service upgrades and discourage new service models
- “Winners and losers” dynamics appear when PT investments are considered shaping territorial development

Additional comments:

Competition assessment should include the financing map: “who pays what” and “who benefits where”

Political influence

1. **Fares and subsidies are “electoral explosives”**

- Observation:

Pricing and service quality are politically sensitive because they hit people every day and are visible immediately

- Cause:

Keeping fares low without adequate funding can trigger a decline in service quality; raising fares is politically costly and often resisted

- Implication:

Political pressure can lock systems into bad equilibria (cheap-but-bad or expensive-and-bad), unless subsidy and oversight choices are openly negotiated and sustained over time

2. "Winners and losers" politics: PT investments shape territory and growth

- Observation:

PT projects are often seen as tools that shift development opportunities between municipalities and neighbourhoods

- Cause:

Funding and planning responsibilities are split across levels, and each level has different priorities (economic development, land-use, service costs).

- Implication:

Political disputes across levels can slow decisions, create uncertainty, and push toward compromises that are slow and sometimes unclear in outcomes.

3. Power struggles inside governance networks (who gets a seat at the table)

- Observation:

Network-based governance can be influenced by who designs the network, frames goals, and manages participation

- Cause:

Public actors (including politicians) can use network governance to serve short-term agendas, and they can include or exclude specific stakeholders

- Implication:

Political choices affect legitimacy: systems may become "effective" but contested, or "inclusive" but slow—so meta-governance must balance effectiveness with democratic credibility

4. Public space reallocation is political conflict, not a technical detail

- Observation:

Decisions on kerbside, lanes, parking, and hubs are inherently political because space is scarce and reallocations create clear winners/losers

- Cause:

Prioritising walking/cycling/PT/shared mobility requires reversing a long-standing "car-first" hierarchy, which is politically difficult outside city centres

- Implication:

Political leadership and clear rules are needed to avoid endless conflict; otherwise, space allocation becomes case-by-case bargaining instead of policy delivery

5. **Innovation agendas can distort priorities ("we need a pilot")**

- Observation:

Innovation-oriented networks (e.g., MaaS-related) can emerge partly as a response to political demands for modernisation

- Cause:

Pilots are politically attractive: they signal action while limiting commitment, but new services often stay "stand-alone" and the scalable strategy is underestimated

- Implication:

Without an explicit path from pilot → stable service (integration in mobility plans, funding logic, procurement standards), innovation risks becoming symbolic rather than structural

6. **Incumbent power, informality, and clientelist ties can block reform**

- Observation:

In weaker governance contexts, informal or loosely monitored operators can dominate and reforms lose credibility over time

- Cause:

Governments may be unable or unwilling to enforce oversight and can rely on informal/clientelist relationships with operators

- Implication:

Political influence can preserve fragmented, underperforming systems, even when better governance designs are known

7. **Public perceptions matter (trust, "this service is slow/unsafe" narratives)**

- Observation:

New service models (especially flexible/on-demand) face persistent public perceptions about slowness or inefficiency; street safety is also a primary concern in mode-priority debates

- Cause:

Users compare lived experience, not policy intentions; visible failures quickly become political arguments against change

- Implication:

Political support often depends on credible performance evidence and clear communication of complementarity with PT

Funding schemes

Core funding mix: taxes + fares + public compensation

Overview:

Public transport rarely covers its full costs through fares alone. A large share of financing comes from public budgets (often taxes), combined with fare revenue, and—where services are contracted—public compensation payments to operators for costs not covered by income

Relevance for Public Transport:

- Tax-based funding keeps services available even when farebox revenue is insufficient
- Contract-based compensation supports stable service delivery where market revenues do not cover costs (especially low-demand areas)

Multi-level cost-sharing (who pays what across levels)

Overview:

Financing is often split across national, regional, and municipal levels. There are frequent disagreements between regional and local governments on financing and ambition levels, and the importance of transfers and shared funding logic

Relevance for Public Transport:

- Clear cost-sharing reduces delays and political conflict about "who pays" for network upgrades and new services
- Stable multi-level funding supports long-term service planning (instead of short-term, demand-only decisions)

Public funding choices shape outcomes (affordability vs quality)

Overview:

Subsidies are not "nice to have"; they are a structural lever. Systems with strong regulation + subsidies + oversight can deliver affordability and quality, while low fares without sufficient financial support can push quality down ("cheap service trap")

Relevance for Public Transport:

- Subsidies can be universal or targeted to expand access to high-quality services
- If subsidies are absent or poorly designed, users may face either high fares for poor service, or low fares with declining quality

Funding new service models (DRT / flexible services): define rates, tariffs, and monitoring

Overview:

For DRT and flexible services making funding explicit through:

- Public funding rates linked to service objectives and target groups

- Cost-sharing methods between local authorities and other stakeholders
- Tariff differentiation based on service purpose (e.g., regular access vs tourist demand)
- Monitoring dashboards and common indicators to track economic sustainability

Relevance for Public Transport:

- Prevents “pilot collapse” by clarifying how operations will be sustained financially
- Makes flexible services governable: you can fund what you can measure and control

Infrastructure and integration investments (hubs, rolling stock adaptation, digital systems)

Overview:

Funding is not only about paying operators. Infrastructure and integration are major cost areas:

- Mobility hubs (large and small), including space allocation and supporting infrastructure
- Stop/station equipment (bike racks/lockers, shared mobility parking) and rolling stock adaptations (space for micromobility)
- Digital integration (data standards, single-interface information/sales, integrated ticketing/payment)
- Energy/grid capacity at hubs (charging demand)

Relevance for Public Transport:

- Without these investments, “integration” stays a slogan and the user experience remains fragmented
- These costs often require long-term planning and are not always financeable through fares

Funding logic across phases (experiment → consolidation → stable operation)

Overview:

It is important to support experimentation and then build a financial bridge to stable service. For flexible services, they recommend helping authorities and operators identify public funding opportunities and experimentation pathways, while designing contracts and tariffs that work long-term

Relevance for Public Transport:

- Early experimentation is easier than long-term operation; without a planned bridge, services remain temporary or unstable
- Consolidation requires standardised models and procurement pathways so scaling does not restart from zero each time

Performance-based funding (pay for outcomes, not only for supply)

Overview:

Use performance-based indicators and monitoring to demand accountability from providers, especially in shared mobility integration and flexible services

Relevance for Public Transport:

- Links money to what matters: reliability, access, utilisation, inclusion, and system complementarity
- Reduces the risk of paying for services that do not deliver public value

How to Co-Define the Best Governance Scheme

Public transport should not be forced into one single governance model. A PT programme can combine different schemes across areas (urban core vs peri-urban vs rural), service types (fixed routes vs demand-responsive), and integration maturity (stand-alone → integrated network).

1. **Start from "user outcomes", not from institutions**

Define what the PT system must deliver, in simple measurable terms:

- Affordability (who can pay, and for what) and quality (frequency, reliability, safety, accessibility)
- PT as a backbone, with other services only as complements where they add value

2. **Choose the service portfolio and where each service makes sense**

Different contexts require different governance intensity and funding logic:

- high-demand corridors → stronger service obligations and integration needs
- low-demand areas/off-peak → flexible services may be needed, with clear applicability rules and integration into plans

3. **Clarify multi-level roles early (who does what, when, and who pays)**

Make responsibilities explicit across levels:

- local level: street space, stops/hubs, planning permissions, local infrastructure choices
- regional/PT authority: network design, service levels, contracting/procurement, system integration, monitoring
- national level: enabling legal framework + financial resources and capacity support where relevant

4. **Map stakeholders by power, risk, and accountability**

Co-definition only works if you identify:

- who has operational control (operators and tech partners)
- who holds public legitimacy (municipal/regional authorities, user representation)
- who holds key assets (street space, hubs, data interfaces, ticketing channels)
- who takes the financial risk (public budgets vs fare revenue vs compensation)

5. **Design the governance "machinery": networks + contracts, not one or the other**

A workable scheme usually mixes:

- legally binding tools (contracts, tendering, formal partnerships)

- coordination tools (shared plans, working groups, trust-based arrangements)
- and needs a clear meta-governor role to keep the whole system aligned

6. Build a staged pathway for new services (from trial to stable service)

Avoid "forever pilots" by agreeing upfront:

- what is being tested (coverage, cost, user acceptance, integration)
- what evidence is needed to continue / redesign / stop
- how the service moves from experiment → contracted service → scaled network element

7. Put integration on paper: space + hubs + digital interfaces

If the goal is multimodality, define practical integration rules:

- mobility hubs embedded in strategic plans and project approvals (including new developments)
- kerbside/space allocation as a policy tool (priority lanes/parking where justified)
- trusted data-sharing + standards enabling integrated information/booking/ticketing/payment
- "fair access" rules for interfaces so integration does not become selective or exclusionary

8. Decide "who pays for what" with a simple and stable split

Make the financing logic transparent:

- public side typically pays for public service obligations, enabling infrastructure, and (where needed) compensation in contracts
- operators typically pay for vehicles/operations and recover costs via fares + contract payments
- for flexible services: define funding rates, cost-sharing among authorities, and tariff rules early

9. Monitor performance and adjust (otherwise governance is theatre)

Use simple indicators and dashboards to check:

- affordability and quality outcomes
- economic sustainability (especially for flexible services)
- safety and inclusion (including the digital divide)
- and tie corrective actions to contracts and partnership commitments

Governance models for Mobility Hubs

Mobility hubs represent an enabling element for integrated and multimodal transport systems, since they connect different mobility services, infrastructures and user flows within a shared operational and spatial framework[10][11][12]. Their governance therefore goes beyond the physical management of interchange spaces

[10] https://vb.nweurope.eu/projects/project-search/ehubs-smart-shared-green-mobility-hubs/
[11] https://www.interregnorthsea.eu/sharedimobihub
[12] https://www.smartmobilityhubs.eu/

and involves coordination between public authorities, transport operators, infrastructure managers, private mobility providers, and urban planning actors.

Regulatory frameworks

1. **Clear multi-level mandates and coordination (avoid fragmentation)**

Overview:

Mobility hubs involve many public actors (city, district, transport authority, sometimes regional/national bodies) and many private providers. Without a clear allocation of responsibilities, decisions become slow, duplicated, and inconsistent across locations.

Relevance for mobility hubs:

- Clear "who decides what" for: planning, public space, permits, enforcement, data, funding
- Easier replication from one hub to a network of hubs
- Fewer conflicts between transport, urban space, and digital initiatives

Additional comments:

A practical setup needs explicit coordination routines (shared standards, joint steering groups, agreed escalation rules)

2. **Public space and curbside regulation (space, parking, clutter, safety)**

Overview:

Hubs concentrate many modes in limited space. Rules must govern how public space is allocated and controlled (parking management, docking areas, pick-up/drop-off, signage, pedestrian safety, accessibility), including deliveries and logistics services such as parcel lockers, which can reduce vehicle trips but also require rules to avoid uncontrolled space occupation around hubs

Relevance for mobility hubs:

- Prevents "street clutter" and unsafe conflicts between modes
- Enables enforcement (not just "guidelines")
- Makes hubs usable for everyone (incl. people with reduced mobility)

Additional comments:

Parking management and rules for shared mobility (where vehicles can stop/park, how long, penalties) are core regulatory levers, not side details

Conflicts with the concept of door-to-door and on-demand mobility enabled by CCAM. In this case Hubs are efficient solutions for multimodal integration, e.g. Rail/Bus/Air stations complemented by last mile on-demand autonomous service.

The Flemish mobility hub strategy[13] offers a relevant example in this respect, as it provides a practical backbone for translating the mobility hub concept into operational requirements.

3. Provider access rules and minimum service standards (quality, equity, reliability)

Overview:

A hub is not just infrastructure; it is a regulated access point for multiple services. Authorities need clear conditions for who can operate at the hub and what minimum standards they must meet

Relevance for mobility hubs:

- Protects public interest goals (accessibility, inclusion, affordability, coverage)
- Supports service reliability and user trust
- Reduces disputes between providers and the hub manager/public authority

Additional comments:

Standards often cover: physical design requirements, accessibility, operating hours, maintenance responsibilities, customer support, and safety measures

4. Data governance and performance monitoring (evidence-based steering)

Overview:

Hubs require data to manage performance (usage, turnover, availability, service reliability, safety incidents, maintenance). But data sharing is often sensitive (privacy, commercial confidentiality) and needs clear rules

Relevance for mobility hubs:

- Enables KPI-based governance (what works, what fails, where to invest)
- Supports adaptation over time (especially in “trial-and-learn” approaches)
- Improves transparency and accountability across multiple partners

Additional comments:

If data duties are unclear, monitoring becomes voluntary and patchy. The framework should define what data, at what frequency, in what format, and who can access it

Hubs realise a multimodal integration and data sharing is essential to provide a seamless experience to the travellers.

5. Interoperability requirements (information, booking, payment, wayfinding)

[13] https://wegenenverkeer.be/sites/default/files/uploads/documenten/Ontwerpwijzer-Hoppinpunten_v1.1.pdf

Overview:

Users experience mobility hubs as "one system", but providers operate as separate systems. Regulation (or contractual standards) is needed to ensure interoperability across physical, digital, and informational layers Bundling information in one platform and using standards such as the TOMP-API can improve the user experience and reduce barriers for smaller providers.[14]

Relevance for mobility hubs:

- Easier multimodal journeys (consistent wayfinding + coherent digital interfaces)
- Lower barriers for occasional users and vulnerable groups
- Better scalability from a few hubs to a citywide network; this also requires recognising different hub sizes, from a micromobility point to a central railway station
- Using just one standard creates an equal level playing field, which is relevant for smaller/new providers at hubs.

Additional comments:

Interoperability is not only "app integration". It also includes consistent signage, unified branding/communication, and easy non-digital access (e.g., kiosks/help points) where needed

6. Contracting and funding rules (procurement, concessions, subsidies)

Overview:

Many hubs are not financially self-sustaining at the start, especially in low-demand or equity-focused locations. The regulatory framework must allow realistic funding mixes and procurement models (public delivery, PPP, concessions, partnerships)

Relevance for mobility hubs:

- Makes long-term operation and maintenance financially viable
- Clarifies who pays for: core infrastructure, digital tools, staffing, upkeep, upgrades
- Reduces "plan-to-implementation" failure (good plans, weak delivery)

Additional comments:

Procurement rules should support integration across services and avoid "silo contracts" that block coordination (e.g., separate contracts for shelters, parking, digital tools, etc.). Flemish procurement desks for Hoppin materials were indicated as an example to help local municipalities implement consistent hub components.[15]

7. Experimental permissions and a clear path from pilots to stable operation

[14] https://github.com/TOMP-WG/TOMP-API
[15] https://aankoopcentralehoppin.be/

Overview:

Cities often start with pilots to learn what works. But pilots can get stuck if there is no defined path to move from temporary setups to stable, long-term rules and responsibilities

Relevance for mobility hubs:

- Supports safe experimentation without permanent lock-in
- Creates a stepwise route: test → improve → scale to a network
- Reduces uncertainty for providers and investors

Additional comments:

The framework should define review points and decision criteria (performance, inclusion outcomes, safety, public space impacts) and who has authority to scale, modify, or stop

Governance models (overview)

Public-led network governance (SUMP-based, multi-level coordination, PT integrated)

Description

In this model, the city (or regional transport authority) treats mobility hubs as public-interest infrastructure and develops them as a coherent network, not as isolated projects. Hubs are planned within the SUMP and designed to support policy goals like multimodality, accessibility and inclusion, using consistent standards for elements such as wayfinding/branding, service quality, and integration with digital tools.

Governance approach

The city/transport authority sets the SUMP vision, selects locations and standards, coordinates approvals, and funds core public-space works; mobility providers (typically via tenders/permits) deliver services and share operational data; the public lead monitors KPIs and iterates the network design and rules over time.

Advantages

- Strong alignment with public goals (accessibility, inclusion, reduced car dependency) through SUMP integration. For accessibility, specific subsidies can be put in place to make hubs more accessible for impaired users
- Consistency at scale (branding, wayfinding, user experience) across hubs, improving usability.
- Better coordination of many actors (public transport, shared mobility, sometimes freight/logistics functions)
- Ability to subsidise “non-profitable but necessary” hubs (e.g., low-demand or equity-relevant locations)
- Structured monitoring and learning via staged planning and monitoring in the SUMP cycle

Challenges

- Coordination burden:

multiple authorities and overlapping governance levels must align (local–regional–national–EU)

- From plan to implementation gap:

governance capacity, procurement skills, digital tools and workforce/data literacy are needed, not only infrastructure

- Complex stakeholder management:

pre-existing contracts (street furniture, shelters, energy, etc.) and different provider incentives slow integration

- Inclusivity and digital divide:

app-based integration helps uptake, but analogue access and support may still be needed

Examples (mapping)

- Vienna: "WienMobil Station": citywide network planned by Wiener Linien, approved by the city; funded by the City of Vienna; hubs mostly in public space; coordination with multiple authorities and partners; linked to a multimodal app; embedded in local SUMP [5]
- Hamburg: "hvv switch" stations: public transport operator leads planning/implementation/operations under city mandate, with contractual partnerships and unified branding, plus an app for booking/payment [5]
- Brussels Smart Mobility Hub: public agency lead with public consultations and joint planning with stakeholders (operators, private providers, local communities) [1]
- Rome – San Paolo hub (SUMP aligned with logistics strategy; parcel lockers, cargo bikes, bike boxes; replication planned) [4]

Regulatory/legal gaps

- Public space rules:

clear permissions/conditions are needed for parking, docking, and avoiding clutter/conflicts between modes

- Data governance:

need workable rules for sharing usage data for monitoring/learning while managing privacy and security risks

- Interoperability requirements:

standards for system integration (information/booking/payment) are often unclear or fragmented

- Multi-level alignment:

responsibilities and decision rights can be blurred across governance layers, making delivery slow

Operator - PPP concession - led governance (private hub operator under public standards, access rules and KPIs)

Description

In this model, a mobility hub (or a group of hubs) is delivered and run by a private hub operator under a public mandate. The public side defines what the hub must achieve (e.g., multimodal access, quality standards, accessibility, integration with public transport), while the operator organises day-to-day operations and integrates multiple mobility providers (shared bikes/scooters/carsharing, sometimes services and retail). The logic is to treat the hub as a managed "place + service bundle", with clear performance obligations and a single accountable operator.

Governance approach

The public authority awards a concession/PPP contract and sets rules, standards and KPIs; the private hub operator designs/implements and runs the hub (operations, maintenance, integration of providers) and finances it fully or partly, recovering costs through a mix of commercial revenues and/or public payments, while the authority monitors performance and can adjust conditions at renewal or review points.

Advantages

- Single point of accountability for operations, maintenance and user experience
- Faster delivery and professional management compared with fully public delivery in complex settings
- Risk sharing: operational and delivery risks can be shifted partly to the operator if KPIs are clear
- Room for innovation (digital services, integrated customer interfaces, service bundling) within public guardrails

Challenges

- Contract lock-in:

long concessions can reduce flexibility when mobility services and needs change

- Commercial vs public goals:

the operator may optimise revenue, not equity, unless standards are strict

- Provider coordination is hard:

many services, different incentives, and legacy agreements can block integration

- Data and interoperability tensions:

operators need data to manage performance, but providers may resist sharing

- Public capacity is still required:

weak contract design or weak monitoring leads to weak outcomes

Examples (mapping)

- Gothenburg – “Mobility Hotel” (partnership-based hub concept) [4]

Regulatory/legal gaps

- Clear rules for access and non-discrimination:

who can use the hub, under what conditions, and at what price

- Public-space permissions and enforcement:

managing clutter, parking/docking, safety, and conflicts between modes

- Data-sharing obligations:

what must be shared for monitoring/KPIs, and how privacy/security are protected

- Interoperability requirements:

minimum standards for information/booking/payment integration across providers

- Procurement/contracting constraints:

ensuring contracts allow learning and adaptation without breaking public rules

Experimental co-governance (multi-actor partnership, participatory design, iterative/learning-based steering)

Description

In this model, mobility hubs are developed through an adaptive, trial-and-learn process rather than a fixed "build once" plan. The hub is treated as a living project where the public sector, mobility providers, and local stakeholders co-design the concept, test solutions in real settings, and update services and rules based on evidence and user feedback. The focus is on managing uncertainty (demand, technology, behaviour change) and improving integration step by step (physical, digital and social inclusion).

Governance approach

The public authority convenes the partnership, enables pilots in public space, and funds core public objectives; operators and partners co-invest and run pilots, share data and lessons, and together decide go/no-go and scaling after each iteration, with roles and budgets adjusted at defined review cycles.

Advantages

- High flexibility:
services and layouts can be changed quickly when needs or market conditions shift.
- Better fit to local context through co-design with communities and targeted user groups
- Faster learning:
pilots generate real evidence for what works before scaling
- Supports inclusion by explicitly addressing barriers (digital divide, accessibility, safety perceptions)
- Reduces implementation risk by starting small and scaling only after proven performance

Challenges

- Fragmentation risk:
many actors and weak leadership can lead to unclear ownership and slow decisions
- Hard to institutionalise:
pilots can remain "temporary" without a clear pathway to stable funding and long-term responsibility
- Data-sharing and trust issues:
partners may disagree on what data to share and how it is used
- Political and cultural resistance:
car-oriented norms and legacy priorities can block deeper change
- Operational complexity:
iterative governance needs skills, time, and staff capacity for coordination and monitoring

Examples (mapping)

- Munich and Vienna hub governance trajectories analysed as multi-actor, evolving arrangements (showing stability vs change dynamics) [2]
- Brussels Smart Mobility Hub approach involving consultations and stakeholder engagement in planning [1][16]

[16] https://data-mobility.irisnet.be/graph/media/filer_public/cb/a4/cba4bbcb-0a54-4db5-9603-28f44bb2e608/mobility_hubs_visiedocument.pdf

- SmartHubs "integration ladder" approach (physical, digital, democratic integration) built around staged maturity and iterative improvement. [3][17]

Regulatory/legal gaps

- Pilot-to-scale rules:

unclear pathways to move from trial permits to long-term authorisations

- Temporary use of public space:

rules often do not fit iterative layouts and frequent reconfiguration

- Accountability during experiments:

who is responsible when multiple partners operate different parts of the hub

- Data governance for learning:

balancing monitoring needs with privacy, security and commercial sensitivity

- Unclear decision rights across levels:

multi-level governance can blur who can approve, fund, or stop changes

Market dynamics and competition assessment

1. **Multi-actor market with overlapping roles (public, private, community)**

Overview:

Mobility hubs sit at the intersection of public transport, shared mobility providers, city space management, and sometimes commercial/real-estate actors. The "market" is not one industry. It is an ecosystem of services and infrastructure that must work together

Why it matters:

- Competition is not only "provider vs provider", but also "ecosystem vs ecosystem" (who shapes the hub experience)
- Coordination failures can block integration even if services exist

2. **Public space as the key scarce resource (competition for access)**

Overview:

The main bottleneck is often not vehicles or apps, but space: curb, parking, docking areas, pedestrian flows, and safety buffers. Providers compete for the best locations and visibility

Why it matters:

- Space rules determine winners and losers (who gets prime spots, who gets pushed out)
- Parking and curb management become direct tools that shape market outcomes

[17] https://vb.nweurope.eu/media/19725/dt151-updated-implementation-report-leuven.pdf

3. Market entry is shaped by permits and hub access conditions

Overview:

Entry is largely defined by local decisions: who is allowed to operate at the hub, under which conditions, and with which service standards (quality, accessibility, operating rules). In practice, only part of the shared-mobility offer is physically clustered at hubs; for example, in Flanders, hub operators generally reflect the PT and shared mobility providers are selected through regional tenders.

Why it matters:

- Strict requirements in tenders and permits can protect public goals but reduce the number of entrants
- Loose requirements can increase entry but create clutter and conflicts
- If conditions differ across hubs or districts, smaller players face higher compliance costs

4. Integration can create "gatekeepers" (digital and physical)

Overview:

When hubs move toward integrated user journeys (information, booking, payment, unified wayfinding), control can concentrate around the actor that manages the interface or the hub operations

Why it matters:

- The "hub operator" or the main platform can become the gatekeeper of demand
- Without interoperability and fair access, integration can reduce competition even if many providers exist

5. Data access and reporting are a competition variable

Overview:

Performance-based governance needs data (usage, availability, turnover, incidents, service reliability). But data is unevenly held: some actors see the full picture, others see only their slice

Why it matters:

- Data asymmetry can lock smaller providers out of planning and optimisation decisions
- If data sharing is voluntary, market monitoring becomes patchy and biased
- Common reporting formats reduce disputes and make performance comparable

6. Economics: viability is uneven, so markets tend to "cherry-pick"

Overview:

Many hubs are not financially attractive from day one, especially outside prime areas or where equity goals matter. This pushes private actors to focus on high-demand sites unless public funding or obligations rebalance incentives

Why it matters:

- Risk of over-service in profitable zones and under-service elsewhere. This risk can be mitigated through service-distribution obligations in permits or concession agreements. For example, authorities may require operators to balance deployment by linking access to profitable areas with minimum service provision in less profitable zones, as appears to be the case in Brussels for shared cars. This helps prevent mobility hubs and shared services from concentrating only where demand is strongest.
- Public subsidies or contracts may be needed for network coverage and inclusion
- Long-term operations and maintenance funding becomes a core market determinant

7. Competition and collaboration coexist (and can conflict)

Overview:

Hubs require collaboration (shared space, shared rules, shared user information), but providers still compete for users. This creates "coopetition": collaboration is needed to run the system, but incentives may push toward fragmentation

Why it matters:

- Partnerships can accelerate delivery, but unclear roles can slow decisions
- Living-lab or pilot approaches help learning, but they need a path to stable arrangements

8. Scaling dynamics: from isolated hubs to networks

Overview:

Hubs create more value when they form a network with consistent standards (physical design, wayfinding/branding, digital integration). Scaling changes competition: it rewards actors that can replicate, integrate, and comply across sites

Why it matters:

- Standardisation lowers user confusion and increases adoption
- Scaling also raises the stakes of who sets the "rules of the network"

Political influence

1. Car-space reallocation as the "make-or-break" political issue (parking and curb space)

- Observation:

Mobility hubs often require taking space away from private cars (parking spaces, kerbside areas) and reallocating it to shared/public modes and safer walking/cycling access

- Cause:

Space is scarce and highly visible; changes affect daily routines and can trigger resistance rooted in car-oriented norms

- Implication:

Political support often depends on whether authorities can justify and enforce space reallocation (e.g., via parking management and local parking rules) and manage backlash

2. "Smart city" visibility vs real mobility transition goals

- Observation:

Mobility hubs are frequently framed as a flagship "smart" solution (branding, visibility, digital integration)

- Cause:

Cities and operators gain reputational benefits from being seen as innovative; hubs are a tangible, communicable project

- Implication:

Political attention may tilt toward launching a branded concept (or a showcase hub) rather than solving harder issues (network coverage, inclusion, long-term operations, maintenance)

3. Stakeholder engagement as legitimacy building (and a political risk)

- Observation:

Participation and co-design are used to build acceptance and legitimacy for hub decisions

- Cause:

Hubs affect residents, businesses, and multiple user groups; participation can improve design quality and reduce conflicts

- Implication:

Participation becomes politically sensitive: if it is weak, people contest decisions; if it is strong, it requires time, budget, and careful representation to avoid "non-representative influence"

4. Power asymmetries and "who controls the story"

- Observation:

New commercial mobility providers become more important in hub ecosystems, which can shift power relations

- Cause:

Providers may control key services, operational know-how, and sometimes data; public administrations must coordinate across many departments

- Implication:

Political choices can drift toward market-driven outcomes unless the public side keeps clear leadership, clear roles, and monitoring capacity

5. Multi-level alignment and competence frictions

- Observation:

Mobility hubs sit across governance levels (local, regional, national, and sometimes EU-linked programmes and goals)

- Cause:

Different levels influence funding, standards, and planning frameworks; scaling from pilots to networks increases the need for alignment

- Implication:

Disputes or misalignment on “who decides and who pays” can slow implementation and create uneven outcomes across locations

6. “Pilot politics” and experimental governance

- Observation:

Cities often start with pilots and publicly supported experimentation, then attempt to upscale into networks

- Cause:

Pilots are a pragmatic response to uncertainty (institutional gaps, unclear arrangements, evolving markets)-

- Implication:

Political leadership is tested at the transition point: without a clear route from pilot to stable funding and responsibilities, hubs risk staying fragmented or remaining “forever pilots”

7. Budget priorities and subsidy choices shape what is possible

- Observation:

Many hubs (or hub components) need public funding, especially to ensure network coverage and equity outcomes

- Cause:

Not every location is commercially attractive; maintenance and staffing are ongoing costs, not one-off CAPEX

- Implication:

Political bargaining over budgets determines whether hubs become a consistent network service or a set of isolated projects with uneven quality

Funding schemes

Blended funding is the default (public + private + project-based)

- Overview:

Mobility hubs are usually financed through a mix of sources because the hub combines public-space works, service integration, and sometimes commercial elements

- Typical funding sources:
  - Public budgets for public-space infrastructure and network roll-out
  - EU / project funding to support pilots, tools, and learning-oriented initiatives
  - Private investment (operators, partners, sometimes corporates) for services, technology, and operations in specific settings

Funding gap: hubs require a clear long-term public-value funding logic

- Overview:

Hubs should not be assessed only through short-term commercial viability. Funding design is a core governance decision because hubs often deliver public benefits such as emissions reduction, accessibility, modal shift and network integration.

- Implication

Without stable funding, hubs risk remaining isolated pilots or declining in quality due to underfunded operations and maintenance

What public money should pay for (focus on "public value" components)

- Overview:

A recurring point is that public funding should focus on components that deliver broad societal benefits, rather than financing services that are already commercially viable

- Examples of "public value" cost items:
  - Public-space reconfiguration and basic hub infrastructure
  - Network consistency elements (e.g., signage/wayfinding, standardisation) and often publicly funded EV charging or energy infrastructure where relevant
  - Governance capacity (coordination, monitoring, staff time)

Subsidies and incentives are needed for equity and low-demand locations

- Overview:

Market-driven supply tends to concentrate in attractive areas. There is the need for subsidies where demand is low or equity goals require coverage (rural areas, peripheral areas, underserved groups)

- Typical tools mentioned:
  - Direct subsidies for services or for keeping services affordable
  - Incentives (e.g., infrastructure subsidies, tax incentives, support to private initiatives)

Contracts, concessions, and PPPs as funding/delivery mechanisms

- Overview:

Public authorities can finance hubs by setting conditions and letting market actors deliver under those conditions (including concessions). This is described as a practical way to combine public direction with private delivery capacity

- Funding logic (simple):
  - Public side may fund land/public works and set requirements;
  - Private side may fund operations/technology and recover costs through agreed revenue streams or business opportunities, within public conditions

Revenue logic mentioned: non-mobility services and cross-selling

- Overview:

Hubs can generate value (and potentially revenue) through non-mobility services and "cross-selling" opportunities linked to the hub concept

- Typical examples of revenue-related elements mentioned:
  - Non-mobility services (e.g., kiosks, parcel lockers) that increase convenience and can support the business case
  - Synergies between services ("cross selling") to strengthen viability

What funding is typically needed (CAPEX vs OPEX)

- CAPEX (upfront):
  - Hub infrastructure and public-space works (including mode integration elements)
  - Digital integration elements and tools (platform/interface components are treated as part of the hub system)
- OPEX (ongoing):
  - Maintenance and upkeep of hubs (explicitly highlighted as essential)
  - Staffing for coordination, supervision, and ongoing operations inside public institutions and operators

Funding logic across phases (pilot → scale → stable operation)

- Overview:

There is a common pattern: pilots may be financed by a lead operator or project money; scaling requires public co-financing; stable operation needs a long-term commitment and clear allocation of who pays what.

- Implication:

The "money bridge" from pilot to long-term operation is a frequent risk: pilots are easier than sustained network delivery

How to co-define the best governance scheme

Cities should not force mobility hubs into one single governance model. A hub programme can combine different schemes across areas (centre vs periphery), hub types (small vs major interchanges), and maturity stages (pilot vs network roll-out). The key is to co-define a scheme that matches local goals, stakeholder power, funding reality, and implementation capacity

1. **Start from public purpose, not from the "hub concept"**

Define what hubs must deliver for the city. Keep objectives simple and measurable, for example:

- improve access to public transport (first/last mile)
- increase multimodal uptake (shared mobility + PT)
- reduce car dominance and manage parking/curb space
- ensure accessibility and social inclusion
- improve the user experience (clear wayfinding, safety, reliability)

2. Decide the scope: single hub vs network (and the minimum standard)

A hub creates limited value if it stays isolated. Agree early on:

- whether you aim for a network of hubs
- a minimum standard that every hub must meet (design, accessibility, signage, service rules)
- what can vary by location (services offered, size, staffing, business elements). For example, the typology designed for Flanders[18]

3. Use a simple "integration ladder" to align stakeholders

To avoid talking past each other, structure the co-definition around:

- Physical integration: layout, safe access, docking/parking, interchanges
- Digital integration: information, booking/payment options, data reporting
- Democratic integration: participation, inclusion, local legitimacy

This makes trade-offs explicit (e.g., "digital-first" vs "inclusive access for non-app users")

4. Map stakeholders with a blunt question: who decides, who operates, who pays?

Co-definition works only if roles are explicit:

- City / transport authority: sets objectives, allocates public space, issues permit, enforces rules, funds public-value parts
- Public transport operator: anchors the network, ensures interchange quality, supports integration
- Shared mobility / MaaS providers: deliver services, comply with access rules, share agreed data
- Local communities / users: shape design priorities and acceptance through structured engagement
- Private partners (where relevant): contribute assets, services, or operations under conditions

5. Choose the governance "backbone" (and allow hybrids)

Pick one backbone scheme as the default, then allow exceptions:

- Public-led network governance for consistent citywide roll-out and equity coverage
- Operator/PPP/concession-led where operational efficiency and bundling are needed, but under strict public standards
- Experimental co-governance where uncertainty is high and you need learning before scaling

Hybrid logic is normal (e.g., public-led network + experimental pilots in new districts)

6. Build a staged process with clear gates (pilot → improve → scale)

Avoid "forever pilots" by agreeing upfront:

- what counts as success (usage, accessibility, safety, clutter reduction, satisfaction)
- what evidence is required at each stage

[18] https://wegenenverkeer.be/zakelijk/documenten/ontwerprichtlijnen/hoppinpunten

- who validates results
- what decisions are allowed at the gate: scale / redesign / pause / stop

7. Lock in public-space rules early (or the scheme collapses in the street)

Hubs live in contested space. Agree on:

- parking and curb management rules (where vehicles can stop/park, how long, penalties)
- docking / no-parking zones to avoid clutter and conflicts
- responsibilities for cleanliness, maintenance, and repairs
- enforcement approach (who enforces, how often, with what tools)

8. Make data and monitoring non-negotiable (minimum dataset + simple KPIs)

If you cannot measure, you cannot govern. Co-define:

- a minimum dataset for all providers (usage, availability, turnover, incidents where relevant)
- frequency and format (comparable reporting)

who can access what (authority, operator, auditors)

what happens if data is missing or inconsistent

Keep KPIs few and operational (e.g., availability, uptime, response time for maintenance, space compliance).

9. Decide “who pays for what” with a transparent split (CAPEX + OPEX)

Funding is not only construction. Co-define a clear split:

- Public side typically funds: public-space works, network standardisation, coordination capacity, inclusion measures, monitoring capability
- Private side typically funds: service operations, fleet availability, customer interfaces (when commercial), day-to-day service delivery

Also decide early how you cover the viability gap for low-demand or equity-focused locations (subsidies/incentives).

10. Protect openness and fair access while enabling integration

Integration can create gatekeepers. To avoid market capture:

- set non-discriminatory access rules for hub space where feasible
- avoid design choices that lock the hub into one provider’s proprietary setup
- require interoperability where practical (at least information and wayfinding consistency)
- keep entry conditions proportionate (not so heavy that only big players survive)

11. Fund capacity, not only concrete and signage

Implementation fails when cities lack:

- procurement and contracting capability
- staff time for coordination and stakeholder management
- digital and data skills for monitoring and continuous improvement

Include these “soft costs” in the programme budget from the start

Governance models for MaaS

Regulatory frameworks

MaaS requires a regulatory environment that ensures interoperability, fair competition, and user protection through a multi-layered governance structure that combines EU-level data and transport law with national and local operational rules. Within this structure, national transport regulators should be recognised as key MaaS governance enablers, since they can help translate overarching European principles into workable access conditions and competition rules for mobility platforms. The Italian case illustrates both the relevance and the limits of this arrangement. While the Autorità di Regolazione dei Trasporti (ART) plays an important role at national level and the National Access Point, managed by the Ministry of Transport through the CCISS, is progressively aligning with EU Delegated Regulation 2024/490, the fragmentation of competences between the State, Regions, and local public transport authorities remains a critical governance challenge.

At the EU level, the ITS Directive and Delegated Regulation (EU) 2024/490 lay the foundation for technical and legal interoperability by requiring Member States to provide multimodal travel and traffic data through National Access Points. For example, in Italy, this framework has recently been strengthened by the national transposition published in February 2026[19], which, while not using the term MaaS, defines a “servizio digitale di mobilità multimodale” as a service providing multimodal traffic and travel data, including features for booking, payment, or ticketing. This development reinforces the regulatory basis for MaaS data governance in Italy and shows that the national framework is already addressing MaaS in substantive terms.

The Data Act and Data Governance Act define fair data-sharing obligations, while the Open Data Directive makes transport a priority high-value dataset.

Privacy and user rights are safeguarded by GDPR and ePrivacy, which regulate consent, profiling, and geolocation data, essential for account-based ticketing.

EU competition law (Arts. 101–102 TFEU) prevents market foreclosure by dominant operators.

National and local authorities can operationalise these principles through open API standards, minimum data-sharing obligations, and non-discriminatory ticket resale rules. Public procurement and Public Service Obligation (PSO) contracts are powerful levers to implement interoperability.

Account-Based Ticketing (ABT) and open-loop systems support integration but need clear rules on clearing, settlement, and revenue sharing.

Data governance should align with the OECD Transport Equity and Access framework, ensuring transparent access control and auditability.

[19] https://www.gazzettaufficiale.it/eli/id/2026/02/18/26A00822/SG)

Current gaps include fragmented revenue-sharing models, lack of cross-border ticketing identifiers, and unclear liability allocation. Platform governance, particularly ranking transparency and gatekeeping, remains weakly regulated

Governance models (overview)

Central Control scheme

Description

This model places a public authority (PA), whether national, regional, or local, at the centre of the MaaS ecosystem. The authority does not just set the rules but also manages the digital and physical infrastructure and controls how operators can participate. It defines technical standards, data-sharing conditions, and ticketing structures, ensuring that all actors follow the same framework. The PA develops the platform and selects the public and private transport service providers to be integrated. This governance model aims to achieve full system integration by managing fares, routing, real-time information, and service quality, so that users experience MaaS as a single and seamless network. It also makes it easier to control service standards and pursue climate goals, while creating clear lines of responsibility and alignment with public transport strategies. The Italian experience, including cases such as Milan where ATM has progressively integrated shared mobility services into its platform, shows the relevance of this model. At the same time, a fully centralised approach faces scalability challenges in the Italian context because of the high number of local public transport operators and the absence of a unified national ticketing system. For this reason, the model works best where a single strong public transport authority already exists and may require institutional consolidation as a prerequisite. It can also reduce flexibility and slow innovation if participation rules are too rigid.

Governance approach

- Public, centralised, with total control on the platform; collaboration with transport service providers
- No direct investment from private entities
- Data-sharing obligations for all operators

Advantages

- Alignment with public goals
- Ensures full interoperability in transport service
- Fare integration
- Unified data collection and monitoring
- Targeted policies for disadvantaged groups

Challenges

- Requires administrative capabilities and long-term funding
- Slower platform innovation, difficulty to scale
- Heavy responsibility for managing sensitive data
- High operational and infrastructure costs rely on public funding, limiting economic sustainability
- Risk of political influence over strategic and operational decisions (e.g. in transport service provider selection)
- High risk of lock-in due to full dependence on a single public platform and infrastructure

Regulatory/legal gaps

- Fair market access must be guaranteed through transparent entry rules for private transport operators. Without clear procedures, participation can favour incumbents and create distortion in the competition
- Public rules often lack flexibility, making it difficult to onboard new services quickly or adapt to changing market conditions
- Revenue sharing and liability allocation
- Strong central control may trigger antitrust concerns if pricing or access conditions are not applied evenly across the market

Delegated Operations

Description

In this model, the public authority maintains strategic oversight while operational responsibilities are transferred to a private entity. The authority establishes the regulatory framework, defines participation criteria, sets data-sharing requirements and determines service and quality standards. It does not, however, operate the MaaS platform directly.

The private operator is responsible for the development of the MaaS platform. This includes technical infrastructure, service integration, platform management, and customer-facing functions.

This arrangement allows the public sector to maintain control over strategic objectives while benefiting from the flexibility and innovation capacity of the private sector.

In this model, the Public Private Partnership (PPP) is mainly functional rather than financial, with the public sector providing most of the funding and strategic control while the private partner focuses on operational delivery.

The contractual framework is central to this model. It must clearly outline roles and responsibilities and guarantee that the private partner operates in line with public objectives.

Governance approach

- The public authority defines rules and objectives, while a private operator(s) manages the MaaS platform → A private operator manages under public oversight
- Collaboration is formalised and monitored through contract
- Public authority does not have direct control on data

Advantages

- Combines public control with private sector efficiency
- Reduces operational burden on public authorities
- Speeds up implementation and innovation (faster scaling)
- Attract private investment and expertise

Challenges

- Requires clear and well-designed contracts
- Risk of dependency on a single operator, especially if the platform infrastructure is proprietary
- PA need to monitor compliance and performance (KPI)

- PA has no direct control on data

Regulatory/legal gaps

- One of the main issues concerns data sharing: rules are often unclear about what private operators must provide, how data can be used by the public authority, and how ownership or reuse rights are defined
- Without well-defined legal frameworks, there is a risk that some operators might benefit from preferential treatment, undermining fair competition and market transparency
- There are no clear standards for allocating responsibility when multiple parties are involved, especially in cases of service disruption or user claims

Multi-Actor Coordination

Description

In this model, no single player fully controls the MaaS system. Instead, responsibilities are shared among multiple public and private actors, each contributing to the design, operation, and evolution of the ecosystem.

Public authorities setting common goals and other actors participating in joint coordination structures. Operational decisions are distributed among operators, who manage their own services while aligning through agreed standards and coordination mechanisms. Public authorities typically define strategic objectives and basic rules, while private operators and other stakeholders help shape and deliver services.

Coordination happens through formal agreements, joint decision-making bodies, or structured partnerships, often supported by shared data platforms and technical standards. This structure allows more flexibility and distributes operational responsibilities, but it also requires strong cooperation and alignment between actors with different interests.

The model is often used in complex urban and regional contexts where multiple transport agencies, municipalities, and private providers operate in parallel. It focuses on collective governance, not centralised control.

Governance approach

- Shared decision-making between multiple actors (PA, private operators, and user representatives)
- Responsibilities and roles are distributed across different stakeholders
- Coordination relies on shared standards, data exchange, and continuous stakeholder dialogue
- No single entity has full control over the system

Advantages

- Distributes responsibilities, reducing the risks on a single actor
- Encourages innovation and flexibility through collaboration between multiple stakeholders
- Can better reflect local needs and priorities through shared decision-making
- Promotes transparency and trust among participants through open processes and shared standards

Challenges

- Coordination is more complex and can slow down decision-making
- Requires strong mechanisms for negotiation, monitoring, and conflict resolution

- Risk of unclear responsibilities, making accountability more difficult
- Data sharing and standardisation can be harder to enforce without a single controlling entity

Regulatory/legal gaps

- Lack of clear legal frameworks defining roles and responsibilities among multiple actors can create ambiguity and disputes
- Unclear procedures for data sharing and access may lead to inconsistent application of rules across operators
- Procurement and contractual tools are not always suited to multi-party agreements, creating legal uncertainty
- No standard mechanisms for allocating liability in case of service failures involving several operators
- Risk of unequal treatment if participation conditions are not legally harmonised
- Difficult to ensure transparency and accountability without a single authority responsible for enforcement

Federated Data Infrastructure

Description

In this model, there is no single, central MaaS platform. Instead, the system relies on a shared data infrastructure that defines common technical standards, access rules, and interoperability requirements. Public and private operators maintain their own platforms or front ends but must comply with these shared rules to participate in the ecosystem.

A neutral public body or consortium manages the shared data layer, ensuring fair access, standardisation, and security. Decision-making is distributed among multiple actors through agreements and coordination mechanisms, rather than being concentrated in a single authority.

For users, this means they can choose between multiple apps or service providers, but all offer access to the same network of mobility services: information on routes, fares, availability, and ticketing is consistent across platforms, ensuring a seamless experience. Users are not locked into a single operator and can select the service that best fits their needs while still benefiting from a fully integrated system.

Governance approach

- Shared governance between multiple actors
- A neutral public body or consortium manages the common data infrastructure
- Operators maintain autonomy but must follow shared rules and standards
- Coordination happens through agreements and technical protocols rather than centralised control
- Decision-making is distributed and based on cooperation and compliance with common interoperability requirements

Advantages

- Encourages innovation and competition by allowing multiple operators to build user-facing services
- Ensures consistent and reliable information through a shared data backbone
- Reduces the risk of monopolies or vendor lock-in
- Gives users freedom of choice while maintaining service integration

Challenges

- Requires strong technical and legal frameworks to ensure compliance and interoperability
- Coordination can be complex when many actors are involved
- No single authority means slower decision-making and more negotiation
- Multiple front ends make it harder to monitor performance and enforce consistent service standards

Regulatory/legal gaps

Private-Led Initiative

Description

In this model, a single private actor develops, manages, and controls the entire MaaS platform. All rules on access, data sharing, service integration, and pricing are defined unilaterally by the platform owner. Public authorities have a limited or reactive role, intervening only through general regulatory frameworks (e.g. competition law, privacy, safety).

Mobility providers can participate only under the conditions set by the private platform, which acts as a gatekeeper between users and services. The platform's technological and market power gives it significant influence over service visibility and pricing strategies.

This model can enable fast deployment and seamless integration but comes with high risks of lock-in, market concentration, and limited public accountability.

Governance approach

- Full control concentrated in a single private actor
- Platform owner sets all technical, operational, and commercial rules
- Public authorities have only a limited, regulatory oversight role
- Participation of other mobility providers depends entirely on the platform's conditions
- Decision-making is unilateral and market-driven, not negotiated

Advantages

- Fast deployment and scaling thanks to private investment and technology
- High level of service integration and user experience consistency
- No dependency on public funding or lengthy political processes
- Clear and centralised decision-making enables quick adaptations to market demand

Challenges

- High risk of market concentration and monopolistic behaviour
- Lock-in effects for both users and service providers
- Lack of transparency and limited accountability to public objectives
- Public authorities have little or no influence over pricing, access, or service quality
- Risk of excluding smaller operators unable to meet platform conditions
- Strategic decisions driven by commercial interests rather than public goals

Regulatory/legal gaps

- Because the platform is fully private, most transport and mobility-specific rules do not apply, leaving only general competition, privacy, and consumer protection laws in place

- There is no legal obligation to guarantee fair access or non-discriminatory treatment of operators. Data use, pricing structures, and integration rules are set by the platform owner without external oversight. This creates legal blind spots around data sharing, algorithmic transparency, and user protection
- In practice, the legal environment is reactive rather than preventive, allowing the platform to shape the market with minimal regulatory constraints

Market dynamics and competition assessment

1. **Coexistence of Public and Private Logics**

MaaS operates in a hybrid market, where public authorities (usually) control core transport services and infrastructure, while private actors provide complementary or value-added mobility offers. This duality creates both opportunities for integration and friction over control, access, and commercial positioning. The balance between public coordination and private innovation is a central topic

2. **Integration Capacity as Competitive Driver**

Unlike traditional transport markets, competition in MaaS is less about owning assets and more about integration capability. Actors that can best connect services, payment systems, and user interfaces gain strategic advantages. This tends to favour larger or more technologically advanced players, potentially widening gaps with smaller operators

3. **Market Entry Through Standards, Not Assets (linked to 2)**

Participation in MaaS is regulated less by physical presence and more by compliance with technical and regulatory standards (e.g. interoperability, ticketing integration, data-sharing obligations). This lowers entry barriers for digital actors but can exclude smaller mobility providers without the required capacity or resources.

4. **Data as Strategic Resource**

Data is central to market positioning. Access to shared data layers enables service innovation, but control over exclusive data can become a competitive lever. The governance model determines whether data is an open asset fostering competition or a gatekeeping tool reinforcing dominant positions.

5. **Platform Intermediation and Power Concentration**

MaaS platforms can act as powerful intermediaries between users and service providers. If not governed carefully, this can lead to:

- Strong concentration of market power
- Lack of transparency in pricing and service prioritisation
- Unequal access to user data

The governance structure determines whether the platform acts as an open enabler or a closed gatekeeper.

6. **Role of Public Authorities as Market Orchestrators**

Public authorities influence competition through their control of access rules, infrastructure, and data governance frameworks. Depending on the model, they can either maintain a strong central role (e.g. Central Control, Delegated) or create a distributed governance structure (e.g. Federated). Their strategic stance shapes how competitive dynamics evolve.

7. **Dynamic Equilibrium Between Control and Innovation**

The MaaS market does not evolve linearly. Shifts in governance (e.g. moving from centralised to federated approaches) can alter competitive dynamics over time. Markets may start with strong public leadership to build trust and infrastructure, then open progressively to private operators and competition as the system matures.

Political influence

1. **Public Authorities as Central Political Actors**

MaaS governance is strongly influenced by the political role of public authorities, which control key levers such as infrastructure, subsidies, regulatory frameworks, and participation rules. Their strategic choices determine how open or closed the market is, which actors gain access, and how fast the system evolves.

2. **Political Priorities Shape Governance Models**

The adoption of a governance model often reflects broader political objectives. Centralised approaches are more likely in contexts prioritising equity, accessibility, and policy alignment with climate targets. More distributed or federated models tend to emerge when innovation, competition, and market diversification are politically valued.

3. **Policy Stability vs. Political Cycles**

MaaS systems require long-term investment and stable governance. However, political cycles can lead to changing priorities, funding shifts, or regulatory uncertainty. These fluctuations can affect investor confidence, integration timelines, and the overall sustainability of the ecosystem.

4. **Multi-Level Political Tensions**

MaaS often involves multiple governance levels — national, regional, and local. Diverging political priorities between these levels can generate friction over competences, funding responsibilities, and regulatory alignment. This is particularly relevant in countries with decentralised transport governance structures.

5. **Influence on Market Access and Fairness**

Political decisions can directly or indirectly favour certain actors (e.g. incumbents, public operators, or large private platforms). This may happen through selective investment, regulation, or procurement strategies. Ensuring transparent and competitive participation rules is therefore crucial to prevent distortions.

6. **Political Framing of Mobility Goals**

The way mobility is framed politically — as a public service, a market opportunity, or a tool for climate action — influences governance design and implementation. Strong climate or accessibility agendas tend to strengthen the public role, while pro-competition agendas may push toward more open or hybrid models.

7. **Policy as Enabler or Constraint**

Political leadership can accelerate MaaS development through supportive regulation, funding, and coordination structures. Conversely, lack of alignment or political resistance can slow integration, create regulatory gaps, or block implementation entirely.

Funding schemes

Public Funding as Primary Driver

MaaS development is often initiated and supported by public funds, especially in the early stages. Public authorities finance infrastructure, data platforms, integration layers, and sometimes operations. This reflects the strategic role of MaaS in achieving wider mobility, equity, and climate goals.

Limited Private Investment in Early Phases

Private operators tend to enter MaaS ecosystems once technical and institutional frameworks are in place. High uncertainty and unclear revenue models make private investment less attractive at the beginning, reinforcing public sector leadership in funding.

Dependency on Political Priorities

Because funding is strongly tied to public budgets, MaaS initiatives are vulnerable to political shifts. A change in policy direction or budget priorities can slow down or interrupt development, particularly for projects relying on national or regional programs.

Unequal Access to Financial Resources

Large operators and incumbents are often better positioned to co-finance integration or meet technical requirements. Smaller operators, in contrast, may lack the capital to adapt their systems or participate in shared platforms. This creates a structural imbalance in market participation.

Need for Stable, Long-Term Schemes

MaaS ecosystems require stable financial frameworks, not short-term project funding. Fragmented or temporary schemes undermine system reliability, limit private sector engagement, and make scaling difficult.

Potential of Mixed Funding Models

Although the analysis emphasises public leadership, it also points to opportunities for blending public and private resources. Public authorities can cover infrastructure and integration layers, while private actors contribute to service innovation and user-facing solutions. This approach can reduce public dependency and foster competition.

Strategic Role of Subsidies and Incentives

Funding schemes can be used as a policy lever to steer market behaviour. Targeted incentives can support service integration, ensure the inclusion of smaller operators, and align private offerings with public objectives such as accessibility and decarbonisation.

How to co-define the best governance scheme

A MaaS governance scheme should be co-defined as a *public-value framework* (objectives, rules, safeguards) wrapped around a *market ecosystem* (operators, platforms, integrators). The fastest way to get there is to agree upfront on (i) who orchestrates the ecosystem, (ii) which organisational model you are adopting, and (iii) the non-negotiables on data, ticketing and customer protection. In practice: start from shared objectives, map the actors and their incentives, then pick the governance model that best prevents misalignment and lock-in while still enabling innovation.

1. **Define "public purpose" and scope (before debating platforms)**

Set measurable goals (e.g., modal shift, accessibility, emissions, equity), and define what MaaS is allowed to do (and not do). This is needed because platform providers naturally optimise for business outcomes that can diverge from public policy goals.

2. **Choose the organisational/governance model that matches your power balance**

Use a clear typology and pick deliberately:

- Commercial integrator (fast innovation, higher risk of misalignment with public policies)
- Transport-as-integrator (strong alignment with policy, often perceived as less customer-oriented/innovative)
- Open back-end platform / "neutral integration" (public sector sets the shared platform rules; multiple MaaS services/apps can compete on top)
- Regulated utility / public platform (platform treated as public infrastructure with public oversight and access rules)
- Optionally: contracting an integrator through a public award/contract

3. Nominate an orchestrator (and give it real teeth)

An effective MaaS ecosystem needs an entity that can do more than coordinate in a loose sense. It needs an orchestrator with real authority to manage relationships across the ecosystem, standardise information flows, supervise technical and operational procedures, maintain trust, manage participation through mechanisms such as registers or certification of compliance, and mediate conflicts. On the ticketing and MaaS side, this governance body should also oversee a volatile market of commercial digital mobility services and address customer protection issues. For example, In the Italian context, this function is especially important, as the absence of a clearly designated orchestrator has contributed to fragmented pilot initiatives in cities such as Rome, Milan, Naples, and Turin, with limited interoperability between them. For this reason, the orchestrator should be understood as a formal MaaS Governance Body at national level. The orchestrator function should include:

(1) certification of MaaS platforms

(2) supervision of data-sharing compliance

(3) mediation between PT operators and private mobility providers

(4) monitoring of service quality KPIs.

4. Lock data governance and interoperability rules early

Data governance needs to be co-defined before platform design, since the effectiveness of MaaS depends on early clarity about what data is shared, under which conditions, with which standards, and how portability and interoperability are guaranteed to avoid anti-competitive data lock-in. Public authorities have a clear role in setting minimum requirements for data portability and in shaping a framework that is as open as possible and as closed as necessary. In the Italian context, this point is particularly important. The evolution of the National Access Point (NAP) from a static data repository towards a more dynamic data exchange ecosystem shows both the relevance of this direction and the difficulties of implementation. Progress remains slow because of:

(1) heterogeneous data formats across operators

(2) resistance to sharing real-time operational data

(3) unclear legal frameworks for commercial data valorisation

Within this context, structured access to mobility data through NAP mechanisms and licensing principles such as FRAND are key enabling conditions, especially to ensure that data-sharing obligations do not disproportionately favour large platform operators over smaller mobility providers.

5. **Solve ticketing/payment/clearing as a governance problem (not an IT add-on)**

Ticketing, payment and clearing should be treated as a first-order governance deliverable, not as a technical layer to be addressed later. This means clearly defining who does what across the chain. The MaaS Operator typically handles end-user support and payment and distributes fees through a compensation engine, while the MaaS Integrator integrates services and data and exposes them through ideally open and standard interfaces. Alongside this, the governance scheme must define the clearing approach, revenue attribution rules, and, crucially, the clearing house function as an essential governance component. This is particularly important in Italy, where the ticketing and clearing challenge is one of the main bottlenecks for MaaS because regional and local ticketing systems remain non-interoperable, there is no national clearing house for multimodal payments, and account-based ticketing initiatives are emerging in a fragmented way. The report already notes that workable strategies and examples for clearing are often missing. In this context, that gap should be addressed explicitly as part of governance design rather than left to implementation. The European Commission's ongoing work on Multimodal Digital Mobility Services regulation may help provide a legal basis for mandating such clearing mechanisms.

6. **Co-design with stakeholders, then stage the rollout**

Use structured workshops/tables to co-define rules, incentives and participation conditions - because stakeholders may support MaaS goals but still resist data sharing. In one case study, many stakeholders were not positive about data sharing, and about half of participants saw the transport regulator running

MaaS initially as necessary. This matches the broader lesson: you must actively reconcile diverse actor objectives to avoid an unstable ecosystem driven by opportunistic behaviour; the public sector often needs to play a stronger role in early stages when scale/trust is fragile.

Governance models for Micro-Hubs

Regulatory frameworks

1. **TEN-T Regulation and Urban Nodes (Revised 2023)**

Overview:

The revised Trans-European Transport Network (TEN-T) Regulation strengthens the role of urban nodes as critical interfaces between long-distance and last-mile logistics. Cities designated as urban nodes must now develop Sustainable Urban Mobility Plans (SUMPs) with integrated freight strategies.

Relevance for Micro-Hubs:

- Micro-hubs are recognised as key infrastructure to improve last-mile efficiency and reduce congestion
- Cities must plan for multimodal freight terminals, consolidation centres, and zero-emission delivery zones
- Funding eligibility via CEF and ERDF is linked to compliance with TEN-T objectives

Additional comments:

Micro-hubs should be positioned as strategic assets within TEN-T corridors and urban node plans, enabling access to EU infrastructure funds and aligning with freight decarbonisation targets.

2. Urban Mobility Framework (UMF, 2021)

Overview:

The UMF sets out the EU's vision for sustainable urban mobility, including stronger emphasis on freight transport, zero-emission logistics, and digitalisation. It encourages cities to adopt SUMPs and integrate freight into broader mobility strategies.

Relevance for Micro-Hubs:

- Promotes low-emission zones, smart logistics, and shared infrastructure
- Encourages public-private collaboration and innovation in last-mile delivery
- Supports the use of digital tools for routing, coordination, and monitoring

Additional comments:

Micro-hub governance models should reflect UMF principles: inclusivity, efficiency, and digital integration. The framework legitimises shared and coordinated models as policy-compliant solutions.

3. Sustainable Urban Mobility Plans (SUMPs) and Sustainable Urban Logistics Plans (SULPs)

Overview:

SUMPs are strategic plans adopted by cities to guide mobility development. SULPs are freight-specific extensions that address logistics flows, infrastructure, and stakeholder coordination.

Relevance for Micro-Hubs:

- Micro-hubs are often included as key measures in SULPs to reduce freight-related emissions and optimise space use
- SUMP/SULP integration ensures alignment with climate, air quality, and accessibility goals
- Provides a planning and monitoring framework for micro-hub deployment

Additional comments:

Micro-hub initiatives should be embedded in SUMP/SULP processes to ensure policy coherence, stakeholder legitimacy, and access to funding.

4. Climate City Contracts (CCCs)

Overview:

Developed under the EU Mission "100 Climate-Neutral and Smart Cities by 2030," CCCs are multi-stakeholder agreements that formalise cities' commitments to climate neutrality.

Relevance for Micro-Hubs:

- CCCs offer a governance and funding framework to integrate micro-hubs into climate strategies
- Encourage horizontal alignment across sectors (mobility, energy, urban planning)
- Provide access to tailored technical assistance and investment platforms

Additional comments:

Micro-hubs should be framed as enablers of CCC objectives, especially in supporting SMEs, reducing emissions, and revitalising urban spaces.

Additional Legal Instruments

- EU Competition Law (Articles 101–102 TFEU):

Governs collaboration among operators; relevant for shared and coordinated models.

- Public Procurement Directives (2014/24/EU):

Define rules for concession, tendering, and service contracts—critical for Model 2 and Model 4.

- GDPR and Digital Services Act:

Regulate data sharing and platform governance in coordinated delivery models.

- State Aid Rules:

Apply to subsidies and incentives for SME-oriented micro-hubs; require proportionality and transparency.

Governance models

Proprietary systems

Description

In this model, the micro-hub is managed and used by a single operator, typically a major courier or e-commerce platform. The entire system is closed and vertically integrated, from interurban logistics to last-mile delivery. Governance is therefore private and centralised, with direct investment from the operator and no obligation to share with other entities. The main strength of this model lies in the complete control the company exercises over processes: timing, quality standards, and costs are defined internally and fully integrated with the operator's management systems. This ensures fast decision-making and adaptability but comes with limitations. System-wide efficiency is reduced, as each operator develops its own network, leading to potential infrastructure duplication and limited impact on overall traffic reduction

Governance approach

Private, centralised, with direct investment from the operator. Few or no sharing obligations with other entities

Advantages

- Full control over timing, standards, and costs
- Integration with internal company processes
- Fast and agile decision-making

Challenges

- Reduced system efficiency (each operator has its own network)
- Potential infrastructure duplication
- Limited contribution to overall traffic reductio

Examples (mapping)

- UPS – Hamburg: mobile micro-hubs directly managed by the courier, supported by public partnerships but under private governance
- Amazon – Rome and Trento: micro-mobility hubs launched with electric vehicles and cargo bikes

Regulatory/legal gaps

- Antitrust constraints: Large operators may be restricted from collaborating or sharing infrastructure due to competition law (e.g. Article 101 TFEU), especially if coordination affects pricing, market access, or exclusivity
- Service contract rigidity: Couriers often have binding contracts with end customers that define delivery standards and liability, making delegation of last-mile operations legally complex
- Urban space access: Cities may lack clear frameworks for granting exclusive use of public space to private actors, raising issues of transparency, fairness, and public interest
- Data governance: Proprietary systems may not comply with open data or interoperability requirements, limiting integration with city platforms or public dashboards

Shared infrastructure

Description

This model involves a micro-hub made available to multiple operators—couriers, cycle-logistics firms, retailers—who use it under common rules. The infrastructure is shared, but operations remain separate, while management is entrusted to a neutral entity (public, private, or mixed) that ensures fair access and efficient resource allocation. Governance is generally based on a public-private partnership or consortium, with formal rules, shared standards, and cost-sharing among users. This approach optimises space use and reduces the total number of vehicles in circulation, enabling participation by smaller operators. However, it requires strong coordination and transparent management, with risks of conflict among actors with divergent interests or difficulties in operational standardisation.

Governance approach

Public-private partnership or consortium, with formal governance and shared standards. Cost-sharing among users

Advantages

- Optimised use of space
- Reduction in the number of circulating vehicles
- Greater inclusion of small operators and startups

Challenges

- Requires continuous coordination and transparent management

- Risk of conflict among actors with differing interests
- Complexity in cost allocation and operational standardisation

Examples (mapping)

- KoMoDo – Berlin: hub managed by the city with five operators involved
- Madrid – LEAD Project: micro-hub in Plaza Mayor parking area for multiple operators
- Colibri – Montréal: shared hub with exclusive time slots
- Prague – CityHub: publicly supported micro-hub used by multiple couriers to optimise deliveries in the central area and integrate micromobility and pickup points

Regulatory/legal gaps

- Liability fragmentation: Shared use without shared operations creates ambiguity in liability, insurance, and service guarantees
- Procurement and concession rules: Cities may face legal uncertainty in selecting neutral operators or consortia, especially under EU public procurement directives
- Cost-sharing mechanisms: Lack of standardised legal instruments for allocating costs among heterogeneous users (e.g. SMEs, couriers, retailers)
- Access equity: Without formal regulation, dominant players may crowd out smaller ones, undermining the inclusive intent of the model

Last-mile collaboration

Description

This third model involves not only shared infrastructure but also strategic coordination of final deliveries. In this configuration, multiple operators—couriers or retailers—entrust a single entity, often a cycle-logistics company or urban cooperative, with managing the "last mile," enabling consolidated distribution. Governance is based on collaborative agreements, often voluntary or temporary, and may be formalised through operational consortia or digital coordination platforms. The main advantage is resource optimisation: vehicles are used more efficiently and duplicate deliveries are reduced. Its flexibility makes it easily scalable and inclusive of local operators, even at low cost. However, success depends on high levels of trust and coordination among actors, and technological or cultural barriers may arise. Additionally, defining the distribution of economic benefits among participants can be complex

Governance approach

Collaborative, based on voluntary agreements or temporary partnerships. May be formalised via digital platforms or operational consortia

Advantages

- More efficient vehicle uses and reduced duplicate deliveries
- Operational flexibility and scalability
- Inclusion of local operators and low-cost solutions

Challenges

- Requires high levels of trust and coordination

- Potential technological or cultural barriers among stakeholders
- Difficulty in defining individual economic benefits

Examples (mapping)

- Seattle – Neighbourhood Delivery Hub: consolidated delivery via cargo bikes
- New York – NYC DOT: multi-operator hub with public allocation of urban space
- Bologna – URBANE Project: urban cooperatives and operators share infrastructure and final delivery

Regulatory/legal gaps

- Delegation of delivery: Existing courier contracts may prohibit subcontracting or third-party handling of final delivery, especially for sensitive goods or time-critical services
- Digital platform regulation: Coordination via digital tools may trigger GDPR and e-commerce compliance issues, especially regarding data sharing and consent
- Trust and enforceability: Voluntary agreements lack enforceability unless formalised; absence of legal templates for temporary partnerships or urban cooperatives
- Infrastructure use: Cities may not have legal instruments to support dynamic allocation of space (e.g. time slots, shared lockers) across multiple operators

Public or Public-Private Micro-Hubs for SMEs and Local Commerce

Description

This model refers to micro-hubs promoted and set up by public entities or public-private partnerships, specifically aimed at supporting small and medium-sized operators such as artisans, retailers, and micro-couriers. In this case, access is facilitated and often supported by subsidies or reduced tariffs. Governance is public or public-private, with possible assignment via tender, concession, or agreement to cooperatives or local entities. This model promotes inclusivity and supports proximity-based economies, allows integration of additional functions such as lockers, charging points, or neighbourhood services, and can serve as a tool for urban regeneration by repurposing disused buildings or declining markets. At the same time, it presents challenges: the need for initial subsidies, risk of underuse without proper promotion, and complexity in managing multi-service operations

Governance approach

Public or public-private. Possible assignment via tender, concession, or agreement to cooperatives or local entities

Advantages

- Inclusivity and support for proximity-based economies
- Potential integration with other urban functions (lockers, charging, etc.)
- Tool for urban regeneration (reuse of disused areas or markets)

Challenges

- Need for subsidies or incentives in the initial phase
- Risk of underuse if not properly promoted
- Complexity in multi-service management

Examples (mapping)

Gothenburg – MOVE21: micro-hub serving professionals and soft mobility, in collaboration with the municipality

Regulatory/legal gaps

- Subsidy and incentive rules: Public support (e.g. reduced tariffs, grants) must comply with EU state aid rules, requiring justification and proportionality
- Space allocation procedures: Cities often lack transparent, replicable procedures for assigning disused buildings or public land to logistics use
- Multi-service complexity: Legal uncertainty around managing hybrid functions (e.g. lockers, charging stations, retail) under a single governance entity
- Local operator engagement: Absence of legal instruments to prioritise cooperatives or micro-enterprises in tenders or concessions

Market Dynamics and Competition Assessment

1. Fragmented Market Structure

Urban logistics is characterised by a highly fragmented landscape, with a mix of global couriers, national operators, local SMEs, and emerging cycle-logistics providers. This heterogeneity creates both opportunities and tensions:

- Large operators benefit from economies of scale and integrated systems
- Small actors often struggle with access to infrastructure, visibility, and regulatory compliance
- Micro-hubs can either reinforce fragmentation (if proprietary) or mitigate it (if shared or coordinated)

The governance model adopted directly influences market entry conditions, competitive balance, and service diversity.

2. Risk of Infrastructure Duplication

In proprietary models, each operator tends to develop its own network of hubs, vehicles, and delivery flows. This leads to:

- Redundant infrastructure in dense urban areas
- Inefficient use of public space
- Missed opportunities for consolidation and environmental impact reduction

Shared or coordinated models aim to address this but require robust governance and trust mechanisms to function effectively.

3. Barriers to Entry for SMEs

Access to micro-hubs is often conditioned by:

- Technical requirements (e.g. digital integration, vehicle standards)
- Financial thresholds (e.g. rental fees, insurance)
- Operational constraints (e.g. time slots, delivery volumes)

Without targeted support or inclusive governance frameworks, SMEs and local retailers may be excluded, undermining goals of proximity-based commerce and urban regeneration.

4. Competitive Neutrality and Fair Access

Ensuring fair access to shared infrastructure is a regulatory challenge. Key issues include:

- Avoiding preferential treatment for dominant players
- Defining transparent allocation criteria
- Managing conflicts over peak-hour access or high-demand zones

Public-private partnerships and consortia must embed competitive neutrality clauses to prevent market distortion.

5. Delegation and Service Contract Constraints

In coordinated last-mile models, operators may delegate delivery to third parties (e.g. cooperatives, cycle-logistics firms). However:

- Existing contracts with end customers may prohibit subcontracting
- Liability, service standards, and data sharing become complex
- Regulatory clarity is needed to enable flexible, multi-actor delivery chains

This affects the scalability and replicability of collaborative models.

6. Platform Dominance and Data Asymmetry

Digital platforms used for coordination (e.g. booking, routing, feedback) can become gatekeepers, especially if controlled by private actors. Risks include:

- Data monopolisation
- Exclusion of non-digitised operators
- Lack of interoperability with public systems

Cities must define governance rules for platform use, data access, and algorithmic transparency.

7. Public Space as a Competitive Asset

Access to curbside space, disused buildings, and strategic locations is a key enabler of micro-hub deployment. However:

- Allocation procedures are often opaque or ad hoc
- Dominant players may secure prime locations through lobbying or early investment
- Cities need clear, replicable frameworks for space assignment, balancing efficiency with equity

This is especially relevant for Model 4, where public space is leveraged to support SMEs and local commerce.

8. Strategic Role of Cities as Market Shapers

Municipalities are not just regulators—they are market actors. Through:

- Space allocation
- Procurement and concessions
- Incentive schemes
- Data governance

Political influence

1. Low Political Priority: "Goods Don't Vote"

- Observation:

Urban logistics often receives limited political attention compared to passenger mobility, public transport, or cycling infrastructure.

- Cause:

Freight users (logistics operators, SMEs, retailers) are not direct constituents in electoral terms. Their interests are diffuse, fragmented, and less visible.

- Implication:

Politicians may deprioritise logistics reforms unless linked to broader public benefits (e.g. air quality, urban regeneration, support for local commerce)

2. Resistance to Pricing Measures in ZTLs

- Challenge:

Increasing access fees to Low Emission Zones (LEZs) or ZTLs based on the "polluter pays" principle often faces political resistance

- Reason:

Fear of backlash from commercial stakeholders, local businesses, or voters concerned about rising costs

- Evidence:

Studies show that while LEZs improve air quality, their implementation is politically sensitive and often delayed or diluted

3. Fragmentation of Competences

- Issue:

Logistics governance often falls between departments (mobility, commerce, environment), leading to unclear mandates and diluted accountability

- Political effect:

Lack of a clear champion within city leadership; decisions are postponed or delegated without strategic ownership

- Risk:

Micro-hub initiatives may stall due to interdepartmental inertia or conflicting priorities

4. Limited Awareness of Logistics as a Strategic Lever

- Gap:

Politicians may not perceive urban logistics as a tool for achieving climate, equity, or economic goals

- Opportunity:

Framing micro-hubs as enablers of urban regeneration, support for SMEs, and climate-neutral delivery can elevate their political relevance

5. Short-Termism and Electoral Cycles

- Barrier:

Logistics reforms often require long-term investment and behavioural change, which may not yield visible results within a single mandate

- Effect:

Politicians may avoid endorsing disruptive measures (e.g. space reallocation, pricing reforms) that could provoke short-term opposition

6. Vulnerability to Lobbying and Status Quo Pressure

- Observation:

Large operators may exert pressure to preserve proprietary models and resist shared infrastructure or coordination schemes

- Risk:

Political decisions may favour dominant players, undermining inclusive governance and SME participation

Funding schemes

General Overview of Available Funding Instruments

Urban logistics and micro-hub deployment can be supported through a mix of EU, national, regional, and local funding schemes, including:

- EU Structural and Investment Funds (ESIF)

Support for infrastructure, SME competitiveness, and urban regeneration (e.g. ERDF, ESF+)

- Horizon Europe and Mission-Oriented Programmes

Funding for innovation, pilot projects, and governance models (e.g. MOVE21, URBANE, LEAD)

- Connecting Europe Facility (CEF)

Focused on TEN-T and urban nodes, including last-mile logistics and multimodal hubs

- National Recovery and Resilience Plans (NRRPs)

Country-specific investments in sustainable mobility, digitalisation, and urban transformation

- Local and Regional Funds

Often linked to Sustainable Urban Mobility Plans (SUMPs), PAESCs, or Climate City Contracts

- Public Procurement and Concession Models

Cities may allocate funding through tenders, service contracts, or long-term concessions

- Project Financing and PPPs

Used for mixed governance models, leveraging private capital with public guarantees or co-investment

Funding Specificities by Governance Model

Model 1 – Proprietary Systems

- Funding Type: typically self-financed by private operators
- Public Role: Limited to enabling conditions (e.g. permitting, access to space)
- Constraints: May be excluded from public funding due to lack of shared benefit or open access

Model 2 – Shared Infrastructure

- Funding Type: Eligible for EU and national co-funding (e.g. ERDF, Horizon Europe)
- Mechanisms: Public-private partnerships, consortia, or cooperative models
- Needs: Investment in neutral management entities, digital platforms, and shared equipment

Model 3 – Last-Mile Coordination

- Funding Type: Often supported through innovation grants or pilot schemes
- Mechanisms: Horizon Europe, local innovation funds, or cooperative subsidies
- Needs: Support for digital coordination tools, training, and SME inclusion

Model 4 – Public/Public-Private Micro-Hubs for SMEs

- Funding Type: Strong eligibility for structural funds, urban regeneration programmes, and PAESC-linked investments
- Mechanisms: Public tenders, concession models, or direct subsidies
- Needs: Initial capital for infrastructure, operating subsidies, and multi-service integration (e.g. lockers, charging stations)

Strategic Recommendations

- Combine funding sources: Blend EU, national, and local instruments to cover CAPEX and OPEX
- Align with climate and digital agendas: Link micro-hub projects to broader strategies (e.g. CCCs, PAESCs, Digital Europe)
- Use GO-X modules to simulate financial scenarios: Evaluate cost-benefit and funding leverage
- Engage stakeholders early: Co-design funding strategies with SMEs, cooperatives, and city departments

How to Co-Define the Best Governance Scheme

Cities aiming to implement micro-hubs should not be constrained to selecting a single governance model. Instead, a micro-hub network can—and often should—include a variety of hubs, each tailored to its territorial context, logistics function, and stakeholder composition. This adaptive approach allows for differentiated governance schemes that reflect the complexity of urban logistics ecosystems and the diversity of actors involved.

Stakeholder Typologies and Governance Implications

The governance model of each micro-hub should be co-defined based on the profile, resources, and expectations of the stakeholders who use or manage it. Four main categories can be identified:

- Large operators: These include international express couriers (e.g. UPS, DHL, FedEx), large retail chains (GDO), and global e-commerce platforms (e.g. Amazon, Zalando). They typically favour proprietary or market-driven models that allow full operational control and integration with their logistics networks. However, exclusive reliance on proprietary schemes risks urban fragmentation, infrastructure duplication, and limited coordination with other actors.
- Small and medium operators: This group includes cycle-logistics firms, local SMEs, artisans, and retailers engaged in direct-to-consumer delivery. Their needs differ significantly from large players: they require inclusive models that reduce fixed costs and ensure shared access to infrastructure. Public-private partnerships, cooperatives, or operator consortia are particularly suitable, offering economies of scale without compromising autonomy.
- Public or mixed entities: Local authorities, mobility agencies, and municipal companies can act as promoters, regulators, or guarantors of neutral access. They may provide public spaces (e.g. disused markets, parking lots) and assign management through tenders or concessions. Public or mixed governance enables alignment between system-wide goals (e.g. traffic reduction, equity, sustainability) and market dynamics.
- Hybrid or consortium-based configurations: These involve partnerships among public and private actors, large and small, organised into cooperatives or supply chain consortia. Such models aim to balance operational efficiency with fairness, facilitating shared standards, data exchange, and equitable distribution of costs and benefits.

Understanding the interplay between these stakeholder categories is essential to designing governance schemes that are both effective and inclusive.

Territorial Scale and Functional Role

The territorial scale and logistics function of the area served by a micro-hub significantly influence the appropriate governance model. Three main levels can be distinguished:

- Local micro-areas: These include neighbourhoods, low-traffic zones, or “15-minute city” districts. Governance should be flexible and proximity-oriented, favouring collaborative models inspired by door-to-door logic. Micro-hubs in these areas can integrate with local commerce and soft mobility (e.g. cargo bikes, pedestrian access), serving not only as distribution points but also as community-facing services.
- Intermediate areas or exchange nodes: Such as public parking lots, railway stations, or intermodal hubs. These are well-suited to multi-operator models with shared access rules and neutral management. Governance must ensure coexistence among actors, transparency in operations, and technological interoperability.
- Metropolitan or peri-urban zones: Including Urban Distribution Centres (UDCs) and logistics platforms located at city edges. These require more structured and centralised governance, high technical standards, and integrated metropolitan planning. Their systemic role involves coordinating flows across multiple supply chains and serving as bases for wider urban distribution.

In short, the narrower the territorial scope, the more flexible and collaborative the governance; the broader and more strategic the area, the stronger and more standardised the coordination required.

Site Selection and Spatial Typologies

The physical location of a micro-hub is a strategic determinant of its governance model. It affects the technical configuration, management scale, stakeholder profile, and operational logic. Based on LOCUS project documentation, several urban typologies emerge:

- Redevelopment areas: Disused markets, abandoned stations, or unused public buildings—ideal for integrated interventions with social value and multifunctional reuse.
- High-value zones: Historic centres or protected districts—require logistics compatible with environmental and aesthetic constraints.
- Underutilised private spaces: Vacant parking lots, warehouses, or industrial buildings—can be activated quickly through market-led initiatives.
- Mixed-use or intermodal parking areas: Already connected to public transport or other urban functions—suitable for light logistics conversion.
- Private-use parking: Within commercial or corporate premises—can host dedicated logistics solutions.
- Low-traffic districts and 15-minute neighbourhoods: Where vehicle access is restricted—micro-hubs can support local commerce and reuse municipal assets.

Logistics Compatibility and Economic Viability

The suitability of logistics chains for micro-hub integration depends on several key factors:

- Frequency and timing of urban access
- Load fragmentation and parcel size
- Proximity requirements to end users
- Willingness to share space and operations
- Technical and regulatory needs of transported goods

These elements guide the selection of governance models and infrastructure design.

To ensure long-term viability, micro-hubs must be economically sustainable and attractive to operators. Viability depends on balancing operational costs, business models, public incentives, and value-added services. Strategies include:

- Calibrated usage fees: Per parcel, time slot, or monthly access—adapted to operator size and volume
- Logistics-as-a-Service: Micro-hubs offer delivery capacity as a shared service to couriers, retailers, or platforms
- Mixed public-private revenue models: Income from fees and services is shared between public and private partners

Adoption can be accelerated through:

- Favourable regulations: Preferential ZTL access, extended permits, or relaxed restrictions for hub users
- Voluntary reward schemes: Accreditation mechanisms offering tangible benefits
- Initial incentives: Reduced rental fees, subsidies for cargo bikes or electric vans

Finally, micro-hubs should evolve into multifunctional spaces offering:

- EV charging and secure overnight parking
- Digital booking and real-time flow management
- Lockers and temporary storage for click & collect
- Integration with public transport and neighbourhood services

When supported by innovative business models, targeted incentives, and well-designed ancillary services, micro-hubs can become stable, high-impact infrastructures that foster urban regeneration and sustainable logistics.

Governance models for Dynamic Kerbside Management

Regulatory frameworks

1. **Multi-level allocation of responsibilities (avoid fragmentation)**

Overview:

Kerbside rules are mainly local, but enabling conditions often sit at higher levels (national/EU). If tasks are not aligned, cities face inconsistent rules, slow approvals, and weak enforcement—especially across borders

Relevance for dynamic kerbside management:

- Clarifies who sets rules (local), who enables tools (national/EU), and who supports coordination (regional/metropolitan)
- Supports scaling from single pilots to citywide or metro-wide schemes with fewer legal resets

Additional comments:

A practical setup benefits from formal coordination mechanisms (shared minimum requirements, data exchange, and clear boundaries on what cities can regulate)

2. **Legal instruments for allocating and re-allocating kerb space (static → dynamic)**

Overview:

Dynamic kerbside management needs a clear legal basis to assign (and reassign) curb uses by time, location, user type, and activity (loading, pick-up/drop-off, parking, charging, etc.). In practice, even pilots can require formal legal changes

Relevance for dynamic kerbside management:

- Enables time-based reallocation without constant legal disputes
- Makes rules enforceable (dynamic rules only work if they are legally valid and communicable)

Additional comments:

Practical barrier: each “use profile” may require a traffic regulation order (or equivalent) and signage, which can slow down dynamism unless the legal process is streamlined

3. **Pricing, permits, and revenue governance (manage demand + manage impacts)**

Overview:

Pricing, permits, monitoring and fines are core regulatory instruments for managing demand at the kerb. Shifting space away from parking can significantly affect municipal revenue, so the regulatory framework must address both demand management and fiscal impacts.

Relevance for dynamic kerbside management:

- Pricing curb access can replace or complement parking pricing to manage traffic and demand
- Permit systems can define who is allowed (e.g., freight, residents, disabled users) and under what conditions

Additional comments:

Pricing/permits can be seen as instruments, but they do not provide a detailed "best practice" formula for dynamic kerb pricing (levels, caps, etc.). That part would need additional sources later

4. Compliance and enforcement modernisation (rules without enforcement are just wishes)

Overview:

Dynamic kerbside rules require modern enforcement: proportionate, efficient and increasingly digital. Enforcement must also work for non-resident vehicles to avoid "impunity effects." As parking rights are increasingly linked to number plates, all numbered vehicles should be covered by clear enforcement procedures.

Relevance for dynamic kerbside management:

- Supports compliance with time- and location-specific rules
- Reduces illegal stopping/double parking that undermines freight efficiency and safety

Additional comments:

Key enabling needs include decriminalised enforcement (where appropriate), legal permission for tools like licence plate scanning (e.g., ANPR), and mechanisms for cross-border owner information exchange

5. Standardised, machine-readable kerb rules (make regulatory intent "computable")

Overview:

Dynamic kerbside management depends on translating curb rules into a format that apps, platforms, and enforcement systems can understand automatically. Common standards reduce ambiguity and make updates scalable

Relevance for dynamic kerbside management:

- Enables integration of curb rules into navigation/logistics apps and decision-support tools
- Improves monitoring and comparability across districts and cities

Additional comments:

The analysis points to the need for common referencing standards and highlight CDS (Curb Data Specification) and alignment with other mobility data standards; it also notes that curb regulation data is

often not standardised today. This also points to possible updates of national road codes and regulatory procedures so that kerb rules can be digitised and enforced consistently.

6. Data governance: access duties, privacy, security, and commercial sensitivity

Overview:

Kerbside governance increasingly relies on data (inventories, payments, telematics, sensor signals). Regulatory frameworks must balance public oversight needs with privacy, security, and commercially sensitive information

Relevance for dynamic kerbside management:

- Makes it possible to require operator data (as a condition of licensing/permission) to monitor impacts
- Protects citizens and operators while enabling evidence-based decisions

Additional comments:

The analysis mentions privacy/security/accountability needs and show practical mechanisms like trusted intermediaries. It does not define a full legal template (data minimisation rules, retention periods, lawful bases by jurisdiction)

7. Institutional capacity and operational readiness (skills, tools, and fragmentation)

Overview:

Even with good rules, dynamic kerbside management fails if cities lack capacity: data skills, urban logistics expertise, and cross-department coordination

Relevance for dynamic kerbside management:

- Ensures cities can maintain inventories, update rules, interpret data, and run pilots credibly
- Reduces reliance on ad-hoc workarounds and improves long-term sustainability of the system; parking fees and other user charges can also act as revenue generators and behavioural levers

8. Equity, accessibility, and exemptions (who is protected, who gets priority)

Overview:

Kerbside regulation must define fair access across user groups (residents, freight, shared mobility, disabled users) and ensure that design and enforcement do not exclude vulnerable groups

Relevance for dynamic kerbside management:

- Supports legitimate exemptions (e.g., disabled access) while preventing abuse
- Improves legitimacy of curb reallocation decisions

Additional comments:

The analysis discusses equity/accessibility principles and disabled parking enforcement needs, but it provides limited operational detail on how to design dynamic exemptions in practice

Governance models (overview)

Municipality-led regulator–operator model (in-house or enforcement concession)

Description

In this model, the city (local road/transport authority) leads dynamic kerbside management as a public function. It defines how kerb space is used (parking, loading/unloading, pick-up/drop-off, etc.), links it to broader mobility goals, and improves compliance through clearer rules, signage, payments and (increasingly) digital enforcement. The model can include time-based reallocation (e.g., parking by day, pick-up/drop-off by night) but still relies on formal local regulation and on-the-ground implementation.

Governance approach

City departments set kerb rules and allocate space (design → trial/pilot → adjust → scale), pay for infrastructure and enforcement (directly or via a contracted operator), and monitor impacts; users/operators (drivers, logistics firms, ride services) pay via fees/permits/parking charges and fines and must comply; national/EU levels enable the system by allowing modern enforcement tools and providing access to vehicle owner information for enforcement (including non-residents). Existing on-street parking operators can be considered as contracted operational partners where they already manage comparable payment, enforcement and user-facing processes.

Advantages

- Clear accountability:
one public actor sets priorities and resolves trade-offs
- Direct link to city objectives:
space can be reallocated to improve safety, access, and public space quality
- Better compliance potential:
digitised enforcement and simpler “easy-to-comply” systems improve effectiveness
- Revenue control:
the city can manage parking/kerb revenues and plan for revenue impacts when shifting kerb uses

Challenges

- Institutional fragmentation:
kerb data and responsibilities can be split across multiple departments
- Capacity and expertise gaps:
cities often lack resources and specialised know-how (especially on urban logistics)
- Compliance and enforcement remain hard:
even with pilots, illegal stopping/parking persists
- Dynamic use is less “legible”:
frequent changes by time/location can confuse users and require strong wayfinding and signage

- Political resistance:

reallocating kerb space away from parking can be contentious. This challenge can be mitigated through regulatory systems, geo-referenced areas and mobile ANPR, managing the same space for different users at different times of day

Examples (mapping)

- Washington, DC

temporary reallocation of parking to pick-up/drop-off at night; required multiple ordinance changes; enforcement and wayfinding issues during the trial [2]

- Paris

city-created interactive dataset of legal freight loading zones (location + rules, including flexible hours), usable online or embedded in third-party apps [2]

- Bremen

awareness actions showing impacts of illegal parking on emergency services (used to support compliance) [1]

- London “Street Types” and Seattle “Flex Zones” as strategic approaches to classify streets and set context-specific priorities for kerb space [2]

Regulatory/legal gaps

- Enabling framework gap:

cities may need national legislation that explicitly allows digitised / decriminalised enforcement and modern tools (e.g., plate scanning)

- Cross-border enforcement gap:

effective enforcement for non-resident vehicles requires secure access to ownership data and information exchange mechanisms

- Kerb reallocation complexity:

changing kerb use often requires formal legal acts/ordinances; even a single pilot may require multiple regulatory changes

- Dynamic kerb legality and signage burden:

each time/location use profile may require a formal legal basis and associated signage, slowing down “dynamic” implementation

Dedicated Curb Authority / multi-stakeholder adjudication body

Description

In this model, the city creates (or empowers) a dedicated body to manage competing kerbside demands. The focus is to mediate trade-offs (freight loading, passenger pick-up/drop-off, parking, bus/bike access, safety) and to reallocate kerb space with high flexibility, potentially moving toward real-time adjustments. It relies on structured stakeholder engagement, clear performance criteria, and operational coordination across agencies.

Governance approach

A curb authority (or cross-agency working group) convenes stakeholders, defines priority rules and KPIs, runs pilots and reallocates space over time, while the city funds the unit/enforcement (sometimes with contracted support) and recovers costs through permits/fees/fines, requiring operators to share data as a condition to operate.

Advantages

- Better conflict resolution:
a single place to settle "who gets the curb, when" based on agreed priorities
- Cross-department coordination:
reduces silos between transport, parking, police, planning, logistics
- More adaptive management:
easier to test, adjust, and scale dynamic kerbside measures
- More credible decision-making:
stakeholder input + KPIs make trade-offs more transparent

Challenges

- Needs a strong mandate:
without real authority, it becomes a "talking shop"
- Time and transaction costs:
convening stakeholders and negotiating rules takes effort
- Data access and trust:
operators may resist sharing; public bodies may struggle to handle sensitive data
- Enforcement still matters:
flexible allocation fails if compliance is low
- cities may need to reframe dynamic kerbside management as an extension of digitalised parking management to all vehicle types

Examples (mapping)

- Washington, DC (Dupont Circle area):
a stakeholder working group (Business Improvement District + multiple city agencies + nightlife venues) designed and monitored a trial reallocating parking to night-time pick-up/drop-off; the BID acted as a third-party holder for sensitive ride-service data. [2]
- San Francisco:
pilot programme developed by the transport agency at the request of the mayor, involving public agencies and private stakeholders, with performance criteria and a focus on reallocating kerb space to reduce illegal stopping. [2]
- FUA-level coordination frameworks (e.g., city-regions supporting municipalities on parking policy):
examples of supra-municipal governance arrangements used to coordinate local implementation. [1]

Regulatory/legal gaps

- Mandate gap:

unclear legal authority for a dedicated body to overrule or coordinate multiple agencies and municipalities

- Pilot-to-legal change friction:

even temporary reallocation can require multiple ordinance changes, slowing iteration

- Data governance gap:

lack of standard, lawful mechanisms for operator data sharing, third-party data holding, and privacy-safe use

- Enforcement powers gap:

flexible rules require enforceable instruments and legally supported digital enforcement tools

"Coding the Curb" open-standard civic data commons model

Description

In this model, the kerb is managed through a shared digital "language": every kerb segment is mapped and its rules are translated into machine-readable data. The goal is to make kerb rules clear, consistent, and usable by digital services (navigation, freight apps, enforcement tools, city analytics). Instead of each operator inventing its own map and interpretation, the city promotes (or requires) open standards and common datasets, so that rules can be updated once and reused by many actors. This model is often a prerequisite for dynamic kerbside management, because dynamic rules only work if they can be communicated and understood in real time. This builds on capabilities that parking operators in most European countries have used for years in managing on-street spaces (about 18 million street spaces), but extends them to a wider range of kerb users and use cases.

Governance approach

The city (or a public lead partner) funds and maintains the official kerb inventory and rule set in an open standard, operators contribute usage/demand data under clear conditions, and tech/app providers build services on top of the shared data, while the city uses the same dataset to monitor outcomes and support enforcement.

Advantages

- One source of truth:

fewer conflicting maps and fewer "grey zones" for users and operators

- Scales across services:

the same kerb data supports freight, ride pick-up/drop-off, parking management, and enforcement

- Faster updates:

when rules change, updates propagate digitally instead of relying only on static signage

- Enables innovation:

third parties can build tools (apps, routing, compliance) without starting from zero

Challenges

- Data quality and maintenance burden:

mapping, keeping rules up to date, and managing edge cases is hard work

- Complex rules are hard to encode:

time windows, exemptions, vehicle types, and local exceptions increase complexity

- Governance and ownership disputes:
who owns the dataset, who validates changes, who is liable for errors

- Incentives for sharing:
private operators may not want to share operational data without clear value and safeguards

Examples (mapping)

- Paris:
interactive dataset of legal freight loading zones (including location and rules, with flexible hours) and option to embed the data in third-party apps. [2]

- FlexCurb pilots (4 cities):
uses the Curb Data Specification and combines a city platform (inventory and analysis) with a driver app to guide legal loading and reduce cruising/double parking. [3]

Regulatory/legal gaps

- Data standardisation gap:
no universal obligation or consistent rules to publish kerb regulations in machine-readable form

- Data-sharing and privacy gap:
unclear legal basis and safeguards for sharing operator data (telematics, trip patterns) while protecting privacy and commercial sensitivity

- Liability gap:
unclear responsibility when digital kerb information is wrong or outdated and causes operational or safety problems

- Procurement/lock-in risk:
cities may adopt tools without ensuring data portability and open access, limiting long-term governance control

Digital managed-service platform model (vendor-led / PPP, potentially proprietary components)

Description

In this model, dynamic kerbside management is delivered as a digital service by a technology provider (sometimes in a public–private partnership). The provider supplies the core tools the city often lacks: a platform to build and maintain a kerb inventory, analyse demand and conflicts, and support decisions; and sometimes apps/APIs that help drivers find legal (and likely available) space. The model is practical when cities have limited capacity, because it bundles software, data integration, and operational support into one managed solution.

Governance approach

The city sets objectives and operating rules and pays the provider (contract/PPP) to deploy and run the platform, the provider builds/operates the digital system and integrates data, and users/operators pay indirectly (fees/permits/charges, and fines when non-compliant), while the city uses the platform outputs to adjust allocation and improve enforcement.

Advantages

- Fast capability upgrade:
cities can deploy advanced tools without building everything in-house
- Better operational usability:
apps can reduce cruising, double parking, and rule confusion for drivers
- Stronger analytics:
helps quantify demand–supply gaps and test policy options with data
- Supports scaling:
once the system is built, it can expand to more streets, use cases, and time bands

Challenges

- Vendor dependence and lock-in risk:
the city may lose control if data and logic are not portable
- Data integration complexity:
combining kerb rules, signage, telematics, and sensors is difficult
- Enforcement and compliance still required:
digital guidance helps, but does not replace enforcement
- Equity and access concerns:
benefits may concentrate on digitally equipped operators; smaller actors may lag
- Ongoing costs:
subscriptions, updates, support, and data maintenance are continuous, not one-off

Examples (mapping)

- FlexCurb pilots (4 cities):
a managed digital solution combining a city platform (inventory + analytics) and a driver app to guide legal loading and reduce double parking/cruising; uses limited sensors plus fleet telematics and standardised kerb data. (Source: Curbside Management: A Digital Solution Space Optimisation (Rothbard et al., 2025))

Regulatory/legal gaps

- Procurement and governance gap:
contracts may not require open standards, interoperability, and data portability, creating lock-in
- Data governance and privacy gap:
unclear rules on collecting/using fleet telematics, sharing with the city, and protecting commercial sensitivity
- Accountability gap:
unclear responsibility if the platform's guidance is wrong, outdated, or causes safety/operational issues
- Enforcement enablement gap:
digital systems work best with legally supported digital enforcement tools, which may not be fully enabled everywhere

Market dynamics and competition assessment

1. The curb becomes a scarce “marketplace” (competition for access)

Overview:

Dynamic kerbside management sits in a context where many actors want the same limited space: private car parking, freight loading/unloading, ride pick-up/drop-off, micro-mobility, maintenance, etc. As new on-demand and delivery services grow, the main competition shifts from “road space” to curb access at the right time and place

Why it matters:

- Allocation decisions create winners and losers (by user type, location, and time window)
- Curb access becomes a critical operational input for private services

2. Platform-based mobility increases competitive pressure at the curb

Overview:

Ride services organised through digital platforms generate large volumes of pick-up/drop-off events and intensify competition in dense areas. Platforms also influence user demand through app-based dispatching and pricing mechanisms

Why it matters:

- Cities face pressure to adapt curb rules faster than traditional planning cycles
- Platform-driven operations can change traffic patterns and curb demand quickly

3. Regulation shapes market entry (permits, fees, operating conditions)

Overview:

Entry and scale for curb-using services depend heavily on local rules: permits, operating zones, fees, and compliance obligations. The design of these rules affects how many players can realistically participate

Why it matters:

- Complex permit systems can favour actors with legal/operational capacity
- Clear and consistent rules lower compliance costs and reduce “grey zones”

4. Pricing and revenue are part of market design (not just finance)

Overview:

Pricing curb use (and not only parking) is presented as a way to manage demand and maintain the ability to steer traffic. At the same time, shifting curb space away from parking can reduce municipal revenues, which can create institutional resistance to change

Why it matters:

- Pricing can change competitive behaviour (where and when operators concentrate)
- Revenue dependence can bias decisions toward "parking-first" outcomes

5. Data asymmetry and interoperability affect competition (gatekeeper risk)

Overview:

Operational data is often held by private operators and platforms, while cities need data to monitor impacts and adjust policies. Without interoperability and common standards, the actors with the best data (or the biggest data systems) gain an advantage

Why it matters:

- Data access can become a de facto entry barrier
- Open, machine-readable curb rules reduce information advantages and improve fairness

6. A vendor market is emerging for "kerb management as a service"

Overview:

Digital solutions (platforms + apps + data integration) create a supplier market of technology providers supporting cities and operators. This can accelerate deployment, but it also introduces competition issues linked to procurement choices and system design

Why it matters:

- If a city adopts a closed solution, it can tilt the playing field toward selected providers
- Open standards help keep the ecosystem contestable (multiple providers can connect)

7. Large operators vs SMEs (capacity gap as a competitive factor)

Overview:

Some solutions rely on telematics data, system integration, and digital workflows. Larger logistics providers and organised fleets are more likely to participate effectively, while smaller operators may struggle without support

Why it matters:

- Competition may shift toward actors that can integrate digitally and comply at scale
- Cities may need specific engagement channels for SMEs to avoid exclusion

Political influence

Parking space reallocation as the "make-or-break" political issue

- Observation:

Changing kerb use (especially reducing general parking) quickly becomes political

- Cause:

Parking is visible, personal, and tied to daily routines; losses feel immediate, while benefits (safety, access, reduced congestion) are less tangible

- Implication:

Political support often depends on clear framing ("what the city gains"), strong communication, and visible enforcement to avoid chaos

Revenue politics (money drives decisions, even when nobody admits it)

- Observation:

Kerb decisions are strongly influenced by revenue effects from parking and related charges

- Cause:

Reallocating kerb space can reduce parking income and create budget pressure for cities

- Implication:

Policies may be watered down or delayed unless there is a credible plan for revenue impacts and reinvestment

Stakeholder pressure and local lobbying (businesses, freight, nightlife, platforms)

- Observation:

Kerbside allocation creates immediate conflicts among organised interests (retailers, freight operators, ride services, residents)

- Cause:

Each group depends on kerb access for operations or quality of life, and they can mobilise fast

- Implication:

Cities often need structured stakeholder processes or mediators to keep decisions stable and prevent constant reversals

"Pilot politics": safer than full reform, but easy to get stuck

- Observation:

Cities often prefer pilots and trials over permanent kerb reforms

- Cause:

Pilots signal action while limiting political risk and allowing rollback if backlash grows

- Implication:

Without a clear pathway from pilot → rules → enforcement → scaling, dynamic kerbside management can stall in repeated experiments

Internal city politics and fragmentation (everyone touches the curb, nobody owns it)

- Observation:

Kerbside management spans transport, parking, police/enforcement, planning, digital/innovation, and sometimes logistics policy

- Cause:

Responsibilities and data are split across departments and systems

- Implication:

Without a clear political sponsor and operational lead, coordination failures slow decisions and weaken enforcement. The operational lead should sit with the authority responsible for road-space use, with kerbside management treated as a core component of that mandate

Data sharing and privacy as politically sensitive trade-offs

- Observation:

Cities need data from operators to manage the kerb effectively, but data access can become controversial

- Cause:

Operator data can be commercially sensitive; some datasets can raise privacy concerns if mishandled

- Implication:

Political acceptability improves when data governance is credible (clear purpose limits, trusted intermediaries, and transparency on what is collected and why)

Vendor influence and procurement choices shape the "story" of what's possible

- Observation:

Technology providers can strongly influence how cities imagine kerbside solutions (platform-first narratives, proprietary toolchains)

- Cause:

Cities often lack specialised capacity, so vendors bring both tools and "the model"

- Implication:

Political leaders may gravitate to "quick tech wins," increasing lock-in risk unless standards and portability are protected

Equity and accessibility as hard political boundaries

- Observation:

Kerb rules can be politically challenged if they are seen as unfair (e.g., excluding smaller operators or vulnerable users)

- Cause:

Dynamic systems can advantage digitally equipped fleets; enforcement can disproportionately hit some groups if not designed carefully

- Implication:

Equity safeguards (exemptions, accessible design, fair enforcement) are often required to keep political legitimacy

Funding schemes

1. Main funding sources (who pays)

Dynamic kerbside management can be financed through a mix of public budgets and user-based revenues, with private actors funding their own operational tools

- User fees and permits
  - Parking fees (on-street and off-street), time-based charges, and permit fees
  - New "space occupancy" fees for specific curb users (e.g., shared mobility parking/areas, charging spaces)
- Fines and enforcement-related income
  - Fines support compliance and can also contribute to the financial model (where legally allowed)
- Earmarked revenues
  - Part of parking/curb revenues can be ring-fenced to fund sustainable mobility measures (and increase public acceptance through transparency and participatory budgeting)

- Local government budgets
  - Funding for curb reallocation measures, signage/wayfinding, staff capacity, and enforcement operations
- Higher-level public support (EU / national / regional)
  - Financial and technical support programmes for sustainable urban mobility measures, including parking/curbside management and digitalisation
  - Innovation funding for pilots and tool development
- Public–private partnerships, tenders, concessions, service contracts
  - Cities can procure "kerb management as a service" (platforms, data integration, apps, analytics) through contracts designed to reward innovation
- Private sector investment
  - Operators invest in fleet systems (telematics), driver tools/apps, and integration with city rules and payments (including company-based payment workflows)

2. What funding is typically needed (CAPEX vs OPEX)

- CAPEX (upfront investment)
  - Creating/updating a curb inventory and encoding regulations in digital form
  - Digital payment and access systems (e.g., plate-based recognition, multi-channel payments)
  - Limited sensors and supporting infrastructure (where used)
  - Initial system integration (city data portals, operator data feeds, apps/APIs)

- OPEX (ongoing costs)
  - Continuous rule updates and data maintenance (including specialist support where encoding is complex)
  - Enforcement operations and monitoring
  - Platform licensing/hosting/support (for managed-service solutions)
  - Stakeholder engagement, communications, and change management

3. Funding logic across phases (setup → pilot → scale → operations)

- Setup phase
  - Mostly public funding (staff time, inventory building, basic digitalisation), sometimes supported by higher-level programmes
- Pilot phase
  - Often supported by innovation funding plus city operational resources; pilots generate evidence and refine data needs
- Scale-up phase
  - Higher demand for stable funding: digital backbone, enforcement capacity, and integration across areas and user groups
- Operational phase
  Sustainability depends on a clear "end-state money model":
  - recurring user fees/permits/occupancy charges, plus
  - fines (where legally and politically acceptable), plus
  - public budget for public-good functions (equity safeguards, oversight, coordination)

4. Procurement and contracting as a funding mechanism

When cities procure digital kerbside services, funding can be structured through:

- Service contracts / concessions
  - City pays the provider to deploy and operate tools; provider delivers platform/app capabilities and integration
- Innovation-friendly tender design
  - Contracts can reward innovation, skills, and data quality rather than only lowest price
- Data and interoperability conditions
  - Funding choices should protect long-term contestability (avoid lock-in) by requiring standardised, reusable curb data outputs

Explicit gap: the analysis recommends tender/concession approaches but does not give a detailed template for performance-based payments (KPIs, bonus/penalty formulas).

5. Strategic recommendations (cross-cutting)

- Plan the "revenue transition" early
  - If shifting curb use reduces parking revenue, define how to replace it (e.g., curb access/occupancy fees) and how to reinvest
- Use transparency to protect political support
  - Make revenue use visible and linked to mobility improvements; participatory budgeting can increase acceptance
- Fund capability, not only tech
  - Staff capacity, enforcement readiness, and data maintenance are ongoing costs, not one-off extras
- Keep the ecosystem contestable
  - Use standards and procurement clauses that preserve data portability and avoid single-vendor dependency

How to co-define the best governance scheme

Cities should not force dynamic kerbside management into one single governance model. A kerb programme can combine different schemes across street types, use cases, and maturity stages (pilot vs scaled operations). The key is to co-define a scheme that matches local objectives, stakeholder power, operational readiness, and tolerance for disruption

1. Start from "public purpose", not from the tool

Define what dynamic kerbside management is allowed to achieve (and what it must not cause). Keep it simple and measurable.

- reduce illegal stopping and improve safety and emergency access
- improve access and reliability for deliveries and essential services
- support public transport, walking/cycling (do not undermine them)
- reduce cruising, double parking, and congestion impacts
- protect liveability and public space quality

2. Choose the initial kerb use cases and operating context

Different contexts need different governance intensity. Start where complexity is manageable.

- freight loading/unloading management (commercial streets, high delivery demand)
- pick-up/drop-off management (nightlife zones, stations, busy intersections)

Time-based reallocation (different rules by hour/day)

- sensitive streets (bus corridors, school streets, emergency routes)
- "street types" approach: assign priorities by street function before adding dynamics

3. Build the baseline: inventory first, then "rules that computers can read"

Dynamic management collapses without an authoritative baseline.

- map kerb segments and current rules (who can do what, where, when)
- encode rules in a machine-readable format so updates propagate consistently
- decide governance for updates: who proposes changes, who validates, how fast updates go live
- treat signage/wayfinding as part of the system (dynamic rules must still be understandable on-street)

4. Map stakeholders and their governance implications

Co-definition works only if you clarify who has leverage, who bears risk, who pays, and who is accountable.

- city departments (transport, parking, police/enforcement, planning, digital): set direction, allocate space, enforce rules
- freight/logistics operators: need predictable loading access; provide operational insight and (sometimes) data
- ride services / pick-up-drop-off generators: create spikes in demand; must comply with zones/time windows
- local businesses and residents: political legitimacy; daily impacts; feedback loops

- BIDs or local intermediaries: can coordinate pilots and mediate conflicts in dense areas
- tech providers / data holders: can enable the system but may create dependency if not governed well

5. Select a governance mix, not a single "winner"

Pick the combination that fits your capacity and risk tolerance.

- municipality-led for clear accountability and enforcement authority
- curb authority / adjudication body when conflicts are high and coordination is weak
- open-standard "coding the curb" when you want interoperability and market contestability
- managed-service platform when city capacity is limited and speed matters

Decision rule: if the city wants long-term control and competition, protect standards + portability; if the city needs fast capability, use a service model but lock in data ownership and interoperability from day one.

6. Agree on data-sharing rules early (or the scheme will be blind)

If the city wants to steer outcomes, it must secure a minimum dataset and clear conditions.

- what data is required (rules, inventory updates, usage/demand indicators where feasible)
- frequency and format (standardised, comparable)
- privacy and commercial sensitivity safeguards
- who can access what (city teams, auditors, public transparency where appropriate)
- what happens if data is missing, inaccurate, or withheld

If trust is low, use a neutral data-handling arrangement (e.g., third-party or controlled access).

7. Design compliance: "easy to comply" + credible enforcement

Dynamic kerb rules only work when compliance is realistic.

- simplify rules and make them legible (users cannot follow what they cannot understand)
- combine digital guidance (apps/APIs) with physical signals (signage/markings)
- modernise enforcement where legally possible (digital payments, plate-based checks)
- address "non-resident" enforcement where relevant (otherwise compliance becomes optional for outsiders)

8. Decide "who pays for what" with a simple split

Keep the financing logic transparent and stable across phases.

- public side typically pays for: inventory, rule management, signage, enforcement capacity, monitoring, coordination
- private side typically pays for: fleet tools/telematics, operational integration, driver workflows, internal compliance processes
- user-based revenues typically come from: fees/permits/charges (and fines where legally allowed)

Also plan the political reality: reallocating space away from parking can hit revenue—define early how that gap is managed and how revenues are reinvested

9. **Use a staged process with "pilot-to-scale gates"**

Avoid endless pilots by defining stage transitions upfront.

- Stage 0: design + conflict framing (priorities, street types, baseline inventory)
- Stage 1: small pilot (limited geography/time window; clear rules; strong monitoring)
- Stage 2: expanded pilot (more streets, more users, tighter enforcement)
- Stage 3: operational deployment (stable processes for updates, data, enforcement, funding)
- Stage 4: scaling/replication (standardised playbook across districts)

For each gate, agree in advance:

- what evidence is required (compliance, safety impacts, reduced double parking, reduced cruising)
- who validates it (city team, curb authority, third party where needed)
- decision options (scale, adjust, pause, stop)

Governance models for CCAM

Regulatory frameworks

1. **Multi-level allocation of responsibilities (avoid "patchwork")**

Overview:

CCAM governance is split across levels of government (e.g., UNECE/EU/national/city or federal/state/city). Some issues are mainly technical and safety-related, while others concern permits, road operations, insurance, and urban impacts. If responsibilities are not aligned, the result is a patchwork: different rules across jurisdictions, duplicated procedures, and uncertainty for operators and cities.

Relevance for CCAM:

- Clear division of tasks:

reduces overlaps and "who decides what" conflicts

- Consistent scaling conditions:

deployments can be replicated across areas with fewer rule changes

- Less regulatory uncertainty:

reduces delays and legal risk when moving from pilots to wider operation

Additional comments:

A practical framework needs explicit coordination mechanisms (common minimum requirements, information exchange, and clear boundaries on which level can regulate what).

The regulatory building blocks for autonomous vehicles combine technical type approval with conditions for commercial deployment, within fragmented but evolving global frameworks. In Europe, AV regulation is anchored in EU Regulation 2022/1426 and complemented by national regimes in countries such as Germany, France, Switzerland, Spain, and Croatia, creating an urgent need for harmonisation, whereas the United States relies on a self-certification, trial-and-error model that varies by state, and China applies a

comprehensive framework characterised by strong government control. Permit allocation by authorities is often perceived as opaque, while UNECE aims to introduce a more harmonised regulation by June 2026. Across all regions, self-driving systems must complete the dynamic driving task within their operational design domain, comply with traffic rules, avoid accidents, prioritise property damage over personal injury, exclude any discrimination based on human characteristics, and ensure data storage and exchange with authorities. Beyond technical approval, operators typically require a regional licence to operate in a targeted operating domain, which risks overlap and duplication of requirements, increasing costs and delays. In Europe, enabling driverless operation generally involves three steps: ADS type approval under EU or national rules, vehicle registration with compulsory insurance, and an operating permit for defined routes, often including local testing and human technical supervision. Safety and risk are central concepts, supported by standards such as ISO 26262 and ISO 21448 (SOTIF), alongside GSR, Euro NCAP, GDPR, and global UNECE, IEEE, SAE, and ASAM standards, yet ethical and legal safety dimensions remain insufficiently covered by purely technical definitions. While Europe clearly follows a "safety first" approach, the lack of a standardised, practical, and scalable application of the legal framework, combined with limited real-world experience, makes AV homologation complex, prompting industry calls for clearer, scenario-based safety verification pathways to accelerate deployment.

2. Vehicle safety standards and "type approval" modernisation

Overview:

Many safety rules were written for vehicles with human drivers and assume traditional driver-centric design. CCAM requires updating these rules, so they remain safety-robust without blocking innovation. A common approach is to keep safety objectives but revise technical requirements so they fit automated driving systems.

Relevance for CCAM:

- Legal operability of new vehicle designs:
enables automated vehicles that do not match traditional layouts
- Safety-first baseline:
creates a minimum safety floor for public trust and acceptance
- Innovation without obsolete barriers:
removes requirements that no longer improve safety in automated contexts

Additional comments:

This layer must connect to local deployment rules: safe vehicle design is necessary, but not sufficient to manage service-level impacts in cities.

3. Testing and deployment permissions (permits, exemptions, staged access)

Overview:

CCAM usually enters cities through permissions that enable testing and operation under defined conditions. Higher authorities may allow exemptions/waivers in the near term, while local/regional

authorities manage permits for testing and operations. If designed well, this creates a formal path from experimentation to deployment.

Relevance for CCAM:

- Controlled experimentation:

pilots run on designated routes or constrained areas to reduce risk

- Stepwise scaling:

permissions can expand as capability and evidence grow

- Faster learning under uncertainty:

real-world trials reduce reliance on assumptions

Additional comments:

A recurring gap is the “ladder”: clear criteria for moving from test → limited service → wider deployment, and who signs off at each step.

4. Disclosure and transparency duties (safety compliance, malfunctions, incidents)

Overview:

Regulators may promote or require transparency about safety, malfunctions, and incidents. In early phases, transparency may also rely on voluntary industry disclosures. The goal is to enable oversight and trust without forcing a single technical solution.

Relevance for CCAM:

- Trust building:

visibility on safety and incidents supports acceptance

- Better oversight:

authorities can detect recurring failures and respond faster

Additional comments:

Disclosure works best when formats are standardised and comparable, and when responsibilities for noncompliance are explicit.

5. Data governance, privacy, and cybersecurity (as a regulatory backbone)

Overview:

CCAM depends on data (connectivity, sensors, platforms) and generates large volumes of operational data. Governance can increasingly rely on data access (mandatory reporting or partnerships) and may shift from descriptive rules to measurable indicators and thresholds. This requires clear rules on privacy, cybersecurity, and commercial confidentiality.

Relevance for CCAM:

- Evidence-based regulation:

makes it possible to steer outcomes like safety and congestion

- Service-level governance:

covers not only the vehicle, but also fleet operations and mobility services

- Risk management:

privacy/cyber rules reduce exposure and increase confidence

Additional comments:

Authorities need skills and tools to use data responsibly; lack of capacity and trust can block public–private data cooperation.

6. Liability, insurance, and accident responsibility

Overview:

Automation shifts responsibility away from a human driver toward software and system performance, involving operators, manufacturers, and possibly remote supervision. Traditional collision liability frameworks can be unclear when there is no “driver” in the usual sense, creating uncertainty that slows adoption.

Relevance for CCAM:

- Deployment prerequisite:

unclear liability discourages operators, insurers, and cities

- Consumer confidence:

users expect clear accountability when incidents happen

Additional comments:

A workable framework needs explicit allocation of responsibility across the CCAM chain (vehicle, software, remote operations, service provider).

7. Infrastructure and communications alignment (roads, traffic management, connectivity)

Overview:

CCAM performance depends on infrastructure readiness and connectivity. Regulatory frameworks therefore touch both physical infrastructure (road quality, signage, traffic systems) and digital infrastructure (communications governance). Public–private cooperation is often needed to accelerate readiness.

Relevance for CCAM:

- Operational safety and reliability:

infrastructure adequacy is a key adoption factor

- System-level benefits:

supports better traffic management and information sharing

Additional comments:

Infrastructure alignment should be coordinated with city measures (pick-up/drop-off management, parking, street design) to avoid unintended congestion effects.

8. Urban planning and "soft law" integration (SUMPs and cross-sector strategies)

Overview:

Cities often steer CCAM through planning documents that are not legally binding but shape priorities and acceptable pathways. These plans can be spread across transport, smart city, climate, and development strategies. They can guide CCAM toward shared and sustainable mobility—or allow drift toward car-centric outcomes if goals are vague.

Relevance for CCAM:

- Strategic direction:

defines what CCAM should support (e.g., multimodal integration, accessibility)

- Policy coherence across sectors:

reduces contradictions between transport, climate, and digital agendas

Additional comments:

Soft law needs a bridge to enforceable tools (permits, conditions, budgets). Otherwise, it remains intent with limited impact on deployments.

Governance models (overview)

Operator-led deployments (proprietary platform model)

Description

In this model, the service is designed and controlled primarily by a private or public operator (e.g., a public transport operator, a mobility platform/TNC, sometimes together with an OEM). The operator defines the "package" of the offer: service type (robotaxi, automated shuttle as a service), where it runs, how users access it (typically app-based), pricing, fleet management and the operational concept. This comes from the logic of app-based mobility platforms that already operate in the for-hire market and are now moving toward automated fleets because of major cost-saving potential.

In practice, early deployments often start in restricted operational settings chosen by the operator to reduce complexity and risk, for example:

- low-speed operations
- controlled or semi-controlled environments (campuses, pedestrian zones)
- remote supervision (a staffed remote operation centre)

- sometimes dedicated or partially segregated infrastructure

This model tends to create regulatory pressure because it brings “new players” into markets that are often heavily regulated (e.g., taxis), and authorities may struggle to react fast enough when a platform scales quickly.

Governance approach

The operator defines the service and runs it end-to-end (design → pilot → scale) and finances the fleet/operations (recovering costs through user fares), while public authorities mainly authorise and supervise basic safety/compliance and adjust conditions after deployment if impacts emerge (often supported by operator-led transparency such as voluntary safety disclosures).

Advantages

- Speed and scalability:

platforms can scale quickly thanks to capital and strong user uptake (observed with TNCs)

- Operational efficiency and consumer benefits:

app-based services can deliver efficiency gains and convenience, which makes them attractive to users

- Rapid learning from pilots:

controlled deployments allow iterative improvement before wider rollout

Challenges

- Regulatory conflict with incumbents:

the model disrupts heavily regulated legacy services (e.g., taxis), creating political and legal tension

- Authorities “behind the curve”:

fast change can catch regulators off-guard, especially when services do not fit existing categories

- Public trust and safety expectations:

acceptance depends strongly on safety; if safety is not clearly demonstrated, uptake stalls

Examples (mapping)

- Uber–Volvo and Lyft–Ford cooperation concepts combining e-hailing platforms and highly automated vehicles
- Large trials already taking place (e.g., Waymo; Uber/Volvo partnership mentioned as trials)
- More recent examples are: Waymo; Bolt-Pony.ai-Stellantis; Uber-Waymo; MOIA-VW-Mobileye; Verne-Pony.Ai; De Lijn-WeRide; BVG Berlin-MOIA; Uber-MOIA-Mobileye; HOLON-Mobileye

Regulatory/legal gaps

- Category/fit gap:

platform-based services may not fall under existing regulatory structures; automation blurs old legal categories

- Service regulation gap:

governing the vehicle alone is insufficient if the automated fleet is deployed as a competing mobility service

- Liability ambiguity:

global legal gaps make it hard to assign liability (operator vs manufacturer), and automation raises questions about software responsibility

- Data/privacy vs operational needs:

privacy concerns and data protection requirements can clash with operational data needs

Data-led, performance -based regulation (KPI governance)

Description

This model regulates CCAM services by focusing on measurable outcomes instead of detailed, prescriptive rules. This model does not define a full CCAM system design; it provides a data-driven way to monitor and steer services once they are deployed and scaling. Traditional "descriptive" requirements (what a provider must do, step by step) are translated into quantifiable targets and indicators linked to public goals (e.g., safety, congestion, consumer protection, sustainability).

Regulators get access to operational data (through mandatory reporting or data-sharing partnerships). They use analytics to run a dashboard-style oversight: if a service crosses predefined policy/performance thresholds, it is flagged and triggers review or corrective action.

The key idea is: flexibility for operators, control for the public sector. Operators can choose lighter, less burdensome compliance paths as long as they provide the information needed to prove that public outcomes are being met.

Governance approach

The public authority sets the policy objectives and the KPIs/thresholds, builds (or appoints) a data-reporting and monitoring system, and intervenes when indicators show problems; the operator funds and delivers data collection/reporting and adjusts operations to stay within thresholds, while the public side pays (at least) for oversight capacity and enforcement.

Advantages

- More flexible regulation:

rules can adapt as technology and business models change

- Faster problem detection:

issues like congestion impacts or market abuse can be seen early through data signals

- Targeted enforcement:

interventions are triggered by evidence (breaches of thresholds), not by blanket restrictions

- Innovation-friendly:

operators can experiment with different operational solutions, as long as outcomes stay within limits

- Comparable oversight:

KPIs make it easier to compare performance across operators and over time

Challenges

- Data access and quality:

without reliable, standardised data, the whole model collapses

- Public capability gap:

authorities need skills, tools, and staffing to analyse data and act on it

- Privacy and cybersecurity:

more data sharing increases exposure and public concern

- Gaming the metrics:

operators may optimise for KPIs while creating side effects not captured by the indicators

- Choosing the "right" KPIs:

thresholds must reflect what society actually wants, not just what is easy to measure

Examples (mapping)

- US (NHTSA): mandatory crash reporting for ADS + Level 2 ADAS (Standing General Order 2021-01)
- California (DMV): annual "disengagement reports" for AV testing programs
- California (CPUC): quarterly reporting for AV Passenger Service pilot programs

Regulatory/legal gaps

- Legal basis for data access: clear powers to require reporting, define formats, and ensure compliance.
- Data governance rules: who owns what data, what can be shared, for what purpose, and under what safeguards
- Accountability mechanisms: what happens when thresholds are breached (sanctions, service limits, permit changes)
- Third-party reporting framework: rules for "vetted" external reporting systems (validation, liability, conflicts of interest)
- Alignment with public goals: a formal way to ensure KPIs reflect societal objectives, not only operational convenience

City-led strategic planning and soft-law integration (SUMP/urban policy model)

Description

In this model, the city leads CCAM governance mainly through planning and strategy rather than hard law. The city sets a shared vision of what CCAM should deliver for the urban system, such as less congestion, better access, and more liveable streets, and then anchors CCAM within existing policy frameworks such as the SUMP, smart-city plans, climate plans, and wider urban development strategies. In the Italian context, for example, the PUMS framework provides a clear institutional anchor for this approach, since it is mandatory for metropolitan cities. Yet, in practice, very few Italian SUMPs explicitly address CCAM integration. Turin is a notable exception, having incorporated CCAM pilot zones into its PUMS update. This suggests that the model is institutionally viable but still underdeveloped in implementation, and it reinforces the need for clearer EU-level guidance (building on the European Commission's SUMP guidelines (2019 update)) on how SUMPs should incorporate CCAM scenarios within broader urban mobility planning. These plans are often soft law: they are not legally binding, but they strongly influence what projects are prioritised, what is politically acceptable, and what public resources are allocated. The city uses them to steer key choices such as:

- whether CCAM should support public transport and shared mobility, or fuel private car-based automation
- where CCAM should operate (e.g., underserved areas vs. already well-served corridors)
- how to manage trade-offs like public space, accessibility, congestion, and environmental impact

Governance approach

The city defines the goals, priority use cases, and integration rules in its planning documents and coordinates departments (transport, climate, smart city), while operators adapt their services to fit these priorities; the city pays for planning capacity (and sometimes enabling infrastructure/public transport integration), and operators mainly pay for fleets and service operations.

Advantages

- Better alignment with city goals:

CCAM is guided by objectives like liveability, safety, accessibility, and sustainability (not just "deploy the tech")

- Cross-sector coordination:

transport, climate, smart-city, and economic policies point in the same direction instead of working against each other

- Early steering to avoid lock-in:

planning can prevent car-centric trajectories (e.g., induced demand, sprawl) before they become irreversible

- Clearer integration with the mobility system:

CCAM can be positioned as a complement to public transport and MaaS rather than a parallel competitor

- Legitimacy and shared direction:

strategic planning supports public debate and helps justify priorities and trade-offs

Challenges

- Weak enforceability:

soft-law plans can be ignored if they are not translated into permits, contracts, budgets, and street management rules

- Fragmentation and "nice words" risk:

plans can become vague statements across many documents, without concrete implementation pathways

- Uncertainty and lack of data:

cities may struggle to plan impacts reliably when real-world evidence is scarce

- Collective action problems:

private tech actors may pursue their own priorities faster than the city can coordinate a coherent response

- Capacity constraints:

cities need skills and staff to plan CCAM properly and to keep strategies updated

Examples (mapping)

- Cross-sector urban planning used to govern AVs across 10 European capitals, based on analysis of 39 city planning documents, described as soft laws (transport + climate + smart city + other plans)
- Policy direction that CCAM should be integrated into cities' Sustainable Urban Mobility Plans (SUMPs) as part of the urban mobility framework for "safe, accessible, inclusive, smart, resilient and zero-emission" mobility

Regulatory/legal gaps

- Missing bridge from strategy to enforceable tools:

cities often lack clear mechanisms to turn plans into binding conditions (permits, service standards, street access rules)

- Unclear division of powers:

city ambitions may clash with national/regional competences on vehicle rules and deployment permissions

- Weak implementation toolkits:

cities may lack robust methods and instruments to assess CCAM impacts and select “best” pathways under uncertainty

- Data governance not operationalised:

plans can mention goals, but without concrete rules on data access, privacy, and accountability they are hard to implement

- Public transport integration is not guaranteed by planning alone:

without contractual and regulatory instruments, CCAM can drift toward uses that undermine PT rather than strengthening it

Phased experimentation and sandboxing (pilot-to-scale model)

Description

This model introduces CCAM through small pilots first, then expands step by step only if results are acceptable. The idea is to manage uncertainty by keeping early deployments limited, reversible, and closely observed. In the Italian context, this approach has already been tested through pilot projects such as the Turin City Lab initiative for autonomous shuttles, which shows the practical relevance of phased experimentation for CCAM. At the same time, these experiences suggest that the most critical and least governed phase is the transition from pilot to regular operation. While pilots have often produced positive technical results, moving towards stable service has proved more difficult because of the lack of a clear regulatory pathway from testing permits to operating licences, limited integration with existing public transport contracts and service planning, and the absence of dedicated public funding for post-pilot scaling. This makes the governance of pilot programmes, and especially their exit and transition phases, a central issue within this model.

This approach of sandboxing is now empowered by the European Commission through the launch of the European cross-border testbeds: collaborative, large-scale infrastructure projects aimed at harmonizing CCAM and digital services across borders. Key initiatives include, as outlined in the Automotive Action Plan, the establishment of several major autonomous driving corridors by 2026/2027, alongside digital platforms for cross-border public services

Typical steps look like this:

- Pilot in a constrained setting: limited route, low speeds, simple environment, and strong supervision
- Learn and measure: collect evidence on safety, user acceptance, and system impacts
- Adjust rules and operations: change technical setup, operating conditions, or requirements based on what is observed
- Scale gradually: expand to more complex streets, longer routes, or wider service areas only after meeting predefined conditions

- Avoid lock-in: keep the option to pause, redesign, or roll back if negative impacts appear

Governance approach

Public authorities grant time-limited, conditional permissions for pilots (and progressively wider permissions for scaling), define the conditions for moving to the next stage, and fund oversight/testing capacity, while operators fund the pilots and operations, provide evidence from testing, and adapt the service to meet the evolving conditions.

Advantages

- Lower risk at the start:
early deployments are limited in scope, so failures are less damaging
- Learning-by-doing:
real-world evidence replaces assumptions when data is scarce
- More adaptive decisions:
requirements can be refined after each phase, instead of guessing everything upfront
- Faster readiness building:
pilots can reveal what infrastructure, operations, and skills are actually needed
- Better control of path dependencies:
small, reversible steps reduce the chance of "locking in" a bad direction

Challenges

- Slow scaling:
moving from pilot to full deployment can take time and create frustration
- Pilot bias:
success in simple conditions may not translate to complex urban environments
- Fragmented permissions:
different permits and agencies can create heavy administrative burden
- Public expectations risk:
a high-profile pilot can damage trust if safety or service quality disappoints
- Unclear success criteria:
if "go/no-go" conditions are vague, decisions become political instead of evidence-based

Examples (mapping)

- ParkShuttle in Rivium Business Park (near Rotterdam) and a multi-year shuttle demo at Schiphol airport (controlled, partly segregated environments)
- Pilots on designated routes / controlled areas and gradual progression; examples include autonomous shuttle trials in Gothenburg, SmartBus in Aalborg, and a driverless shuttle trial on a specified route in Newcastle (NSW)
- City participation in experiments and testing: Helsinki's testing of automatic electric minibuses (Hernesaari) and experiments in Copenhagen framed around ensuring they improve mobility conditions, support public transport/car sharing, and use alternative energy sources

- Permit-based staged programs (drivered vs driverless) for commercial passenger service, designed to work alongside vehicle safety rules (DMV + CPUC programs; permits granted for drivered deployment and then driverless pilot participation)
- Exemptions/waivers as a "near-term tool" to enable testing/deployment when standard rules are built around human drivers (example: Nuro exemption enabling a low-speed ADS vehicle)

Regulatory/legal gaps

- Clear legal pathway from test to deployment:

many systems lack a consistent "ladder" of permissions with defined stage transitions

- Stage criteria and accountability:

rules often do not specify who decides scale-up, based on what evidence, and with what liability

- Insurance and responsibility in pilots:

requirements can be inconsistent across jurisdictions and hard to compare

- Oversight capacity rules:

authorities may not have formal mandates, tools, or resources for continuous monitoring

- Coordination across levels and agencies:

permits, safety rules, and service regulation may sit in different institutions, creating delays and gaps

Multi-level governance alignment

Description

This model is about how CCAM is governed across levels of government (e.g., EU/national/city or federal/state/city). CCAM creates "overlapping" policy problems: some issues are mainly technical and safety-related, others are about street operations, permits, insurance, urban planning, and public space. If these responsibilities are well aligned, CCAM can scale with clearer rules and predictable requirements. If they are not aligned, the result is a patchwork: different rules across jurisdictions, duplicated procedures, and uncertainty for operators and cities.

Governance approach

A higher level sets or steers the core technical/safety direction and common policy objectives, lower levels manage operations and local impacts (permits, enforcement, planning), and public funding is split between upper-level programs/grants and local implementation capacity, while operators fund fleets and service delivery.

Advantages

- Clearer responsibilities:

each level knows what it controls (e.g., technical safety vs. road operations)

- More consistent rules for scaling:

operators face fewer "different rulebooks" when crossing jurisdictions

- Faster deployment with less duplication:

less repeated permitting, less re-testing, fewer conflicting requirements

- Better investment planning:

public and private actors can invest with more certainty (infrastructure, skills, services)

- Room for local adaptation:

cities can tailor operations to context while still fitting a common framework

Challenges

- Patchwork outcomes:

different local/state approaches create inconsistent requirements for a technology that is inherently mobile

- Authority conflicts and pre-emption debates:

upper levels may try to limit lower-level rules, creating political and legal tension

- Slow coordination:

multiple agencies and levels can delay decisions and blur accountability

- Uneven capacity across cities/regions:

some places can plan, test, and oversee; others cannot, increasing inequality in readiness

- Hard to align goals with tools:

high-level goals may not translate into concrete local instruments and jurisdictions

Examples (mapping)

- Federal–state division and "patchwork" in the US (federal role on vehicle safety design/performance; state role on licensing/operations/insurance; inconsistent state-by-state requirements)
- Debates on federal pre-emption of state/local rules (proposed bills aiming to limit state/local regulation of design/performance)
- EU-level pathways vs local adaptation gap (need to bridge EU policy pathways and city-level implementation considering different readiness and local goals)
- Cities governing via cross-sector planning "soft laws" across multiple policy domains (transport, smart city, climate), showing governance distributed across levels and sectors

Regulatory/legal gaps

- Missing common minimum requirements:

no consistent baseline for testing/operation across jurisdictions leads to fragmentation

- Unclear "handover" rules between levels:

who decides what, when, and with which instruments are often not explicit

- Weak mechanisms to translate high-level goals into local tools:

cities need clearer policy tools and jurisdictions to implement and evaluate pathways locally

- Coordination and information-exchange not institutionalised:

effective deployment requires structured cooperation between public and private actors across levels, but this is not guaranteed by default

Market dynamics and competition assessment

1. Converging market structure (OEMs, tech firms, platforms, PT operators)

CCAM tends to blur traditional boundaries between:

- vehicle manufacturing (OEMs)

- digital technology and software
- mobility service provision (platforms / TNC-like operators)
- public transport and city-managed mobility

This creates new alliances and new competitive arenas, because value shifts from "selling cars" to "operating mobility services" and controlling the user interface (apps, booking, routing).

2. High fixed costs and "winner-takes-most" tendencies

CCAM services usually require heavy upfront investment:

- safety engineering and validation
- fleet purchase and maintenance
- remote supervision and operations management
- data systems and cybersecurity

These fixed costs can favour large players with capital and scale and can push the market toward concentration (few big operators), especially when early deployments are expensive and uncertain.

3. Regulatory conditions as a competition variable (entry rules shape the market)

Market entry is strongly influenced by how permits and rules are designed:

- strict, complex requirements can protect safety but reduce the number of entrants
- light or unclear requirements can accelerate entry but create instability and disputes

If rules differ across jurisdictions, firms that can manage compliance complexity gain an advantage over smaller entrants.

4. "Patchwork" regulation creates uneven playing fields

When requirements vary by region/city:

- scaling becomes costly (new approvals, different technical and reporting rules)
- incumbents can lobby for local advantages
- competition becomes uneven because firms face different burdens depending on where they operate

Harmonisation (or at least common minimum requirements) reduces these distortions and makes competition more comparable.

5. Competition with incumbents and conflict over market design

CCAM (especially robotaxi-style services) can disrupt regulated markets such as taxis and other for-hire services. Typical outcomes:

- strong political and legal conflict during market entry
- pressure on authorities to revise old categories and licensing regimes
- risk of "regulatory whiplash" (rapid tightening after rapid liberalisation)

These dynamic matters because uncertainty discourages investment and can stall adoption.

6. Platform dominance and data asymmetry (gatekeeper risk)

If CCAM is delivered through platform-based services:

- the platform can become the gatekeeper of demand (user access)
- the platform can control key operational data (pricing, routing, performance)
- smaller operators may be forced to integrate on the platform's terms

Without interoperability and fair data rules, the market can tilt toward monopoly-like power, even if multiple fleet operators exist.

7. Public goals vs private incentives (congestion, urban space, PT impacts)

Private operators may optimise for:

- market share
- convenience
- high-demand areas

Cities care about:

- congestion and total vehicle-kilometres
- curb space, pick-up/drop-off impacts, and land-use effects
- public transport priority and shared mobility goals

If governance tools are weak, competitive pressure can push firms toward choices that worsen externalities (e.g., more traffic, pressure on PT), even if each firm is "successful" commercially.

8. Safety reputation as a core competitive dimension

User acceptance is highly sensitive to:

- perceived safety
- infrastructure readiness
- legal clarity and accountability
- privacy concerns (with trade-offs)

This makes safety performance and transparency a competitive factor: firms that can demonstrate safety and reliability gain adoption advantages, while a major incident can damage the whole market (not only one operator).

9. Cities as market shapers, not only regulators

Municipalities influence competition directly through:

- defining priority use cases in mobility plans (what is "allowed/desirable")
- setting local operating zones and conditions (where services can run)
- requiring data reporting or performance evidence
- choosing procurement/partnership models (when CCAM is integrated with public transport)

So cities can tilt the market toward:

- open competition with multiple operators
- controlled competition with strict entry conditions

- or a limited set of authorised providers aligned with city goals.

Political influence

1. Safety as the "make-or-break" political issue

- Observation:

CCAM quickly becomes a political topic when safety is questioned, because accidents and near-misses are highly visible

- Cause:

Public acceptance is strongly driven by perceived safety and trust; one incident can dominate the narrative

- Implication:

Politicians tend to support CCAM only when they can show credible safety assurance and clear accountability

2. Innovation branding vs urban sustainability goals

- Observation:

CCAM is often promoted as part of "smart city" and innovation agendas

- Cause:

City leaders may want visibility, investment, and reputation as a tech-forward city

- Implication:

Political support can tilt toward "deploying the technology" rather than ensuring it serves concrete urban goals (accessibility, liveability, reduced congestion)

3. Conflict with incumbents and regulated markets (taxis, for-hire services)

- Observation:

Operator-led robotaxi or platform-style services can trigger strong political conflict with incumbent services.

- Cause:

Incumbents are organised, vocal, and politically connected; they frame CCAM as unfair competition or job displacement

- Implication:

Decisions become politically sensitive, leading to delays, restrictions, or abrupt policy reversals

4. Power struggles across government levels (pre-emption and competence disputes)

- Observation:

CCAM governance often sits across multiple levels (national/federal, regional/state, city), with overlapping responsibilities

- Cause:

Higher levels may push for uniform rules to support scaling; cities want control over local impacts (traffic, curb space, public transport integration)

- Implication:

Political disputes about “who is in charge” can slow implementation and create unstable rules

5. Fragmented ownership inside city government (no single champion)

- Observation:

CCAM touches transport, digital/innovation, urban planning, climate, and economic development

- Cause:

Responsibilities are split across departments and policy documents (often as soft law)

- Implication:

Without a clear political sponsor, decisions drift into coordination problems, and CCAM gets managed as “everyone’s topic and nobody’s job”

6. Short-termism and “pilot politics”

- Observation:

Cities may prefer pilots and demonstrations over long-term system change

- Cause:

Pilots are politically safer: they signal action and innovation while limiting immediate exposure and liability

- Implication:

CCAM can get stuck in an endless pilot loop, or scale without a clear long-term direction if political pressure is to “show results”

7. Lobbying and narrative control by large tech and mobility actors

- Observation:

Well-funded operators and technology firms can shape debates, standards, and local decisions

- Cause:

They control expertise, data, and the “story” of what CCAM can deliver; public authorities often have weaker technical capacity

- Implication:

Political choices may favour dominant players and proprietary approaches, reducing openness and limiting public steering

8. Privacy and data governance as politically sensitive trade-offs

- Observation:

Data needs for monitoring and safety can clash with privacy concerns

- Cause:

CCAM relies on extensive sensing and reporting; many users accept privacy trade-offs for safety, but this can become controversial

- Implication:

Politicians face a balancing act: demand enough data for oversight without triggering public backlash or legal disputes

Funding schemes

CCAM projects are typically financed through a mix of public and private sources:

- Public R&D and demonstration funding:
  used to de-risk early pilots, testing, and learning before large-scale rollout
- National-to-local financial support:
  higher government levels can provide financial support to cities for mobility transitions and readiness
- Local government transport budgets:
  cities allocate budget to mobility policy, local regulations, and (where relevant) fare policy
- Transport authority funding and contracting:
  when CCAM is treated as a public mobility service (e.g., automated shuttles), authorities can fund it through contracts and structured payments
- Private operator investment:
  operators typically finance vehicles (fleet/rolling stock), operations, and customer services
- Farebox/user revenues:
  ongoing operations can be funded through fares (directly paid by users) or bundled into mobility/ticketing systems

What funding is typically needed (CAPEX vs OPEX)

- CAPEX (upfront investment):
  vehicles/fleet, enabling infrastructure, digital systems, testing equipment, integration tools
- OPEX (ongoing costs):
  operations management, remote supervision (if used), maintenance, customer service, insurance/compliance, monitoring/reporting duties

Funding logic across phases (pilot → scale → operations)

- Pilot phase:
  public demonstration funding + operator co-investment is common, because uncertainty is high and benefits are not yet proven
- Scale-up phase:
  higher need for infrastructure and system integration; cost-sharing becomes important (public for enabling infrastructure and oversight capacity; private for fleets and service operations)
- Operational phase:
  stable funding must come from either fares (commercial model), or service contracts (authority pays operators to deliver defined service levels)

Public procurement and "pay-for-performance" as a funding mechanism

When CCAM is operated like public transport (or complements it), funding can be organised through contracts that include:

- Service fees:
  the authority pays the operator for delivering the service
- Bonuses and penalties:
  payments can be linked to performance (quality, reliability, safety-related targets)
- Budget and asset management decisions:
  authorities may need to define how fare revenues and operating costs are handled, and who owns infrastructure and fleet assets

Strategic recommendations (cross-cutting)

- Plan the "pilot-to-operation money bridge":

pilots are relatively easy to fund, but long-term operations are not. This gap between research and development funding and operational budgets is a structural problem, so it is important to define early whether the end-state will rely on fares, public service contracts, or a hybrid model. In this context, a specific governance and funding response may also be needed, such as dedicated CCAM transition funds at national level, potentially co-financed through EU structural funds and national transport budgets, to bridge the shift from pilot to regular operation. Italy's experience with similar transition challenges in ITS deployment shows how difficult this passage can become when operational funding and institutional responsibility are not addressed from the outset.

- Use stage-gated funding:

release the next funding tranche only when evidence and readiness conditions are met

- Fund public capability, not only vehicles:

data systems and public oversight capacity are enabling infrastructure for any CCAM model, but infrastructure readiness must be understood more broadly. In the Italian context, CCAM deployment also depends on physical infrastructure adaptation, including road markings, signage standardisation, and intersection redesign, alongside digital infrastructure such as V2X systems and 5G coverage. This is especially important given the strong heterogeneity of the road network, which ranges from Alpine roads to dense urban centres, from motorways to historic city streets. While the PNRR has allocated resources for road digitalisation, coordination between national, motorway, and municipal road managers remains fragmented. For this reason, the governance framework should explicitly address infrastructure readiness, including who is responsible for defining, maintaining, and financing CCAM-ready road standards.

- Support the creation of a European single market for CCAM:

for example, by building coalitions of transport authorities committed to deployment, enabling joint procurement and large-scale roll-out of CCAM vehicles at European level.

- Clarify ownership early (fleet vs infrastructure vs data systems):

ownership choices shape long-term market power, lock-in risk, and bargaining leverage in future contracts

How to co-define the best governance scheme

Cities should not force CCAM into one single governance model. A CCAM programme can combine different schemes across use cases, areas, and maturity stages (pilot vs scaled service). The key is to co-define a scheme that matches local objectives, stakeholder power, readiness, and risk tolerance.

1. Start from "public purpose", not from the technology

Define what CCAM is allowed to do for the city (and what it must not do). Keep it simple and measurable.

- reduce crashes and improve perceived safety
- improve access for underserved areas / groups
- support public transport and shared mobility (not replace it)
- avoid increasing congestion or car dependency
- contribute to sustainability targets (space, emissions, liveability)

2. Choose the initial CCAM use cases and the operating context

Different contexts require different governance intensity.

- fixed-route low-speed shuttles in controlled areas (lower complexity)
- mixed-traffic services in dense centres (higher complexity)
- first/last-mile feeders to public transport vs point-to-point robotaxi

A city can allow some use cases early and block others until readiness improves

3. Map stakeholders and their governance implications

Co-definition works only if you clarify who has leverage, who takes risk, who pays, and who is accountable.

- City leadership and departments (transport, climate, planning, digital):
  set direction, allocate street space, coordinate policies, manage public acceptability
- Transport authorities / public transport operators:
  crucial if CCAM is meant to complement PT; can shape service integration and contracting
- National / federal regulators and road safety authorities:
  define what vehicles can legally operate and under what safety conditions
- Private operators (platforms, OEMs, fleet operators):
  bring capital and operational capacity; tend to push for speed and scalability
- Data holders / technology providers:
  control key operational data and monitoring capability (potential gatekeeper role)
- Insurers and legal actors:
  influence deployment feasibility through liability clarity and risk pricing

4. Use a staged co-design process (pilot-to-scale "gates")

Build a shared roadmap with explicit stage transitions.

- Stage 0: design and risk framing (what success and failure look like)
- Stage 1: small pilot (limited geography, controlled conditions)

- Stage 2: expanded pilot (more complexity, higher exposure)
- Stage 3: service deployment (stable operations and governance)
- Stage 4: scaling (replication across districts/cities)

For each gate, agree in advance:

- what evidence is required (safety, service performance, impacts)
- who validates the evidence
- what decision options exist (scale, pause, redesign, stop)

5. Combine planning + performance monitoring (direction + control)

A “best scheme” usually needs both:

- a strategic layer (planning/soft-law integration) to define priorities and acceptable pathways
- an operational layer (data/KPI monitoring) to verify outcomes and trigger corrective actions

This avoids the classic failure mode: strong rhetoric in plans but weak control in operations

6. Agree on data-sharing rules early (or the scheme will be blind)

If the city wants to steer outcomes, it must secure:

- which data must be provided (minimum dataset)
- frequency and format (comparable reporting)
- privacy and cybersecurity safeguards
- who can access what (city, auditors, public)
- what happens when data is missing, inaccurate, or withheld

Without this, performance-based control and fair competition are mostly theatre.

7. Clarify responsibility, liability, and incident management upfront

Because automation shifts responsibility away from a human driver, the governance scheme must specify:

- who is accountable for incidents (operator vs manufacturer vs other actors)
- minimum insurance/coverage requirements
- incident reporting, investigation cooperation, and corrective actions

If this is vague, political support collapses the moment something goes wrong.

8. Decide “who pays for what” using a simple split

Keep the financing logic transparent and stable across phases.

- Public side typically pays for: planning capacity, oversight capability, enabling infrastructure, integration with the urban system
- Private side typically pays for: fleet, operations, customer service, compliance and reporting
- If CCAM is treated as a public service: use service contracts (optionally with performance-linked payments)

9. Protect competitive neutrality while allowing innovation

To avoid market capture and data monopolies:

- define non-discriminatory rules for access where public assets are involved (curb space, permits, data interfaces)
- prevent one platform from becoming the unavoidable gatekeeper
- keep entry conditions proportionate: strict enough for safety, not designed to exclude smaller entrants by default

Governance models for Mobility Dataspaces

Regulatory frameworks

1. Layered EU legal landscape and "intersection management" (avoid legal patchwork)

Overview:

Mobility data sharing in Europe is shaped by two layers at the same time: (i) horizontal EU data laws that apply across sectors, and (ii) mobility-specific rules (mainly ITS, open data, and spatial/environmental data). The main problem is not "missing law", but overlaps, different concepts, and unclear boundaries between instruments (e.g., what counts as accessibility vs re-use)

Relevance for Mobility Data Spaces:

- Reduces confusion about which rule applies to which dataset and use case
- Avoids duplicated compliance work and inconsistent interpretations across countries and projects

Additional comments:

A practical regulatory approach needs explicit "how these laws work together" guidance, otherwise implementation sites spend time navigating concepts instead of shipping usable data sharing

2. Personal vs non-personal data: GDPR as a constant constraint (and capability requirement)

Overview:

Some mobility datasets are personal data (or can become personal when combined). GDPR is therefore a hard baseline. Even de-identified data can remain personal data if it can be re-identified. Mobility data spaces must design governance and technical processes that separate data categories and ensure lawful processing

Relevance for Mobility Data Spaces:

- Determines whether data can be shared at all, and under what safeguards
- Affects trust: unclear GDPR handling increases risk aversion and blocks participation.
-

Additional comments:

The analysis discusses data protection as a recurring practical barrier (not theoretical). This creates a need for standard compliance "recipes" that local actors can apply consistently

There is a fundamental tension at the heart of automated driving: AV systems require large volumes of real-world data to learn, validate, and continuously improve safety, while GDPR rightly restricts the collection, reuse, and sharing of data to protect individual privacy. Society is therefore confronted with a balancing act between collective safety benefits and individual data rights. Public acceptance suggests that the debate is less about whether data is collected at all, and more about why it is collected, how it is protected, and who governs its use. Data sharing is broadly considered acceptable when it is clearly safety-driven and purpose-limited, for example to support incident investigation, root-cause analysis, liability clarification, and systemic risk reduction, especially when access is restricted to authorised actors such as regulators, investigators, insurers, and auditors, in line with GDPR principles of necessity, proportionality, and legitimate purpose. The red line emerges when data use becomes opaque, when access rules, safeguards, or retention periods are unclear, or when data is reused for surveillance, unrelated law-enforcement, or commercial exploitation, triggering fears of loss of control, function creep, and weak accountability. At the same time, the public expects explainability—understanding what happened and why—without exposing identifiable individuals, which makes event-based, system-focused data a key compromise between safety and privacy. Staying on the right side of this balance requires robust anonymisation and pseudonymisation, edge processing that limits data to safety-relevant events, privacy-by-design approaches, and regulatory adaptation that reflects the specificities of AV systems.

3. Open data and spatial data baselines (Open Data + High-Value Datasets + INSPIRE)

Overview:

Part of the mobility data ecosystem is built on rules that push public-sector data toward open, standardised access, including spatial/environmental datasets. INSPIRE focuses on harmonising existing spatial datasets (including transport networks) with common models and metadata. Open Data rules and "high-value datasets" push availability and re-use in machine-readable formats

Relevance for Mobility Data Spaces:

- Provides a minimum pool of re-usable public data that combined can be with other sources
- Encourages consistent metadata and formats, which lowers integration effort

Additional comments:

Open data helps, but it does not solve the "hard part" of mobility data spaces: controlled access to non-open data and operational datasets with restrictions. The report treats this as a key reason why additional instruments are needed

4. Mobility-specific "accessibility mandates" via ITS and delegated regulations (NAPs as a backbone)

Overview:

The ITS framework and its delegated regulations require certain road, traffic, and multimodal travel datasets to be made accessible through National Access Points (NAPs), under non-discriminatory conditions, and with quality/renewal duties. Newer rules extend scope (more data types, more actors, wider networks) and push more dynamic (real-time) information

Relevance for Mobility Data Spaces:

- Creates a regulatory "floor" for data availability and interoperability for key services (RTTI, MMTIS)
- NAPs can serve as an initial building block for a future European mobility data space ecosystem, but their current form has important limitations. The Italian experience shows that they mainly handle static and semi-dynamic data, do not yet implement data sovereignty principles, and lack advanced access control and usage policy enforcement for real-time and controlled data sharing.
- This makes the governance transition from open data publication to controlled data sharing a central challenge for mobility data spaces. In this respect, the evolution of the Italian NAP, also in connection with the gaps being addressed through NAPCORE, offers a useful case. Italy's recent transposition of the ITS Directive further reinforces the legal mandate of the national NAP and the obligations on data holders to provide multimodal travel data, while also highlighting the complexity of moving from a NAP logic to a true mobility data space logic.

Additional comments:

Directly applicable EU rules still often need national additions (e.g., naming competent authorities and enforcement procedures). Without this, mandates risk being "paper rules"

5. Promoting data sharing beyond open data: DGA and Data Act as "fair sharing" tools

Overview:

The EU is shifting from a pure data protection paradigm toward enabling sharing and re-use under fair conditions. The Data Governance Act covers, among other things, reuse of certain public-sector data, regulated data intermediation services, and data altruism. The Data Act is positioned as another major horizontal instrument to enable access/sharing, especially relevant where data is not simply "open"

Relevance for Mobility Data Spaces:

- Supports sharing in cases where bilateral deals are slow, unfair, or blocked by lack of trust
- Helps structure roles such as neutral intermediaries and standard governance patterns

Additional comments:

Implementation sites report difficulty understanding how these newer acts change or interact with older obligations (Open Data / ITS), showing that legal clarity and guidance is still a bottleneck

6. Interoperability and standardisation: legal requirements need technical enforceability

Overview:

Multiple instruments push interoperability in practice through common specifications, metadata, and reference standards. In mobility, ITS delegated rules reference data exchange standards (e.g., for traffic information) and accept alternatives if compatible. INSPIRE similarly mandates harmonised models and metadata for spatial themes

Relevance for Mobility Data Spaces:

- Interoperability turns “sharing” into something that is actually usable across borders and services
- Reduces vendor lock-in and repeated one-off integrations

Additional comments:

A recurring governance issue is that interoperability is not only technical; it needs clear rules for onboarding, monitoring, and compliance so that standards are adopted consistently

7. Contracting, procurement, enforcement capacity, and liability for misuse/breaches

Overview:

Even with EU legislation, many real-world data exchanges are implemented through contracts, tenders, permits, and procurement clauses. Local actors report challenges in writing effective data-sharing duties into contracts, and concerns about liabilities in case of data breaches or misuse. Enforcement also depends on competent authorities and workable procedures

Relevance for Mobility Data Spaces:

- Contracts are often the “last mile” that makes sharing happen (or not happen)
- Weak enforcement and low capacity create uneven adoption and cross-border friction

Additional comments:

The analysis highlights organisational constraints (skills, infrequent practice, multi-agency complexity) as a practical regulatory risk: rules exist, but execution capacity is uneven

Governance models (overview)

Federated, multi-level governance (Nested/Federated EMDS)

Description

In this model, mobility data sharing is organised as a federation of autonomous local/regional data spaces that interconnect under a common European framework. Data stays with participants (no single central database), while the federation enables trusted, secure, interoperable data access across places and use cases. Local instances keep their own internal logic, as long as they adopt common interoperability and sovereignty enablers.

Governance approach

A simple way to say “who does what, when, and who pays” is:

Local/regional data space operators run day-to-day sharing and services; Member States coordinate and bridge local-to-EU alignment; an EU-level EMDS authority sets common rules/standards for harmonisation and interoperability; funding is mixed/multifaceted (local operation + national/EU contributions/grants for common layers and scaling).

Advantages

- Keeps local relevance:

decisions can reflect local mobility needs (subsidiarity / nested governance)

- Interoperability and scale without centralisation:

local data spaces can remain autonomous but still connect for cross-border use cases

- Avoids fragmentation (in theory)

by converging toward shared rules and standards across multiple ecosystems

Challenges

- Coordination burden:

multiple governance levels must “talk to each other”; otherwise, you get misalignment and duplication

- Capacity gaps at local level:

many local/regional actors may lack skills/resources to engage meaningfully early o

- Power asymmetries can skew benefits and influence toward stronger actors unless actively managed
- Unclear rules/processes in practice (boundaries, onboarding, monitoring, conflict resolution) can weaken trust and participation

Examples (mapping)

- German Mobility Data Space, Fintraffic Traffic Data Ecosystem, Eona-X (listed as existing mobility data ecosystems/spaces) [1]
- Milan case: need for coordination to ensure quality/standards/interoperability; duplication of effort with data sent to both a local deployEMDS use case and the regional ecosystem E015 [1]
- Sweden: potential overlaps between national data portal (dataportal.se) and National Access Points (NAPs), highlighting the need to harmonise governance across levels [1]
- OpenStreetMap is cited as a general example of nested governance (not mobility-specific, but used as an illustration of multi-level collaboration) [1]

Regulatory/legal gaps

- Unclear division of responsibilities between EU / Member State / local levels can make it hard to define roles locally
- Risk of “wrong investments” before the common framework is fixed:
- local data spaces may build solutions that later clash with the final EMDS governance/specs
- Legal interoperability is still a practical hurdle:
- aligning contracts/clauses across multiple data spaces is explicitly highlighted as a need
- Complex and evolving EU legal landscape (e.g., interaction/overlaps and real-world application of newer acts) creates uncertainty; some instruments are still “in their infancy”

Public orchestrator + mandated sharing (Authority-led & procurement/regulation-driven)

Description

In this model, a public authority (or a designated national body) acts as the main orchestrator of mobility data sharing. It sets the rules and technical specifications, and it enables access through a public access mechanism (often a National Access Point). Data holders (e.g., transport operators, authorities, infrastructure managers, service providers) are required to make specific datasets available, in standardised formats, so that travel and traffic information services can work across borders.

Governance approach

The public authority defines "what data, in which format, through which access point, and under which compliance checks"; data holders publish and maintain the required data; the public authority monitors/enforces; the access point is mainly publicly funded, while data holders typically cover the cost of producing/updating their data (and cities may add data-sharing duties via contracts, permits, funding, or procurement).

Advantages

- Minimum baseline of data availability:
it reduces "if you feel like sharing" dynamics
- Better interoperability through common specifications and standards
- Lower transaction costs:
less time spent negotiating one-off data deals
- Public value orientation:
supports safer, more coordinated, and more efficient mobility services

Challenges

- Uneven implementation across countries:
obligations and access points can be at very different maturity levels
- Capability and budget gaps:
some cities/authorities struggle to design strong tender clauses or to fund data platforms to receive/analyse data
- Data quality and maintenance:
rules may exist, but keeping data updated and reliable is operationally hard
- Scope limits:
earlier rules often required sharing only when data already exists in machine-readable form (this is evolving, but transition is non-trivial)

Examples (mapping)

- National Access Points (NAPs) under the ITS framework as mechanisms to access/exchange/reuse transport data; NAPs can be portals, repositories, marketplaces, etc. [1]
- NAPCORE as a coordination mechanism to harmonise standards and improve interoperability of NAPs in Europe [1]

- Delegated rules for RTTI and MMTIS requiring specific actors to provide data via NAPs; MMTIS revision expands requirements toward dynamic (real-time) information [1]
- Named NAP operators involved in the project context: Fintraffic (Finland), Trafikverket (Sweden), BASt (Germany) [1]
- City–micromobility (e-scooter) agreements including data-sharing provisions; also references to using procurement/funding conditions to obtain private-sector data [1]

Regulatory/legal gaps

- Fragmentation and legal uncertainty:

overlapping laws and non-harmonised national transposition create confusion about obligations

- Unclear boundary between "accessibility" and "re-use" across different EU instruments can make compliance ambiguous
- Limited general mandates for private-sector data sharing in the public interest (beyond specific cases), leaving gaps that often get filled by contracts
- Practical enforcement design is not automatic:

rules may still require national designation of responsible authorities and enforcement procedures to work well

Regulated neutral intermediation (DGA-style data intermediation services)

Description

In this model, mobility data sharing is enabled by a neutral intermediary that connects data holders with data users. The intermediary provides the "plumbing" for trusted exchange: onboarding, identity checks, catalogues, access workflows, and basic governance services. The key idea is to reduce distrust and transaction friction, especially when many actors want to share data but do not want bilateral negotiations with everyone. The intermediary is expected to stay neutral and not exploit the data for its own competitive advantage.

Governance approach

The intermediary runs the platform and access processes and charges service fees; data holders decide which datasets to offer and under which conditions; data users request access and pay for the service (and possibly for the data); public authorities register/supervise the intermediary and enforce neutrality and transparency rules.

Advantages

- Trust and neutrality by design:

clearer separation between "platform operator" and "data exploiter"

- Lower transaction costs:

one onboarding and one set of procedures instead of many bilateral deals

- Scalability for multi-actor ecosystems:

easier to add new participants and datasets over time

- Can support common governance services (standard contracts, access logging, basic compliance support)

Challenges

- Business model risk:

if fees are too high, smaller actors will not join; if too low, the intermediary is not sustainable

- Neutrality in practice:

keeping the intermediary truly neutral is hard when large actors have power and bargaining leverage

- Data quality and liability questions:

if shared data is wrong or outdated, responsibility can become unclear across the chain

- Interoperability is still needed:

an intermediary does not magically fix incompatible formats or poor metadata

Regulatory/legal gaps

- Practical compliance uncertainty:

rules exist, but operational details (how to prove neutrality, how audits work, how enforcement scales) may remain unclear in practice

- Contracting complexity remains:

even with an intermediary, participants still need workable clauses on permitted use, confidentiality, and re-use conditions

- Overlap with other legal regimes:

data sharing must still align with data protection, trade secrets, and sector rules, which can create grey zones

Market dynamics and competition assessment

1. **Fragmented market structure (public bodies, operators, platforms, tech, data intermediaries)**

Mobility data is produced and held by many actors (public authorities, infrastructure managers, public transport operators, shared mobility providers, mapping/tech firms, and platform players). The result is a fragmented market where value depends on who can access, combine, and reuse data across silos.

2. **Data concentration and bargaining power (asymmetry problem)**

A recurring dynamic is power imbalance: large private actors and “big tech” often control major datasets and digital infrastructures, while local and regional public bodies can be weaker and struggle to access privately held data in a sustainable way. This can translate into:

- unequal negotiating power in data-sharing deals
- dependency on dominant players’ terms
- risk that benefits of data reuse are captured by a few actors

3. **Incentive mismatch and under-sharing (ROI is unclear)**

Data sharing is not free. It requires investments (legal work, technical work, security, skills, governance). There is a common issue: those who pay the costs are not always those who get the benefits, which reduces willingness to share. Typical frictions include:

- unclear future value of data (hard to justify quality upgrades)
- limited control over third-party reuse, but high reputational/liability risk if data is misused
- low or misaligned incentives, especially for smaller actors

4. High transaction costs favour larger players

Even when data could be shared, transaction costs can be high:

negotiating contracts and usage conditions

- identifying the "right" data holder in complex ownership/control chains
- managing privacy, commercial sensitivity, and security concerns

These costs tend to favour players with legal/technical capacity, pushing smaller actors to the margins.

5. Marketplaces and intermediaries: efficiency gain, but new concentration risks

The shift from purely bilateral contracts toward platforms/marketplaces/intermediation can reduce friction (discovery, standard workflows). But it also introduces competition questions:

- does the intermediary stay neutral, or become a bottleneck?
- can fees exclude SMEs?

does "one access point" create a new gatekeeper?

6. Gatekeeper risk and platform competition (DMA relevance)

Where mobility data flows through large digital platforms, competition can tilt toward "gatekeeper" dynamics:

- control over user access and critical datasets
- self-preferencing risks (platform favouring its own services)
- lock-in effects if portability/interoperability are weak

This is why platform regulation that pushes interoperability, portability, and access to generated data can matter indirectly for mobility data spaces.

7. Competition law constraints on data sharing (cooperation vs collusion)

Data sharing can be pro-competitive (reducing information asymmetries and enabling innovation), but it can also become anti-competitive, especially when competitors exchange commercially sensitive information. Key implications:

- governance must screen "high-risk" data exchanges
- using a third-party intermediary does not automatically remove competition-law risk
- exclusivity or discriminatory access conditions can create market power issues

8. Pricing, fees, and "who pays" affects competition and adoption

Cost recovery models influence who can participate:

- charging for public-sector data can reduce reuse and innovation
- fees for reuse of protected data must be transparent and non-discriminatory, but pricing still shapes access
- reduced/zero-fee approaches can help SMEs and start-ups participate

Overall, pricing policy is a competition lever, not just an accounting detail

9. Capacity gaps create uneven playing fields across cities and countries

Implementation varies widely across places (maturity of access points, interpretation of standards, ability to write effective contracts, ability to use data once obtained). This creates:

- uneven entry conditions for data users and service providers
- uneven ability of public authorities to negotiate and enforce data access
- practical fragmentation even when the regulatory intent is harmonisation

Political influence

1. Political support and institutional leadership as a "make-or-break" factor

- Observation:

Data sharing progress often depends on strong political backing and clear public leadership

- Cause:

Public administrations face uneven digital maturity, limited skills, and weak coordination; without political push, data work is deprioritised

- Implication:

Data spaces risk drifting into fragmented, slow, and inconsistent implementation

2. Power asymmetries and agenda-setting by dominant actors

- Observation:

Large private players can strongly influence what data gets shared and on what terms

- Cause:

They control key datasets and digital infrastructure, while many local/regional authorities have weaker bargaining positions

- Implication:

Governance choices may tilt toward dominant actors' interests unless rules explicitly protect smaller stakeholders and public value

3. "Who pays shapes the rules" (funding as political leverage)

- Observation:

Funding bodies often end up shaping governance structures and platform rules

- Cause:

Budget control translates into influence over priorities, access conditions, monitoring, and enforcement design

- Implication:

If communities/citizens are not represented, political legitimacy can weaken and trust can drop

4. Public value narrative is politically necessary (and often missing)

- Observation:

Data sharing needs a clear story of societal benefit to gain and keep political support

- Cause:

Costs are visible (staff, platforms, compliance) while benefits can be indirect or delayed; stakeholders also disagree on whether data is a commodity or a public good

- Implication:

Projects may stall unless they show a tangible "why" (clear use cases, measurable benefits, "killer app" logic)

5. Privacy, security, and "how open is too open" become political trade-offs

- Observation:

Data openness can quickly become politically sensitive (privacy, national security, misuse)

- Cause:

More sharing and reuse increase risks; aggregated datasets can create security concerns; the "optimal openness" depends on context

- Implication:

Politicians tend to demand stronger governance controls, which can slow openness but may be required for trust

6. Multi-level politics and coordination struggles (local–regional–national–EU)

- Observation:

Mobility data governance sits across multiple levels and can suffer from "everyone in charge, nobody accountable"

- Cause:

Local relevance pushes decentralisation, but lack of national coordination can create fragmented solutions and weak standardisation

- Implication:

Scaling across borders becomes politically and operationally harder without clear coordination mechanisms

7. Participation gaps undermine legitimacy (citizens and under-represented groups)

- Observation:

Those affected by data use often have limited influence on rulemaking

- Cause:

Missing mechanisms for participation and onboarding; under-represented groups may lack information, skills, and resources to engage

- Implication:

Political criticism can grow ("decisions made over people's heads"), reducing trust and long-term sustainability

8. Cities use "contract politics" when law is not enough (but capacity is uneven)

- Observation:

Municipalities try to obtain data via contracts, procurement, permits, or funding conditions

- Cause:

Mandates do not cover all needed private-sector data; contracts are a practical workaround

- Implication:

Results vary widely: some cities succeed, others fail due to lack of know-how, procedures, or money for data platforms

Funding schemes

Mobility data space initiatives are typically financed through a mixed model (public + private), because costs are real and benefits are often distributed across many actors:

- EU / national public funding (foundation + scaling support):
  used to build shared layers (interoperability, cross-border infrastructure, guidance) and to speed up harmonisation and interconnection between existing initiatives
- Member State contributions (consortium-style funding):
  countries co-fund joint governance and cross-border services (e.g., through a formal consortium/legal entity)
- Local / regional public budgets:
  used to run local data platforms, maintain datasets, and build administrative capacity (legal, technical, governance)
- Private sector investment by data holders:
  companies invest when they expect a return (e.g., licensing fees, value-added services, or strategic advantage)
- Fees and charges (selective, case-dependent):
  - service fees charged by intermediaries or platform operators for running exchange processes
    fees for reuse of certain protected public-sector data (with the option of reduced/zero fees for SMEs/start-ups in some cases)
  - open data charging is possible in practice, but it can reduce reuse and value creation

Additional comment:

Mobility data space initiatives are typically financed through a mixed public and private model, because costs are real and benefits are often distributed across many actors. For example, in the Italian context, the main funding sources for mobility data infrastructure include PNRR and NextGenerationEU allocations for transport digitalisation, National and Regional Operational Programme funds, CEF Digital and

Transport calls, and more limited private investment, mainly from larger operators. At the same time, a structural challenge is that most of these resources are project-based and time-limited, while mobility data space governance requires long-term operational sustainability. For this reason, financial sustainability by design should be treated as a core governance principle, meaning that the governance model should define from the outset how operational costs will be covered after the initial public investment phase, including the possible use of fee-based models for value-added data services.

What funding is typically needed (CAPEX vs OPEX)

CAPEX (upfront investment)

- Data infrastructure: APIs, catalogues/metadata, access management, secure exchange mechanisms
- Interoperability work: formats, standards alignment, cross-border connectors
- Data preparation: cleaning, documentation, licensing information, governance setup
- Security and compliance tooling: risk controls, auditability, protection mechanisms

OPEX (ongoing costs)

- Platform operations: hosting, maintenance, support, onboarding/offboarding
- Governance operations: monitoring, enforcement processes, dispute handling, contract updates
- Data maintenance: continuous updates, quality management, versioning
- User engagement: support to ensure data is actually reused (communities, documentation, helpdesk)

Funding logic across phases (foundation → implementation → scaling)

Foundation / alignment phase:

- Public funding is often needed to align rules, standards, and governance, especially when the future common framework is still evolving.

Implementation / operationalisation phase:

- Higher costs appear for running real exchanges (platform services, legal work, cross-actor processes). Cost-sharing becomes central: public actors fund enabling infrastructure and oversight capacity; data holders fund their own data readiness; fees may appear for services

Scaling / value creation phase:

The key issue is sustainability: initiatives need a stable model for who pays ongoing OPEX. Common approaches are:

- public budgets for public-interest functions
- service fees for platform/intermediation functions
- selective charges for reuse of protected datasets
- hybrid cost-sharing frameworks across participants (including reciprocity expectations)

Public procurement, contracts, and "conditional funding" as a financing lever

Where legal mandates are not enough (especially for private-sector data), public bodies often use:

- procurement clauses (data sharing as a contract obligation)

- permit/operating conditions

public funding conditions (share data if you receive support)

How to co-define the best governance scheme

1. Start from "public value", not from the platform

Define what the data space is allowed to achieve (and what it must not do). Keep it simple and measurable, for example:

- better multimodal travel information and reliability
- safer and more efficient traffic management
- improved accessibility and inclusion (who benefits?)
- support sustainability goals (emissions, space, liveability)
- avoid lock-in, discrimination, or market capture
- This principle is particularly important in the Italian context, where there is a risk that mobility dataspaces may be shaped primarily by commercial interests, such as navigation app providers or fleet management companies, rather than by public policy objectives. Italy's experience with digitalisation investments under the PNRR shows that, without a clear public-value framing, data infrastructure projects can end up serving incumbent operators more than opening the market or improving public services. For this reason, the governance scheme should not just define broad public objectives, but also set minimum public-value data-sharing obligations that apply to all dataspace participants, regardless

2. Define scope and boundaries early (otherwise it becomes a "data swamp")

Be explicit about:

- which geography is in scope (city, region, cross-border corridor)
- which domains are included (PT, road traffic, shared mobility, logistics, parking, etc.)
- who can be a member (public bodies, operators, private firms, researchers)
- what is out of scope (high-risk personal data, sensitive security data, etc.)

3. Pick the first "data products" and use cases (small but real)

Choose a small set of priority use cases and translate them into concrete "data products":

- which datasets are needed (minimum dataset)
- update frequency (static vs near real-time)
- required quality level (completeness, accuracy, timeliness)
- who consumes the output and how it is used

Start with cases where the value is clear and the risks are manageable

4. Map stakeholders and their governance implications (power, risk, accountability)

Co-definition works only if you clarify who has leverage, who takes risk, who pays, and who is accountable:

- public authorities (mobility, digital, planning): set public value goals, ensure legitimacy and oversight

- data holders (operators, infrastructure managers, platforms): control critical datasets and update processes
- data users (service providers, researchers, planners): need predictable access and clarity on permitted reuse
- intermediaries/technical operators: run onboarding, catalogue, access workflows, security controls
- regulators/auditors: ensure compliance (privacy, security, competition, non-discrimination)

Also be honest about asymmetries:

- large actors can dominate standards, terms, and timelines
- smaller actors may be excluded unless rules and fees are designed to be proportional

5. Agree "who does what, when, and who pays" in one clear operating picture

Write a simple operating split (one sentence, no poetry), e.g.:

- Data holders publish/maintain datasets and meet quality duties

Data space operator / intermediary runs catalogue, access control, logging, support

- Public authority / governing board sets rules, resolves conflicts, monitors compliance
- Funding combines public budgets for common layers + participant contributions and/or service fees for operations

6. Lock in interoperability and quality rules (otherwise sharing is theatre)

Make interoperability and quality enforceable from day one:

- common metadata and documentation requirements

minimum technical interfaces (APIs, formats, identifiers)

- quality management (validation checks, versioning, update rules)
- "FAIR-like" expectations: findable, accessible under clear conditions, interoperable, reusable

7. Fix the "rules of the game" for access, reuse, and sensitive data

Agree early on:

- access tiers (open / restricted / controlled access)
- permitted uses and prohibited uses (including onward sharing)
- handling of personal data, re-identification risks, and security-sensitive information
- protection of trade secrets and commercially sensitive datasets

competition safeguards (avoid exchanging commercially sensitive info between competitors)

8. Build monitoring, enforcement, and conflict resolution (Ostrom logic, in practice)

A stable scheme needs:

- monitoring: who checks compliance, how often, with what evidence
- graduated responses: warnings → corrective actions → suspension/penalties
- a fast conflict-resolution path (so disputes don't kill the ecosystem)
- transparent decision-making and periodic rule updates
- a nested setup when multiple levels exist (local autonomy + shared federation rules)

9. **Use a staged roadmap with "gates" (pilot → scale → steady state)**

Define phases and gate conditions upfront:

- Stage 0: design and risk framing (what success/failure looks like)
- Stage 1: limited implementation (few datasets, few users, controlled access)
- Stage 2: expansion (more datasets, more actors, tighter quality requirements)
- Stage 3: operational service (stable funding, enforcement routines, audited processes)
- Stage 4: federation/scaling (cross-region interoperability, replication, long-term governance)

Vertical and Horizontal governance integration

Regulatory frameworks

1. **Multi-level allocation of responsibilities and competences (avoid "fragmentation")**

Overview:

Responsibilities are spread across administrative levels, and competences often overlap (or leave "cracks"). If roles are not clear, plans and measures become inconsistent across territories and hard to implement

Relevance for vertical & horizontal integration:

- Enables coherent proximity / polycentric strategies across municipalities and regions
- Reduces "who decides what" conflicts between national, regional and local actors
- Improves consistency when scaling policies across a metropolitan area

Additional comments:

A practical framework needs explicit role boundaries (what is decided at which level) and a clear mechanism to solve competence conflicts when they appear

2. **Formalised cooperation structures (make coordination durable)**

Overview:

Integrated governance works better when cooperation is not informal or person-dependent. Formal rules (statutes/mandates, signed commitments, clear participation terms) increase stability and continuity

Relevance:

- Protects coordination from political turnover and staff changes
- Helps keep horizontal actors (stakeholders, neighbouring authorities) engaged over time
- Makes responsibilities easier to assign and track

Additional comments:

Formalisation should be lightweight: enough to create accountability, not so heavy that it kills participation

3. "Peer-based" multi-stakeholder dialogue requirements (legitimacy + trust)

Overview:

A stable dialogue platform can be treated as a governance requirement: actors from different levels and sectors participate as peers, not as "top-down" recipients

Relevance:

- Creates shared objectives before arguing about instruments and projects
- Reduces resistance by involving local realities and non-government stakeholders early
- Supports horizontal integration (between municipalities) and cross-sector integration (mobility, energy, spatial planning)

Additional comments:

The framework needs a credible convenor (often neutral) and clear rules on who must be involved for legitimacy (in some contexts, national involvement is key)

4. Responsibility allocation inside decentralised processes (avoid "ownership dissipation")

Overview:

When governance is very horizontal and distributed, responsibility can become vague. This leads to low ownership, delays, and "everyone agrees, nobody delivers"

Relevance:

- Critical for metropolitan coordination and proximity planning, where delivery is split across many local bodies
- Important for cross-sector innovations, where mandates and objectives differ by organisation

Additional comments:

The regulatory framework should push for explicit task allocation (who leads, who supports, who approves, who monitors) and a minimum accountability structure

5. Funding and administrative burden alignment (avoid "deadline-driven governance")

Overview:

Integrated projects often depend on programme funding with strict deadlines and heavy reporting. Smaller authorities may lack capacity and face extra administrative costs

Relevance:

- Without capacity and time, integrated planning becomes a paper exercise

- Deadline pressure can distort priorities and reduce coordination quality
- Financial risk sensitivity can block cross-sector experiments

Additional comments:

The framework should encourage using existing reporting tools/processes (avoid duplication), reducing local administrative burden, and clarifying co-funding rules for shared initiatives

6. Permitting and public-space governance (clear rules for "where" decisions)

Overview:

Integrated mobility solutions often compete for public space and must fit local spatial plans and existing concessions. Conflicts emerge when departments or actors have different priorities for the same location

Relevance:

- Proximity planning and TOD-like interventions depend on location choices and trade-offs
- Cross-sector infrastructure (e.g., charging linked to transit assets) triggers permitting complexity

Additional comments:

A workable framework needs a defined forum and process to resolve public-space conflicts (not only technical feasibility), and clear criteria for prioritisation when goals clash

7. Legal pathways for cross-sector infrastructure use (energy–mobility integration)

Overview:

When an asset built for one sector is used for another (e.g., transit power infrastructure supporting charging), existing legal categories may not fit. This creates uncertainty about the applicant, ownership, responsibilities, and exemptions

Relevance:

- Without a recognised legal route, projects stall even when technically feasible
- Legal uncertainty increases costs, delays, and risk aversion among partners

Additional comments:

The regulatory framework should clarify: permitted cross-sector use cases, which legal entity can apply, how to handle split legal vs economic ownership, and which regulatory approvals/exemptions may be needed

8. Monitoring and reporting duties (from plans to implementation)

Overview:

Integrated governance is stronger when reporting and monitoring are built in: progress tracking, indicator monitoring, and periodic review

Relevance:

- Supports long-term continuity across political cycles
- Makes coordination measurable (not just "meetings happened")
- Helps identify where vertical/horizontal alignment is failing

Additional comments:

Reporting should be standardised (templates/tools) and proportionate, otherwise it becomes an administrative tax that reduces real delivery

Governance models (overview)

Multi-level Dialogue & Co-Decision Platform (MLG "Dialogue Platform")

Description

A permanent, structured platform that brings together national government, local/regional authorities, and other stakeholders (civil society, business, investors, academia) to discuss policy options and co-shape strategies and plans. In the NECPlatform logic, it is explicitly meant to strengthen vertical and horizontal integration and to avoid "top-down-only" planning by creating a stable space for dialogue, feedback, and coordination.

Governance approach

A neutral/legitimate convenor runs the platform (sets agenda, moderates, manages meetings and tools); national authorities participate to ensure legitimacy and policy uptake; local/regional authorities and stakeholders bring needs, data, and implementation realities; roles and decision rules are clarified in statutes/mandates and (ideally) a contract, while funding typically combines programme/public resources with in-kind time from members.

Advantages

- Better alignment across levels (reduces planning mismatches between national and local agendas).
- Legitimacy and trust when the "right actors" (including national level where relevant) are involved
- More robust decisions thanks to equal-weight participation and peer-based dialogue (not one level imposing)
- Capacity building and shared learning (peer exchange, shared tools, practical support)

Challenges

- Agenda misalignment and competence conflicts across levels can block progress
- Time- and people-intensive (skills, facilitation, participatory tools)
- Hard to keep stakeholders engaged, especially private sector and citizens
- Blurred accountability if decision-making is too decentralised (who owns which task)
- Funding cycles and reporting deadlines can overload smaller entities

Examples (mapping)

- NECPlatform / Climate & Energy Dialogue (CED) Platforms (designed to support multi-level dialogue around national plans) [1]
- Flemish Climate Pact (Belgium):
  regional–municipal pact including mobility among pillars, with monitoring and periodic dialogue [1]
- Croatian National Adaptation Strategy:
  national "hub" collecting broad stakeholder feedback to align strategy with local needs [1]
- PentaHelix approach for local plans (Croatia):
  task force + regular roundtables combining public/private/academia/NGOs/citizens [1]

Regulatory/legal gaps

- Implementation gap:

national plans can fail to systematically involve local/regional authorities and stakeholders, creating a need for formal dialogue mechanisms

- Competence/accountability gap:

overlaps and cracks between who controls supply vs demand (or policy vs delivery) make coordination hard without clear mandates

- Formalisation gap:

without contracts/statutes defining roles and powers, participation can weaken with political change and turnover

Hybrid Energy–Mobility Consortium led by an Asset Owner (e.g., public transport operator as anchor)

Description

In this model, a key infrastructure owner in the mobility system (often a public transport operator) leads a partnership to connect mobility services with energy infrastructure. The idea is to use existing assets (e.g., rail power supply, depots, stations) to enable new low-carbon mobility functions (e.g., EV charging), while keeping public transport operations safe and reliable.

Governance approach

The asset owner initiates and coordinates the project, the municipality grants permits and decides on public-space priorities, the grid/energy actors define technical and safety conditions, and private service providers build and run the added service; costs and risks are shared through contracts, with funding coming from a mix of public support (if available) and private investment, and revenues mainly coming from service use (e.g., charging fees).

Advantages

- Faster access to infrastructure by reusing existing mobility assets instead of building everything from scratch
- System integration:

energy and mobility decisions are made together, not in separate silos

- Potential public value:

supports electrification while leveraging public transport hubs and networks

- Learning-by-doing:

pilots create practical experience for scaling later

Challenges

- Misaligned objectives and mandates between organisations (public transport vs energy vs city planning)
- Complex coordination:

many actors must agree on timing, responsibilities, and operational constraints

- Ownership and risk disputes:

"who owns what" and "who carries the risk" can block progress

- Public space and political priorities can override technical logic (location choices, trade-offs)

Examples (mapping)

- Rotterdam "E-PT-hub" concept:

RET explored using metro power infrastructure to supply EV charging, involving public transport and energy stakeholders [2]

Regulatory/legal gaps

- No clear legal pathway for cross-sector use of public transport energy assets (mobility infrastructure used for energy services)
- Unclear allocation of responsibilities (safety, reliability, liabilities) when multiple sectors share one system
- Procurement/contracting ambiguity for hybrid projects that do not fit standard public transport or energy project templates
- Permission and public-space rules can be unclear when charging infrastructure is tied to transport assets and stations

Polycentric Metropolitan Steering Body (joint governance across municipalities)

Description

In this model, several municipalities that function as one urban area create a joint steering body to coordinate policies and investments across the whole "polycentric" territory. The goal is to avoid fragmented decisions and to align local actions (land use, services, mobility networks) so that proximity-based planning can work across municipal borders.

Governance approach

Mayors (and municipal representatives) form a joint executive/assembly that sets shared priorities and a metropolitan investment plan, a small technical secretariat coordinates and monitors delivery, each municipality implements projects locally, and funding comes from municipal contributions plus regional/national/EU programmes aligned to the common plan.

Advantages

- Coherent network decisions (mobility, services, and infrastructure planned as one system)

- Reduced rivalry and duplication between neighbouring municipalities
- Stronger access to funding with a single pipeline of priority projects
- More resilient governance than “one-city leadership”, if roles are shared and documented

Challenges

- Hard politics:

different agendas, party rivalry, and personal conflicts can block cooperation

- Unclear ownership when decision-making is too distributed (“who is responsible for what”)
- Capacity gaps:

smaller municipalities may lack staff and struggle with extra coordination workload

- Leadership fragility if success depends on a single “champion” that may disappear

Examples (mapping)

- Intermunicipal Communities (Portugal):

formal bodies with an inter-municipal assembly and an executive council made of mayors; competencies include metropolitan investment plans and participation in transport networks [1]

- Metropolitan Cities (Italy):

sub-regional bodies covering large urban areas, with a “metropolitan mayor” and coordination functions at metro scale [1]

- DELTA Programme (Netherlands):

cooperation across levels and territories, organised into multiple work regions to translate long-term decisions into plans and measures [1]

Regulatory/legal gaps

- Mandate gap:

unclear powers and boundaries between the metropolitan body and individual municipalities can weaken execution

- Accountability gap:

without explicit task allocation, monitoring can exist, but responsibility stays vague

- Financing gap:

funding is often tied to external programme cycles and deadlines, which can distort priorities and timing

Integrated Public–Private Partnership for Nodes and Corridors (Transit-oriented / proximity redevelopment)

Description

In this model, public authorities and private actors jointly develop and operate an integrated package around key nodes and corridors (e.g., stations, hubs, strategic streets). The partnership bundles planning, infrastructure, and services in one coordinated programme, so investments in mobility and the built environment support each other and deliver proximity and accessibility goals.

Governance approach

The municipality (often with regional/national support) sets the public objectives and grants permits, private partners design/build and sometimes operate assets and services, and a shared PPP agreement defines who delivers which components and when; funding mixes public capital (or grants) with private investment, with returns coming from availability payments, service revenues, and/or project-linked income streams.

Advantages

- One coordinated delivery plan instead of disconnected projects (planning + infrastructure + services)
- Leverages private capital and capabilities when public budgets or capacity are limited
- Clearer risk-sharing if the contract allocates risks to the parties best able to manage them
- Potential to speed up implementation by using a single programme governance structure

Challenges

- High complexity in contracting and coordinating multiple components and stakeholders
- Goal conflicts:

private return expectations may clash with public equity and access goals

- Accountability risk if responsibilities are split across many actors without strong monitoring
- Long timelines can reduce commitment and increase renegotiation pressure

Regulatory/legal gaps

- Contracting fit gap:

integrated projects often do not match standard procurement templates (too cross-sector and multi-component)

- Role clarity gap:

unclear allocation of responsibilities across planning, construction, operations, and service delivery can create disputes

- Finance alignment gap:

funding rules and programme deadlines can push short-term deliverables over long-term integrated outcomes

Market dynamics and competition assessment

1. Cross-sector market boundaries and new roles (energy–mobility convergence)

Overview:

Sustainable mobility innovation can sit at the intersection of public transport, electricity grids, charging services, and urban development. This blurs the line between “transport provider” and “energy/charging provider” and creates new roles and partnerships

Why it matters:

- New value chains emerge (infrastructure + charging + fleet operations)
- Actors that did not “compete” before may now depend on each other or compete for the same space and users

Additional comments:

This convergence increases coordination needs and can slow down market formation if roles are not clearly defined

2. **Infrastructure ownership and concessions shape market power (gatekeeper dynamics)**

Overview:

Access to key assets (rail power grids, depots, station areas, public parking areas) and existing concessions strongly affects who can enter and operate. If the "right to build/operate" is already assigned, newcomers face a high barrier

Why it matters:

- Asset owners or concession holders can become de facto gatekeepers
- Entry is less about technology and more about rights, access, and control of infrastructure

Additional comments:

When legal ownership and economic ownership are split, decision power can become unclear, creating delays and negotiation leverage games

3. **Location decisions and public-space competition are central (the "where" battle)**

Overview:

Even when a solution is technically feasible, the main conflict can be about where it should happen. Charging points and mobility infrastructure compete with other urban priorities (e.g., car-free space, new public squares, local redevelopment plans)

Why it matters:

- Competition is not only between firms, but also between uses of the same space
- Projects can be blocked or relocated due to shifting urban planning priorities

Additional comments:

Market outcomes can change simply because one municipal department (e.g., urban development) has a different plan for the same site

4. **High coordination and administrative costs create entry barriers (capacity asymmetry)**

Overview:

Integrated projects require time, people, facilitation skills, participatory tools, and heavy coordination across many actors. Smaller municipalities and smaller organisations can struggle with added workload and reporting

Why it matters:

- Well-resourced players cope better with complexity, consultants, and long processes
- Smaller entities may drop out or become junior partners with limited influence

Additional comments:

This can unintentionally push the market toward a few actors who can "carry the paperwork and meetings"

5. **Funding design and financial risk sensitivity shape who participates**

Overview:

Funding often relies on programmes with strict application and reporting deadlines, which can collide with local capacity constraints. Financial stress on key actors can also stop projects when costs rise or risks increase

Why it matters:

- Tight deadlines favour actors with strong administrative capacity
- Risk-averse organisations may halt projects if costs escalate or revenues are uncertain

Additional comments:

Co-funding arrangements can help move projects forward, but they also require strong commitment and clear benefit-sharing

6. **Regulatory pathways and legal uncertainty act as a competition variable**

Overview:

When a project uses an unusual legal route (e.g., reclassifying infrastructure roles, requesting exemptions), uncertainty increases time and cost. Even choosing the "right applicant" can be unclear

Why it matters:

- Legal ambiguity delays investment and rewards first movers who can navigate the process
- Organisations may avoid innovation if the legal route is untested and errors are costly

Additional comments:

A market can stall for years not because of technology, but because the legal category does not fit the new hybrid solution

7. Fragmentation and rivalry across jurisdictions distort the playing field

Overview:

Neighbouring authorities may face similar issues but still fail to cooperate due to rivalry, political agendas, or personal antagonisms. This can result in inconsistent priorities and weak sharing of good practices

Why it matters:

- Providers face a more complex landscape when policies differ across municipalities
- Collaboration opportunities may depend on local politics rather than performance

Additional comments:

Without a stable coordination mechanism, the market becomes patchy and harder to scale

8. Public-value criteria can reshape competition (from "first come" to "societal prioritisation")

Overview:

The analysis indicates a move toward prioritising grid capacity and infrastructure choices based on societal value, not only on "first come, first served." This changes what it means to be competitive

Why it matters:

- Actors that can demonstrate strong public value (e.g., essential fleets, public services) may gain priority
- Business cases that ignore public objectives may lose access or legitimacy

Additional comments:

Competition becomes partly a "public value contest," not just a price or speed contest

9. Collaboration is often necessary, but it can also create lock-in risks

Overview:

Cross-sector innovation requires collaboration between transport operators, municipalities, grid actors, and private builders/operators. However, partnerships can become exclusive if one configuration becomes "the only workable path"

Why it matters:

- Collaboration lowers technical and organisational barriers
- But exclusive arrangements can limit future entrants and reduce flexibility

Additional comments:

A key governance question is whether collaboration models remain open to additional partners over time

Political influence

1. Multi-level politics and "who is in charge" conflicts

- Observation:

Integrated mobility and energy initiatives often sit across multiple government levels, with overlapping competences and unclear boundaries

- Cause:

Different levels (and agencies) have different mandates, priorities, and legal powers, so the same project can require approvals and alignment from several "owners of authority"

- Implication:

Political disputes about competence and leadership can slow decisions, create inconsistent signals, and weaken accountability

2. Stakeholder power and influence shape outcomes (not only technical merit)

- Observation:

Some stakeholders have more power, resources, and negotiation leverage than others, and this affects how governance schemes are chosen and how fast projects move

- Cause:

Large organisations often control critical assets, expertise, or funding capacity; smaller actors can struggle to be heard or to sustain engagement

- Implication:

Political choices may tilt toward solutions that fit powerful actors' preferences, even when other options could better support broader access or local needs

3. Intra-government fragmentation creates "everyone's topic, nobody's job"

- Observation:

Integrated initiatives require coordination across departments and policy fields (mobility, energy, spatial planning, redevelopment). This fragmentation creates delays and uncertainty

- Cause:

No single department owns the full problem, and internal priorities can conflict (e.g., transport operations vs urban redevelopment plans for the same site)

- Implication:

Without a strong political sponsor and clear internal coordination, projects drift, stall, or get reshaped by whichever department is most dominant at the moment

4. Public space and redevelopment politics can override infrastructure logic

- Observation:

Conflicts about the use of public space and site selection are politically loaded and can dominate the decision process

- Cause:

The same physical location can be claimed by different agendas (redevelopment, public realm design, traffic reduction, commercial interests), and the "best technical site" may not be politically acceptable

- Implication:

Projects can be blocked, relocated, or delayed for political reasons, changing who benefits and who can participate in the market

5. Short-termism and "process politics" (talking structures vs delivery)

- Observation:

The analysis highlights the importance of dialogue platforms and structured processes, but also shows risks: time intensity, engagement fatigue, and slow translation into implementation

- Cause:

Political actors may prefer visible coordination initiatives (platforms, strategies, consultations) because they are safer than hard trade-offs, and they can fit programme timelines

- Implication:

Governance can become "meeting-heavy" while delivery remains weak, especially when roles and responsibilities are not clearly assigned

6. Financial pressure and risk sensitivity influence political support

- Observation:

Projects can stall when financial conditions worsen or when administrative and reporting burdens become too heavy for local actors

- Cause:

Funding deadlines, co-funding rules, and the capacity limits of smaller municipalities create political reluctance to commit to complex integrated projects

- Implication:

Political support may be conditional and unstable: leaders may back integration in principle, but step away when risks, costs, or administrative burdens rise

Funding schemes

Mixed funding sources (public programmes + partner co-funding + private investment)

The analysis mainly shows funding as a patchwork of sources rather than one clean model. Integrated projects are typically supported by:

- EU / international programme funding (often used to run multi-level processes and support implementation capacity)
- National / regional public funding instruments (linked to broader investment programmes and strategies)

- Local authority budgets (time, staff, and sometimes direct spending).
- Co-funding between project partners (to pay for preparatory work like legal/technical studies and documentation)
- Private investment where market actors have an interest (e.g., charging infrastructure developers), often shaped by concessions/rights

What funding is typically needed (CAPEX vs OPEX)

CAPEX (upfront investment):

- Physical infrastructure and construction work (e.g., charging equipment, site works)
- Enabling upgrades to existing assets (where relevant) to make cross-sector use possible
- Safety-related adaptations (e.g., fire safety constraints can change costs and design)

OPEX (ongoing costs):

- Coordination and governance capacity (secretariat, facilitation, stakeholder engagement)
- Data work and reporting (templates, monitoring, administrative workload).
- Legal and regulatory process costs (preparing files, managing approvals, correcting errors)
- Operational coordination across organisations (meetings, alignment work, internal staff time)

Funding logic across phases (idea → feasibility → pilot/project → continuation)

- Feasibility / early phase:
  - Public funding and programme support are used to de-risk and build capacity (data, planning, multi-level dialogue)
  - Partners may co-fund preparatory work when a new legal route or unconventional setup is required
- Pilot / first concrete project:
  - Funding becomes sensitive to construction cost and organisational financial stress; rising projected costs can stop a project
  - Choosing an initial configuration that avoids high construction costs can be decisive (even if it is not the “perfect” long-term solution)
- Continuation / scaling:
  - Projects need to align with longer-term investment agendas and with rules shaping access to scarce resources (e.g., grid capacity prioritisation)
  - Without a stable funding and ownership logic, “societal rationale” may not translate into organisational ownership, and support can evaporate

Contracting and “who pays for what” mechanisms

Several practical mechanisms that shape funding:

- Contractual cost-sharing among partners (used to fund preparatory legal/technical work)
- Concessions / existing rights that can block or redirect projects (funding and delivery depend on who already holds operating rights)
- Voluntary technical and financial agreements between public and private partners (a structured way to pool resources and responsibilities)

- Programme-driven support that may include “access to finance” support actions, but with limited detail on the exact instruments

Key risks and distortions (what break funding in practice)

- Cost escalation risk: projected cost increases can kill projects, especially when a key actor is financially strained
- Administrative burden risk: heavy reporting and deadlines can overload smaller authorities and reduce participation
- Site and concession conflicts: even funded projects can stall if they clash with redevelopment plans or existing concessions
- Ownership ambiguity: split legal vs economic ownership can delay approvals and complicate who can fund/apply

Strategic recommendations

- Budget for governance, not only infrastructure: coordination capacity and legal work are real costs, not “free overhead”
- Co-fund the “paperwork mountain” early: if a novel legal pathway is needed, shared financing for files/studies reduces delays and conflict
- Reduce administrative load on local actors: simplify reporting and provide support, otherwise small municipalities disengage
- Clarify ownership and payment responsibilities upfront: especially when infrastructure ownership is split across entities
- Check concession and land-use constraints early: avoid funding a design that will be blocked by public-space politics or pre-existing operating rights

How to co-define the best governance scheme

Cities (and metro areas) should not force “15-minute city / polycentric / TOD / proximity planning” into one single governance setup. In practice, you will mix schemes by area (centres vs corridors), function (planning vs delivery), and maturity (design vs implementation). The key is to co-define a scheme that matches objectives, competences, stakeholder power, capacity, and risk tolerance

1. **Start from “public purpose”, not from the organisational chart**

Define what the integrated programme must achieve and what it must avoid. Keep it measurable

- improve access to daily services (proximity)
- reduce car dependency and space pressure
- strengthen public transport as the backbone (for TOD-style choices)
- avoid fragmented decisions across municipalities (“patchwork”)
- avoid projects that are technically feasible but politically/site-wise impossible

2. **Define the integration scope: vertical, horizontal, and cross-sector**

Be explicit about what integration means in your case:

- Vertical integration: which decisions are national/regional vs local (and where approvals are needed)
- Horizontal integration: which municipalities must align (standards, priorities, investment sequencing)
- Cross-sector integration: where mobility intersects with energy, public space, redevelopment, and concessions

If you don't define this, you will spend months arguing about "coordination" without agreeing on what is being coordinated

3. Choose the first spatial focus and keep it realistic

Different spatial choices need different governance intensity. Pick a first scope you can actually manage.

- a set of sub-centres (polycentric design) and their 15-minute catchments
- priority corridors and nodes where accessibility gains are highest
- a limited number of sites where conflicts are predictable (public space, redevelopment plans, existing rights)

Start where coordination benefits are high and stakeholder conflict is still manageable.

4. Map stakeholders and their governance implications (power, risk, money, vetoes)

Co-definition only works if you clarify who has leverage and who can block delivery

- municipalities (often multiple departments with competing priorities)
- metropolitan / inter-municipal bodies (if present)
- national/regional authorities (competences, approvals, programme funding rules)
- asset owners and operators (e.g., public transport operators; infrastructure owners)
- grid / energy actors when electrification infrastructure is involved
- private developers/operators where concessions or service rights matter

For each actor: who decides, who pays, who bears risk, who owns the asset, who has a veto

5. Pick a governance "spine" and then attach delivery modules

Don't over-engineer: choose one backbone structure and connect the rest to it

- a joint steering body for metro-wide alignment (horizontal)
- a multi-level dialogue platform for vertical coordination and stakeholder legitimacy
- project consortia / PPP-like delivery units for specific nodes, corridors, or cross-sector assets

Rule of thumb: one place to align priorities, separate instruments to deliver

6. Formalise roles early (or the scheme will depend on personalities)

Write down the basics in a light but binding way:

- mandate/statute for the steering body or platform
- decision rules (what requires consensus vs majority)
- task allocation (who leads, who supports, who approves)
- conflict-resolution steps (what happens when departments/municipalities disagree)

If it's all informal, it works right up to the moment a key person leaves

7. **Use a staged process with "gates" (design → feasibility → delivery → scaling)**

Build a shared roadmap with clear stage transitions and decision options.

- Stage 0: common objectives + scope + governance setup
- Stage 1: feasibility (including legal pathway, site feasibility, concession conflicts)
- Stage 2: pilot / first implementation package (limited geography, clear owners)
- Stage 3: operational delivery and monitoring (regular reporting, corrective actions)
- Stage 4: replication across centres/corridors

For each gate, agree in advance:

- what evidence is needed (technical, legal, financial, site compatibility)
- who validates it
- what decisions are allowed (scale, pause, redesign, stop)

8. **Decide "who pays for what" in one simple split (and budget governance capacity)**

Keep the financing logic transparent:

- public side typically covers: coordination capacity, planning, monitoring/reporting, enabling investments
- private side (where relevant) covers: delivery/operations under contract or concessions
- partners may co-fund: legal/technical studies when the route is unconventional

Also: budget the boring parts (coordination, reporting, legal work). They are not "free"

9. **Solve the predictable blockers upfront: sites, concessions, legal fit, and ownership**

Before you commit to a "nice plan," check the usual landmines:

- does the chosen site conflict with redevelopment priorities?
- do existing concessions or rights block the intended solution?
- is there a clear legal pathway for cross-sector use of assets?
- is ownership (legal vs economic) clear enough to apply, build, and operate?

Most failures here are not technical—they're governance and rights issues wearing a technical mask

Governance models for UVAR

Regulatory frameworks

1. **Multi-level allocation of responsibilities (avoid "dead ends")**

Overview:

UVARs often sit across levels of government. Cities may set local access rules, but other levels may control key levers such as enforcement powers, legal basis, funding, and access to vehicle registries. If roles are unclear, implementation stalls or becomes inconsistent

Relevance for UVARs:

- Clear “who decides what”: reduces delays and institutional conflicts
- Operational continuity: avoids gaps between policy design and enforceable operation
- Consistency across the territory: helps users and businesses understand rules

Additional comments:

A practical setup needs a written division of tasks plus coordination routines (steering group, shared timelines, escalation path)

2. Legal basis for access rules, charging, exemptions, and permits

Overview:

An UVAR needs an explicit legal basis for the core elements: who is restricted, which vehicles are allowed, how permits and exemptions work, and what happens in non-compliance. Exemptions and transition rules are especially sensitive because they shape fairness and acceptability

Relevance for UVARs:

- Legally robust restrictions: fewer legal challenges and fewer “grey areas.”
- Clear permit/exemption logic: improves public trust and operational clarity
- Structured phasing: allows stepwise tightening (e.g., for LEZ/ZEZ)

Additional comments:

If exemptions are too broad, impacts weaken; if too strict, acceptability drops—so the legal framework must support targeted, transparent exceptions

3. Enforcement, evidence, and sanctions (especially camera/ANPR-based)

Overview:

Most modern UVARs rely on automated enforcement (e.g., ANPR/cameras) plus a back-office process (checks, notifications, fines, appeals). The regulatory framework must clearly allow the use of camera evidence, define enforcement authority, and set due-process rules

Relevance for UVARs:

- Credible enforcement: without it, compliance collapses
- Fair enforcement: rules for notices, appeals, and error correction reduce backlash
- Operational feasibility: enables integration with registries and fine processing

4. Data governance and privacy (plate data, registries, back-office)

Overview:

UVARs process sensitive operational data (license plates, permits, exemptions, enforcement logs). The framework must set what data is collected, who can access it, retention rules, sharing rules between agencies, and safeguards under data protection law

Relevance for UVARs:

- Legitimate enforcement operations: prevents systems being blocked later for privacy reasons
- Trust and acceptability: people need clarity on “what you collect and why.”
- Accountable partnerships: important when private suppliers operate parts of the system

Additional comments:

Data protection constraints are presented as a core design condition, not an afterthought

5. EU/legal principles: proportionality, non-discrimination, and foreign vehicles

Overview:

For LEZ/ZEZ and similar restrictions, rules must respect overarching legal principles such as proportionality and non-discrimination, and avoid making compliance impossible for non-local or foreign vehicles. Clear signage and understandable standards matter

Relevance for UVARs:

- Lower legal risk: reduces exposure to disputes and reversals
- Higher clarity for users: improves compliance, especially for visitors and occasional users
- More defensible exemptions: supports “fair and justified” differentiation

Additional comments:

The analysis explicitly flags these constraints and the need to design UVARs accordingly

6. Financing rules and revenue governance (what pays for what)

Overview:

UVARs have upfront and ongoing costs (technology, operations, maintenance, communications, monitoring). If the scheme includes charges or fines, the framework should clarify revenue handling (collection, allocation, transparency, and potential earmarking to sustainable mobility)

Relevance for UVARs:

- Financial sustainability: prevents schemes dying after the pilot phase
- Public legitimacy: transparent use of revenues can reduce opposition
- Ability to fund mitigation: supports equity measures (alternatives, subsidies, phased transitions)

Additional comments:

The guidance treats financing and revenue management as a governance issue, not only an accounting topic

7. Procurement and PPP safeguards (if private suppliers are involved)

Overview:

When private actors deliver technology and operations, the regulatory/procedural framework must ensure transparent procurement, clear performance requirements, ownership/control of data, and exit/upgrade rules to avoid lock-in

Relevance for UVARs:

- Better system quality: clearer specs and KPIs reduce failures
- Reduced vendor lock-in: protects long-term adaptability
- Accountability: clarifies roles in operation, maintenance, and incident handling

Additional comments:

PPP and concession-type delivery options are explicitly discussed as possible approaches for UVAR system delivery

8. Participation, transparency, and equity safeguards (as “must-have” governance conditions)

Overview:

Even when not written as strict legal obligations, structured participation and transparency mechanisms often function as de-facto governance requirements because they strongly affect acceptability and compliance. Equity impacts (who benefits, who pays, who must adapt) need explicit attention

Relevance for UVARs:

- Higher acceptability: fewer conflicts and better compliance
- Better distributional outcomes: identifies affected groups and needed support
- Adaptive governance: enables adjustments after rollout based on feedback and evidence

Additional comments:

The analysis provides repeated evidence that acceptability and equity are central success conditions for UVARs

Governance models (overview)

Single-lead public authority model (public-led UVAR delivery)

Description

In this model, a public authority (typically the city/municipality) leads the UVAR end-to-end: defining the policy objectives (air quality, congestion, safety, accessibility), choosing the measure type (e.g., LEZ/ZEZ,

restricted access, pricing), setting rules and exemptions, and organising enforcement and communication. The scheme is usually embedded in wider planning instruments (e.g., an integrated mobility plan/SUMP) to align it with other policies and measures.

Governance approach

The city/UVAR authority designs the scheme (objectives → zone/rules → consultation), procures and runs (or oversees) the enforcement and operations (incl. ANPR, fines/charges, complaints handling), and pays mainly through public budgets and/or higher-level public funding, while managing any fees/fines transparently and ideally earmarking revenues for sustainable transport improvements

Advantages

- Clear accountability:

one lead body is responsible for decisions, delivery, and results

- Better policy alignment:

easier to integrate UVAR with mobility plans and complementary measures

- Higher acceptability potential (if well managed):

transparency on revenue use and structured communication can improve trust

Challenges

- Capacity and competence gaps:

the city may not fully control planning, operation, and enforcement (national/regional actors may be needed)

- Upfront funding pressure:

equipment, enforcement systems, communication, and monitoring require early investment

- Political cycle risk:

schemes can face strongest resistance near implementation and may be exposed to electoral timing

- Public opposition if participation is weak:

several cities experienced conflicts when stakeholders felt excluded or impacts were unclear

Examples (mapping)

- Ghent circulation plan (city-led integrated measure within a mobility plan) [1][3]
- Vitoria-Gasteiz superblock scheme used as a main tool within the city's mobility plan [1]
- Amsterdam LEZ tightening communicated directly to affected residents (personal letters) [3]
- Oslo car-free livability programme adjusted after stakeholder concerns (e.g., access for specific groups/services) [3]
- Rome: LEZ implementation (Zone 3) / Lisbon: restricting car access around schools as city measures developed in UPPER. [2]

Regulatory/legal gaps

- Enforcement/legal basis gap:

cities need a solid national/local framework for enforcement tools (e.g., ANPR, fines/charges, access to vehicle databases)

- Competence gap:
unclear division of responsibilities can block “who does what” across city–region–state (including police powers)

- Data protection/privacy constraints:
running ANPR and compliance databases must fit GDPR/data protection rules

- EU-law constraints (for LEZ/ZEZ):
measures must respect proportionality and non-discrimination and avoid making compliance harder for foreign vehicles

Inter-agency and multi-level co-governance model

Description

In this model, an UVAR is designed and delivered through coordinated action across multiple public bodies, because key responsibilities are often split. The city may control street space and local rules, but enforcement powers, vehicle registries, air-quality obligations, or funding can sit at regional or national level. The scheme is managed through formal coordination (e.g., joint working group/steering structure) so that the UVAR can move from design to enforcement without “institutional dead ends”.

Governance approach

A joint city–region–national setup agrees the objectives and the rule package upfront; the city leads day-to-day design and delivery, regional/national bodies provide the legal basis and required assets (e.g., enforcement powers, vehicle data), and costs are shared via city budgets plus regional/national funding streams (with any revenues handled under a pre-agreed allocation).

Advantages

- Access to the full toolbox:
combines local street management with higher-level legal and enforcement powers

- Stronger compliance:
easier to connect enforcement systems to official vehicle databases and sanction mechanisms

- Policy coherence:
links UVAR targets to wider air-quality and mobility objectives set beyond the city boundary

- Resource pooling:
enables co-funding of expensive infrastructure and systems

Challenges

- Slow decisions:
more actors means more negotiation and longer timelines

- Blurred accountability:
citizens may not understand who is responsible when rules change or issues appear

- Conflicting priorities:
city, region, and national bodies may not align on ambition, exemptions, or timing

- Operational friction:

data sharing and system integration can become a bottleneck

Examples (mapping)

- Rome (Green Area / LEZ roadmap):

city policy proposal to the Lazio Region; regional air-quality plan sets targets; enforcement relies on ANPR, integration with Urban Police and traffic monitoring; system needs connection to the national vehicle database; investments funded through multiple public sources [2]

- Jerusalem (LEZ legal updates):

local and national legal frameworks were updated to enable implementation [1]

- General institutional setting example:

guidance notes that cities may need to involve national government, national police, and regional government to cover planning, operation, and enforcement competences [1]

Regulatory/legal gaps

- Competence gaps:

unclear "who is legally allowed to do what" across city–region–state can stall delivery

- Enforcement basis gaps:

camera enforcement, fine issuance, and legal evidence requirements may not be fully enabled

- Data access gaps:

rules for using vehicle registries and sharing data across agencies can be restrictive

- Data protection constraints:

compliance systems must fit privacy requirements, which can limit operational options

Regional harmonised framework model (standardised rules across cities)

Description

In this model, a region (or another higher-level public body) sets common standards for UVARs so that different cities do not run completely different schemes. The shared framework typically covers key elements such as vehicle eligibility (emission classes), basic rules, signage and communication patterns, and sometimes common approaches for permits and exemptions. The goal is to make UVARs easier to understand for users and easier to communicate and enforce across a wider area.

Governance approach

The regional authority defines and updates the common standard and may co-fund shared elements (e.g., guidance, coordination, sometimes shared data/technical components), while each city selects the local zone and operational setup, runs day-to-day operations and communication, and pays local delivery costs (with revenues managed under agreed rules and ideally reinvested in sustainable mobility).

Advantages

- Higher public understanding and acceptance:

fewer different rules reduce confusion and resistance

- More effective communication:
a shared standard makes messaging simpler and more consistent
- Less “boundary shopping” and displacement effects:
common rules reduce incentives to shift trips to nearby non-restricted cities
- Efficiency gains:
cities can reuse common templates and align enforcement approaches

Challenges

- Less local flexibility:
a common standard may not fit every city’s context or political appetite
- Complex coordination:
cities still need alignment on timing, exemptions, and complementary measures
- Equity tension:
the same rule can hit different groups differently across territories, so supporting measures may need local tailoring

Examples (mapping)

- Regional common approach to LEZs in northern Italy (common emissions standards; consistent approach across cities, including thresholds by city size) [1]
- Regional common approach in Germany (shared standards to ease communication and understanding) [1]
- Crit’Air-based vehicle classification used for LEZ restrictions (illustrated through the Paris/Metropole context in the toolbox) [2]

Regulatory/legal gaps

- Mandate gap:
the region may not have a clear legal mandate to impose a binding common standard across municipalities
- Enforcement and data gap:
harmonisation often depends on access to vehicle identification data and legally solid enforcement tools (e.g., camera enforcement, fine processing)
- Cross-border/EU constraints:
common standards still must respect EU legal principles (e.g., non-discrimination and freedom of movement) and address foreign-vehicle compliance
- Data protection constraints:
any shared registers or digital enforcement components must comply with privacy rules

Public–Private Partnership / concession model for UVAR systems and operations (tech-enabled)

Description

In this model, the public authority keeps control of the policy (why, where, and who is allowed), but relies on private partners to deliver the “hard part”: technology, infrastructure, and sometimes operations. This often includes cameras/e-gates, back-office systems, data analytics, maintenance, and user-facing

services (permits, queries, complaints). The partnership is used when the city needs specialised skills, faster delivery, or a way to reduce upfront public investment.

Governance approach

The city defines objectives, rules, zone and exemptions, then runs a transparent tender to contract a private provider to design/install/operate/maintain the UVAR system, and pays through public budgets and/or dedicated funding (sometimes supported by UVAR revenues), while the city supervises performance and keeps authority over sanctions and rule changes.

Advantages

- Access to expertise and capacity:

the city can use specialised technical skills that it may not have in-house

- Faster implementation:

procurement + delivery can be quicker than building everything internally

- Lifecycle focus:

contracts can include maintenance and service levels, not just installation

- Financial flexibility:

options like renting/hiring equipment can reduce upfront budget pressure

Challenges

- Complex contracts:

writing good specs, selecting tenders, and managing the contract require strong public skills

- Vendor lock-in risk:

if standards and data governance are weak, switching provider becomes costly

- Misaligned incentives:

a provider may optimise for system throughput, while the public goal is compliance and fairness

- Trust and acceptability:

people may distrust “private profit” around fines, cameras, or fees if transparency is poor

- Budget constraints still bite:

pilots and deployments can be scaled down if funding is limited

Examples (mapping)

- PPP-type delivery options explicitly mentioned for UVAR system procurement (e.g., DBFM, BOT-style approaches) [1]
- Lisbon bus-lane camera enforcement pilot:

tender for camera-based detection, provider selection, contracting and installation planning; work with national authorities because legislation was not ready for fines based on camera evidence [2]

- Rome “Green Area” LEZ (Zone 3):

large-scale ITS and access-gate rollout funded by multiple public sources; need for connection to national vehicle database; tendering for remaining electronic gates; operating model and “legal tool” definition as next steps [2]

Regulatory/legal gaps

- Camera enforcement validity:

rules may not allow camera outputs to be used as legal evidence for fines

- Who can issue fines:

unclear authorisation for non-police actors (or transport operators) to enforce and sanction

- Data access and sharing:

legal/administrative barriers to use vehicle registries and owner data for enforcement

- Procurement and transparency rules:

weak procurement governance increases legal risk and public backlash

- Privacy/data protection:

systems using plates, permits, and compliance databases must fit strict data-protection requirements

Participatory and equity-first co-design model

Description

In this model, the UVAR is built with a strong focus on public acceptability and fairness. The city does not "announce and enforce" a restriction overnight; it designs the scheme together with key stakeholders (residents, businesses, commuters, vulnerable groups) and pairs restrictions with support measures. The core idea is simple: people accept rules more easily when they understand the purpose, see realistic alternatives, and feel that costs and benefits are shared fairly.

Governance approach

The city co-designs the UVAR with stakeholders before final decisions, defines rules plus mitigation measures, funds support mainly through public budgets and/or earmarked revenues, and continuously monitors impacts and adjusts exemptions, phasing, and complementary services after rollout based on feedback and evidence.

Advantages

- Higher acceptability and compliance:

clearer purpose + involvement reduces resistance and "rule dodging"

- Better equity outcomes:

helps identify who is negatively affected and what support is needed (alternatives, targeted incentives, phased transition)

- Fewer political shocks:

conflicts can be managed earlier, before implementation becomes a crisis

- Better design quality:

stakeholder knowledge improves exemptions, access rules, and operational details

Challenges

- Time and effort:

participation takes time and can slow implementation

- Hard trade-offs remain:
even with engagement, some groups will lose convenience or face costs
- Risk of "consultation theatre":
if people feel ignored, trust drops and opposition increases
- Budget dependency:
equity measures (PT improvements, subsidies, incentives) cost money and need stable funding

Examples (mapping)

- Amsterdam (LEZ tightening):
direct communication to affected residents (e.g., personalised letters) to support acceptance [3]
- Oslo (car-free programme):
scheme adjusted after stakeholder concerns and practical access issues emerged [3]
- Ghent (circulation plan):
integrated package with strong planning/communication logic, often cited as a case where broader framing matters for acceptance [3][1]

Regulatory/legal gaps

- Exemptions and permits:
unclear or inconsistent legal bases for exemptions can undermine fairness and create disputes
- Revenue earmarking:
if the legal framework does not allow (or does not clearly define) reinvesting revenues into sustainable mobility, trust and equity benefits are harder to deliver
- Non-discrimination / proportionality constraints:
equity measures must still respect legal principles (e.g., avoid discriminatory treatment), which can limit "easy" fixes
- Data protection vs monitoring:
collecting data to evaluate distributional impacts and compliance must fit privacy rules, which can restrict what can be measured and shared

Market dynamics and competition assessment

1. UVARs are market-shaping policies, not "neutral" restrictions

Overview:

UVARs change who can enter an area, when, and at what cost. This reshapes daily travel choices and business operations, and it can shift demand toward cleaner vehicles and sustainable modes

Why it matters:

- Creates winners and losers across households, SMEs, and larger operators
- Changes demand for public transport and active modes
- Influences logistics patterns (routes, time windows, vehicle choices)

Additional comments:

The key is that competition happens under new access rules, not in a “free” market

2. Compliance costs can distort competition (especially between large and small actors)

Overview:

UVARs often require investment to comply (vehicle upgrade/replacement, permits, operational changes). Larger firms typically adapt faster because they have capital and fleet renewal plans, while small firms and lower-income users face higher relative costs

Why it matters:

- Risk of pushing small operators out of restricted areas
- Risk of regressive impacts if support measures are weak
- Competitive advantage for actors with newer fleets and better admin capacity

Additional comments:

Equity measures and phased transitions are not “nice to have”: they reduce unfair competitive impacts

3. Patchwork rules raise “transaction costs” and favour the biggest players

Overview:

If each city has different standards, permits, exemptions, and enforcement logic, compliance becomes complex. Firms and users that operate across multiple cities (especially logistics and service providers) face higher administrative burdens

Why it matters:

- Big players can absorb complexity; small players struggle
- Scaling clean operations across cities becomes slower and more expensive
- Confusion reduces compliance and damages acceptance

Additional comments:

Harmonisation across cities reduces entry barriers and makes competition more even

4. Exemptions, permits, and phase-in schedules can create “privileged access”

Overview:

Access rules are not binary; they often include exemptions (residents, disabled users, trades, deliveries, essential services) and gradual tightening over time. These design choices effectively grant or restrict market access

Why it matters:

- Exemptions can protect vulnerable groups and essential services
- Poorly designed exemptions can become loopholes that dilute impacts
- Unclear criteria can trigger perceptions of unfairness and conflict

Additional comments:

Transparent criteria and clear timelines reduce disputes and reduce “policy uncertainty” for businesses

5. Enforcement technology and procurement shape the supplier market (and lock-in risk)

Overview:

Many UVARs depend on cameras/ANPR, back-office systems, data handling, and maintenance. This creates a technology supply market where procurement decisions can concentrate power in a few vendors

Why it matters:

- Vendor selection affects long-term costs and system flexibility
- Weak specs can lead to poor performance and public backlash
- Contracts can create lock-in if data and interfaces are not controlled by the public authority

Additional comments:

PPP/concession delivery can speed up deployment, but it increases the need for strong public contract management and data governance

6. Pricing, fines, and revenue use influence “mode competition”

Overview:

If the UVAR includes charges or produces revenue (fees, fines), how money is used affects the wider mobility market. Reinvestment into public transport, cycling, or shared mobility strengthens sustainable alternatives and improves acceptance

Why it matters:

- Reinforcement loop: restrictions + better alternatives = stronger outcomes
- If revenues are perceived as “just a cash grab,” opposition rises
- Funding stability determines whether mitigation measures can scale

Additional comments:

Revenue governance is a competition factor because it changes the attractiveness of substitutes (PT, cycling, etc.)

7. Acceptability and stability are “market conditions”

Overview:

UVARs face political and social resistance if impacts are not understood or perceived as unfair. Sudden changes, weak communication, or unclear enforcement can trigger backlash and policy reversals. A lack of adequate mobility alternatives is also detrimental to success.

Why it matters:

- Businesses delay investment if they expect rules to change
- Users comply less if they distrust fairness and enforcement
- A stable and transparent pathway reduces uncertainty and supports planned adaptation

Additional comments:

Structured participation and clear monitoring/adjustment rules improve stability, which improves “market predictability”

Political influence

1. Acceptability is the main political battlefield

- Observation:

UVARs become political as soon as people feel personally affected (access, costs, daily routines)

- Cause:

Even when objectives are widely supported (cleaner air, safer streets), the distribution of impacts is contested

- Implication:

Political backing depends less on “technical correctness” and more on whether the scheme is seen as fair, understandable, and supported by workable alternatives

2. Business and accessibility narratives can dominate the debate

- Observation:

Opposition often mobilises around fears of lost customers, reduced car access, or disruption for deliveries and services

- Cause:

These groups are highly visible locally and can quickly frame the policy as “anti-business” or “anti-access”

- Implication:

Cities often end up negotiating compromises (e.g., targeted access, specific exemptions, phased changes) to keep the scheme politically viable

3. Champions and agenda-setting are decisive

- Observation:

Having an identifiable “champion” (or a champion team) increases the chance that an UVAR moves up the political agenda

- Cause:

Champions connect policy goals, technical design, and political windows, and they “set the tone” of the debate

- Implication:

Without a champion, the topic can get stuck between departments and levels of government, especially when controversy rises

4. Election timing and cross-party support shape what is feasible

- Observation:

The greatest resistance tends to cluster around implementation, which makes timing politically sensitive

- Cause:

Politicians face maximum exposure when rules become real (signage, fines, daily inconvenience), not when plans are announced

- Implication:

Implementing early in a legislative period (or building cross-party support to survive electoral cycles) reduces the risk of reversal or delay

5. Political instruments include referenda, consultation, and “public proof”

- Observation:

In several cities, political support has been tested or influenced through referenda, petitions, protests, and public campaigns

- Cause:

UVARs are visible and easy to politicise, so formal and informal channels are used to contest or legitimise them

- Implication:

Trials, phased rollouts, and clear monitoring results can reduce political risk by showing benefits before full expansion

6. Multi-level power and competence disputes create political friction

- Observation:

Delivery often depends on actors beyond the city (legal basis, enforcement powers, vehicle databases), which can become a political bottleneck

- Cause:

Responsibilities are split and sometimes unclear, so “who is in charge” becomes part of the debate

- Implication:

Political alignment across levels (and clear agreements on roles) is often a prerequisite for implementation, not an add-on

7. Enforcement intensity and data issues are politically sensitive

- Observation:

Automated enforcement (ANPR/camera evidence, fine processing) can trigger controversy if legality, fairness, or data protection are questioned

- Cause:

People accept restrictions more when they trust enforcement is accurate, transparent, and legally solid

- Implication:

Gaps in enabling legislation can force cities into "proof-of-concept" pilots and slow down political momentum

8. Equity is political risk management (not only a social objective)

- Observation:

Equity issues can generate strong opposition and can require compensatory measures (reinvestment, incentives, improved alternatives, exemptions)

- Cause:

If impacts are perceived as regressive or unfair, the scheme can be framed as punitive rather than "for liveability"

- Implication:

Political durability improves when UVARs are paired with credible alternatives (PT, cycling networks) and targeted support for affected groups

Funding schemes

1. Typical funding mix (public + revenues + partnerships)

Overview:

UVARs are usually financed through a combination of:

- Local public budgets (planning, communication, enforcement capacity, monitoring)
- National/regional support (co-funding or dedicated programmes, often needed for scale)
- External public funding (when available, e.g., EU/national programmes linked to mobility, air quality, or climate)
- UVAR-related revenues (fees, permits, charges, and fines), mainly as a support to cover costs and fund improvements
- Public–private delivery options (private suppliers finance and deliver systems through contracts, with the public side paying back through agreed payments)
- In-kind contributions from institutional partners (e.g., shared work, access to assets, power supply, joint communication)

Key point:

UVARs are often not net money-makers (unless designed as a toll/charge scheme). The main goal is compliance, not "making money"

2. What funding is typically needed (set-up costs vs running costs)

Upfront / set-up costs (CAPEX-like):

- Planning and studies (design, impacts, zone definition)
- Equipment and infrastructure (e.g., cameras/ANPR, gates, signs, back-office systems)
- Initial communication and public involvement activities
- System setup for permits/exemptions and data handling

Ongoing costs (OPEX-like):

- Enforcement operations (processing, checks, fines/charges, appeals)
- Operation and maintenance (hardware, software, updates, repairs)
- Continuous communication (updates, clarity for users, helpdesk/queries)
- Monitoring and periodic review (performance, equity impacts, adjustments)

3. Funding logic across phases (design → launch → scale → operation)

- Design phase: public funding for studies + engagement; define the long-term financing plan early
- Launch phase: heavier spending on equipment, communication, and enforcement readiness
- Scale / tightening phase: additional investments (more gates/cameras, system upgrades) and higher enforcement/communication effort as rules become stricter
- Steady operation: stable funding for maintenance, back-office, monitoring, and periodic redesign of exemptions and support measures

4. Revenue governance: fees, fines, and trust

Overview:

If the scheme generates revenue (permits, daily passes/charges, fines), how revenues are handled is politically and socially sensitive

Good practice logic:

- Be transparent about how revenues are used
- Manage revenues properly and, ideally, earmark them for sustainable mobility improvements
- Avoid a “fine-driven” narrative: cities should state clearly that the objective is behaviour change and compliance

5. Procurement and PPP as financing tools (and where they bite)

Overview:

Many cities rely on suppliers for UVAR technology and operations. Funding can be structured through:

- Standard public procurement (supply + installation + maintenance contracts)
- PPP-type options (e.g., design–build–finance–maintain or build–operate–transfer style structures)
- Hiring/leasing equipment instead of purchasing, to reduce upfront pressure and include maintenance in the package

Key risk to manage:

Procurement must be transparent, and contracts must be managed actively (specs, standards, tender evaluation, and contract governance)

6. Funding complementary and equity measures (often the "make it acceptable" budget)

Overview:

- UVARs often need parallel spending to reduce negative impacts and increase acceptability, for example:
- Improvements to public transport and alternatives (P&R, service upgrades)
- Financial incentives or targeted support (e.g., scrappage schemes, support for e-bikes/cargo bikes, reduced PT costs)
- Phased implementation and grace periods (which also have admin and communication costs)

Why it matters:

If people face higher costs or restricted access, political support is harder to sustain unless credible alternatives and fairness measures are funded

7. Strategic recommendations (cross-cutting)

- Build a "money bridge" from launch to long-term operation: equipment is easy to fund once; operations and maintenance are the real long-term cost
- Budget for communication and enforcement, not only technology: weak enforcement and unclear messaging undermine compliance
- Plan revenue uses upfront: transparency + reinvestment reduces backlash
- Optimise costs within budget limits: if private travel becomes more expensive, people expect a visible improvement in alternative modes
- Use co-funding and institutional cooperation deliberately: avoid gaps where the city has the policy but not the resources or legal tools to run it

How to co-define the best governance scheme

Cities should not force UVARs into one single governance model. A city can combine different governance arrangements across zone types (LEZ/ZEZ, car-free areas, school streets), policy instruments (restrictions vs pricing vs incentives), and maturity stages (soft launch/pilot → full operation → tightening/expansion). The key is to co-define a scheme that matches local objectives, legal/enforcement readiness, stakeholder power, equity risks, and funding capacity

1. Start from "public purpose", not from the measure label

- Define what the UVAR is allowed to achieve (and what it must avoid). Keep it measurable
- reduce air pollution / emissions (and meet legal targets)
- reduce congestion and traffic pressure in sensitive areas
- improve safety and liveability (streets, noise, public space)

- protect access and fairness for vulnerable groups (residents and special categories of users such as medical staff)
- support sustainable modes (PT, walking, cycling), not undermine them

2. Choose the initial UVAR instrument and ambition level

Different instruments require different governance intensity and different "support packages":

- LEZ vs ZEZ (vehicle eligibility and transition speed are very different)
- car-free / restricted access zones (strong space and access implications)
- pricing / permits / daily passes vs bans (different revenue and acceptability dynamics), including rules for users accessing off-street parking structures
- incentives (e-bike leasing, cycle-to-work, PT subsidies, free PT) as complements, not substitutes

3. Check legal and enforcement readiness before designing details

Most failures are not "policy failures" but legal/enforcement bottlenecks:

- who has the legal power to restrict access and set penalties?
- is camera/ANPR evidence legally valid for fines?
- can you access vehicle registries (including non-local/foreign vehicles)?
- what is legally allowed for exemptions, permits, and due process (appeals)?

4. Map stakeholders and their governance implications (who has leverage, who pays, who takes risk)

Co-definition works only if the real power map is explicit:

- city leadership + departments (transport, climate, planning, IT): set direction, manage acceptability
- police/enforcement bodies: enforcement capacity, evidence standards, operational feasibility
- regional/national authorities: legal basis, data access, alignment with air-quality plans, co-funding
- residents and vulnerable groups: distributional impacts, legitimacy and compliance
- businesses and logistics: operational disruption, adaptation costs, lobbying power
- PT operators / mobility providers: alternatives and mitigation capacity
- technology suppliers: system delivery, data handling, maintenance, lock-in risk

5. Co-design a "rule package" and a "support package"

A restriction without alternatives becomes a political boomerang

Rule package (core design):

- zone boundaries, time windows, vehicle eligibility (standards), penalties
- exemptions and permits (targeted, transparent, time-limited where possible)
- transition path (phase-in dates, warning period, tightening schedule)

Support package (fairness + effectiveness):

- PT service improvements or fare support where needed
- cycling measures and targeted incentives (e.g., e-bikes/cargo bikes)
- scrappage/mobility budgets or targeted help for low-income groups and small operators

- access solutions for essential services and critical deliveries

6. Use a staged co-design process with clear "go / adjust / stop" gates

Build a shared roadmap and decide criteria before launch:

- Stage 0: problem framing + baseline data (traffic, air quality, equity risks)
- Stage 1: scheme design + consultation (rules + support + enforcement plan)
- Stage 2: soft launch / proof-of-concept (systems, signage, admin workflows, communications)
- Stage 3: full operation (stable enforcement + support measures in place)
- Stage 4: tightening/expansion (larger area, stricter standards, more time windows)

For each gate, agree:

- what evidence is required (compliance, impacts, equity, displacement)
- who validates it (city + enforcement + independent checks if needed)
- what decisions are allowed (scale, pause, redesign, add mitigation)

7. Decide "who runs the system" and lock down data governance early

UVARs are operational systems, not only regulations

- choose delivery mode: in-house, supplier-led, or PPP-style delivery for tech/operations
- define data rules: what is collected, who accesses it, retention, GDPR/privacy compliance
- prevent vendor lock-in: clear ownership of data, interfaces, and upgrade pathways

8. Clarify "who pays for what" with a simple split (CAPEX + OPEX)

Keep financing transparent and stable across phases

- public side typically pays for: planning, engagement, signage, oversight, communication, monitoring
- system side costs: cameras/ANPR/back-office setup + maintenance + processing/appeals
- if revenues exist (fees/fines/permits): define allocation and transparency (ideally reinvestment into sustainable modes and mitigation)

9. Monitor, communicate, and adapt (political durability is an operational task)

A good scheme survives because it can learn and adjust

- publish simple KPIs (compliance, air/traffic impacts, equity indicators, complaints)
- run continuous communication (clarity beats slogans)
- adjust exemptions and support measures when evidence shows unfair burdens
- coordinate with neighbouring cities/regions to reduce confusion and patchwork effects

Governance models for Innovative decision-making in mobility

Regulatory frameworks

1. Multi-level allocation of responsibilities (avoid fragmented governance)

Overview:

Innovative mobility decision-making sits across government levels. National bodies can launch and steer innovation/pilot programmes, while cities implement on the ground. Without clear task allocation and coordination, responsibilities blur and implementation becomes inconsistent

Relevance for innovative decision-making in mobility:

- Clarifies who sets rules vs who implements pilots and participation processes
- Enables replication and scaling beyond one city
- Reduces institutional conflict when policies move from experiment → wider adoption

Additional comments:

"Incremental pilot" logic (approved in batches) that requires clear coordination between national agencies and local governments, otherwise pilots scale unevenly

2. Participation rules with real decision influence (avoid tokenism)

Overview:

Participation can be mandated or encouraged, but the quality depends on the legal and institutional design. Ambiguous frameworks can allow authorities to include some groups while bypassing others, and consultations can collect input that cannot be adopted due to municipal legal constraints

Relevance for innovative decision-making in mobility:

- Sets minimum standards on who must be included, especially groups directly affected
- Defines the status of outputs (advisory vs binding)
- Creates a "duty to respond": public authorities must explain how input is used (or why not)

Additional comments:

A recurring issue is the gap between "we listened" and "we changed something". A credible framework needs explicit rules on responsiveness and inclusion.

3. Data protection, privacy, and cybersecurity (as a backbone for participation and AI support)

Overview:

Innovative decision-making relies on data collection (surveys, feedback forms, digital traces) and may use AI/ML for analysis. Privacy and cybersecurity are increasingly prominent issues, and GDPR compliance may require consent processes, privacy policies, and data-subject request mechanisms

Relevance for innovative decision-making in mobility:

- Defines lawful handling of citizen data during engagement (e.g., surveys, workshops, Delphi-style methods)
- Sets safeguards for digital participation tools and AI-supported analysis

- Reduces trust risk: without privacy/cybersecurity, participation collapses fast

Additional comments:

There is the need for GDPR-aligned participation data handling.

4. **Transparency and accountability of the decision process (including tools, assumptions, and evidence)**

Overview:

The analysis describes structured methods that produce outputs (scenarios, agendas/roadmaps, indicators, monitoring and evaluation). A regulatory layer should require transparency on how evidence is used, how options are assessed, and how final choices are made—especially when technical tools are involved

Relevance for innovative decision-making in mobility:

- Makes decisions traceable: what inputs were used, what trade-offs were accepted
- Supports legitimacy of deliberative outputs (forums, workshops, expert methods)
- Enables continuous oversight via monitoring and evaluation indicators

Additional comments:

The analysis supports monitoring/evaluation and indicator-based tracking

5. **Funding, procurement, and partnerships that enable collaboration (without biasing outcomes)**

Overview:

Innovation creates externalities and uncertainty, so public support policies matter. The analysis discusses public funding/support for innovation, city roles as enablers (e.g., grants for grassroots), collaboration across authorities (including shared services or procurement agreements), and the need to avoid criteria that systematically favour only commercially viable initiatives

Relevance for innovative decision-making in mobility:

- Clarifies who pays for participation, facilitation, pilots, and evaluation
- Enables cross-city collaboration through shared procurement/services
- Creates fair funding criteria for community initiatives, not only market-ready projects

Additional comments:

It is supported the idea that procurement/funding design strongly shapes what innovations survive

6. **Pilot-to-scale pathway with formal monitoring and evaluation**

Overview:

An innovation-driven approach often uses pilots approved in waves/batches, with progressive diffusion ("demonstration leading and gradual promotion"). A regulatory framework should formalise the pathway from experimentation to scaling, and tie it to monitoring/evaluation requirements

Relevance for innovative decision-making in mobility:

- Defines when a pilot can expand: criteria + evidence + evaluation
- Avoids permanent "pilot limbo" with no learning or accountability
- Encourages adaptive governance: iterate based on measured outcomes

Additional comments:

The analysis provides a clear rationale for staged scaling and for monitoring/evaluation, but it does not specify universal thresholds (e.g., exact KPI cut-offs)

Governance models (overview)

Institutionalised Participation (City-led / Governance-Driven Democratisation – GDD)

Description

In this model, citizen participation is initiated and managed by public authorities (politicians and public administrators) to support sustainable mobility decisions. Participation is organised through structured and often pre-defined channels (e.g., consultations, hearings, forums, focus groups), mainly to increase legitimacy and improve policy effectiveness. In practice, citizen influence can remain limited, and participation may become "tokenistic" if it does not affect real decisions.

Governance approach

The municipality defines the mobility measure and the participation format, invites selected stakeholders (state actors + non-state actors + private sector), collects input through consultations/deliberations, and then elected officials/civil servants take the final decisions; the process is typically funded by the public authority as part of planning/policy budgets.

Advantages

- Legitimacy and acceptance:

participation can strengthen the perceived legitimacy of behavioural-change mobility policies

- Coordination and learning:

structured dialogue can enable knowledge exchange and coordination across stakeholder groups

- Administrative feasibility:

clear, pre-set formats make participation easier to run at scale (especially in complex mobility systems)

Challenges

- Tokenism risk:

participation may be used mainly to validate pre-established policies, with limited real influence for citizens

- Selective inclusion:
non-state actors can be excluded even when they are directly affected, reducing tacit knowledge and legitimacy

- Power asymmetries:
even in deliberative settings, some groups may be more able to voice interests than others

- "Input without impact":
consultation may capture opinions but not translate them into policy due to legal/institutional constraints

Examples (mapping)

- Seoul transport planning (light rail/subway extension):
civic organisations engaged via a forum with municipal officials and multiple hearings [1]

- Parking Benefit District programmes:
consultation captured stakeholder opinions but these could not be incorporated due to the municipal legal frame [1]

- Land use & transport integration (Melbourne/Perth):
deliberative focus groups involving politicians, public administrators, civil organisations and private citizens [1]

- Driverless shuttles in public transport (Barkarbystaden, Stockholm):
top-down collaborative governance arrangements [1]

Regulatory/legal gaps

- Ambiguous participation rules:
legal frameworks can allow inclusion "on paper" while enabling bypass of affected groups in practice

- Weak obligation to integrate input:
even successful consultations may not change policy if the municipal legal frame does not allow it or does not require responsiveness to citizen input (explicitly observed in the review's cases)

Structured Civic Deliberation (mini-publics: citizen juries and citizens' forums within public decision processes)

Description

In this model, a city creates a structured space where citizens (often together with key stakeholders) discuss mobility options in a more informed and "deliberative" way than a normal public consultation. Participants receive information, compare trade-offs, and produce a set of recommendations (or priorities) that can guide mobility planning and policy choices.

Governance approach

The municipality convenes and pays for the process (selection + facilitation + evidence), citizens/stakeholders deliberate and produce recommendations, and the public authority takes the final decision and explains how (or whether) recommendations are used.

Advantages

- More informed input:

participants discuss options with evidence and constraints, not only opinions

- Higher legitimacy:

decisions can gain acceptance because the process is transparent and reasoned

- Better handling of trade-offs:

deliberation makes conflicts and compromises explicit (space, access, safety, etc.)

- Actionable outputs:

recommendations are usually clearer than generic feedback

Challenges

- Representation risk:

who gets invited/selected can bias outcomes (missing silent or marginalised groups)

- Cost and capacity:

needs facilitation, time, and administrative effort

- Power imbalance:

confident or organised actors can dominate even in "deliberative" settings

- Tokenism risk:

if recommendations are ignored, trust drops fast.

- Legal/institutional limits:

even good proposals may be impossible to adopt under existing municipal rules

Examples (mapping)

- Civic forum + multiple hearings for transport planning (e.g., rail/subway extension discussions) [1]
- Deliberative focus groups for land use and transport integration (involving public officials, civil organisations, private citizens) [1]
- Public hearings as a consultative mechanism for assessing proposals [1]

Regulatory/legal gaps

- Weak "duty to respond":

there may be no formal obligation to integrate deliberation outputs or justify rejection

- Unclear status of recommendations:

advisory outcomes can sit in a grey zone (strong politically, weak legally)

- Procedural ambiguity:

rules on selection, transparency, and inclusion can be under-specified, enabling selective participation

- Municipal legal constraints:

local legal frameworks can block adoption even when stakeholder input is clear

Responsible, Adaptive Co-Design (RRI2SCALE participatory policy-design cycle)

Description

In this model, mobility-related policies are designed through a structured co-design cycle that mixes evidence, future-oriented thinking, and repeated citizen/stakeholder engagement. The goal is to avoid "late fixes" when technology or innovation is already deployed and hard to change. The process starts by understanding local dilemmas and the local research-and-innovation landscape, then explores future trends and builds "techno-moral" scenarios (possible futures with ethical and social trade-offs). These scenarios are shared with the public and tested with stakeholders to validate whether they feel plausible and relevant. Based on this, the city and stakeholders co-create an agenda with clear goals and concrete initiatives. Finally, the policy is monitored and evaluated continuously so the process can be improved while it is running, not only at the end.

Governance approach

A public authority funds and steers a five-phase cycle (research/diagnosis → foresight/scenarios → engagement → co-created agenda & initiatives → monitoring), supported by researchers/facilitators, with citizens and stakeholders shaping priorities while the authority decides, implements, and reports back.

Advantages

- Earlier risk spotting:
dilemmas and trade-offs surface before lock-in
- Better alignment with values:
policies reflect citizen needs, not only technical feasibility
- More robust decisions:
combines evidence, expert input, and lived experience
- Learning by iteration:
monitoring and feedback allow course correction during implementation

Challenges

- Resource-heavy:
needs skills, facilitation, time, and sustained funding
- Complex coordination:
many actors, multiple rounds, and continuous follow-up
- Inclusion is hard:
keeping diverse participation across the whole cycle is difficult
- From ideas to action:
co-created agendas can stall if the administration cannot translate them into budgets and procurement

Examples (mapping)

Full methodology piloted in four European regions (smart transport included):

Vestland (Norway), Overijssel (Netherlands), Kriti/Crete (Greece), Galicia (Spain) [3]

Regulatory/legal gaps

- No clear “commitment rules”:
co-created recommendations may have no formal status, and authorities may not be required to act on them or justify non-adoption

- Unclear governance of tools and methods:
limited formal guidance on how to run scenario-based engagement and ensure transparency, fairness, and accountability

- Weak integration with budgets/procurement:
co-designed initiatives can clash with rigid public budgeting and procurement constraints, creating a gap between planning and delivery

Community-Led Governance / Commoning (bottom-up / Democracy-Driven Governance – DDG)

Description

In this model, mobility change is driven by grassroots groups and community-based initiatives. Citizens do not just “give feedback”; they organise, create solutions, and push for decisions that reflect everyday needs and social justice goals. The aim is to reshape how mobility decisions are made, so participation is meaningful and has real influence, not just consultation.

Governance approach

Community groups initiate and run the initiative (organising activities, gathering local knowledge, proposing actions and priorities, often with volunteer time and local resources), while the public authority decides if/how to formally recognise it, integrate it into plans, and provide enabling support (funding, spaces, access to decision processes).

Advantages

- High empowerment:
citizens gain real influence, not symbolic participation

- Strong local knowledge:
solutions reflect lived experience and local constraints

- Social justice orientation:
makes it easier to surface equity issues and underserved needs

- Trust building:
people trust what they helped build and control

Challenges

- Resource fragility:
grassroots initiatives depend on commitment, time, and uneven capacity

- Access to agenda-setting:
communities often struggle to get the same political access as powerful actors

- Representation risks:
active voices may not represent the whole population

- Scaling difficulty:

what works in one neighbourhood may be hard to replicate without institutional support

Regulatory/legal gaps

- Weak formal pathways for citizen-led influence:

bottom-up initiatives often lack a clear institutional status in decision-making, so their outputs can be easy to ignore

- Ambiguous inclusion rules:

legal frameworks may allow inclusion but still enable authorities to include some affected groups and bypass others

Data-/AI-Enabled Decision Support + Pilot-Based Scaling (innovation-driven, iterative policy experimentation)

Description

In this model, mobility decisions are supported by data and AI tools that help cities analyse problems, test options, and learn from results. Instead of committing to one "big bang" solution, the city runs pilots first, collects feedback and performance data, improves the design, and then scales up in batches. The logic is: build better decisions with better information, and reduce risk through step-by-step implementation.

Governance approach

A national or city authority launches a pilot programme and funds (or subsidises) innovation capacity, local governments implement pilots and invest in data/AI and infrastructure, researchers/companies provide methods and tools, and scaling happens progressively based on monitored results and government approval cycles.

Advantages

- Better evidence for choices:

AI and big data can expand decision information and support decision analysis

- Stronger feedback loops:

data-driven monitoring makes it easier to adjust policies during implementation

- Lower risk through pilots:

starting small reduces uncertainty before scaling

- Scalability by design:

"demonstration → gradual promotion" supports replication across multiple cities or districts

Challenges

- Data dependency:

if data are poor or biased, decisions can become confidently wrong

- Capacity gap:

cities may lack skills, systems, or staff to run data/AI projects well

- Coordination complexity:

pilots involve many actors (government levels, departments, external partners)

- Lock-in risk:

once tools and systems are adopted, changing them can be difficult even if needs evolve

Examples (mapping)

- National Innovative City Pilot Policy (batch-based pilots with "demonstration leading and gradual promotion"; multiple approval batches up to 2022) [4]
- AI used to expand decision-making information and strengthen feedback in urban decision-making; focus on multi-source data and algorithms for more accurate simulation and decision systems [2]
- Driverless shuttle deployment framed as a pilot within public transport development [1]

Regulatory/legal gaps

- Data privacy and cybersecurity:

these become more prominent as cities use big data and AI for decision-making

- Unclear rules for data access and sharing:

pilots need data flows across actors, but responsibilities and constraints are often not clearly defined in practice

Market dynamics and competition assessment

1. A crowded "supplier landscape" (many actors, different logics)

Overview:

Innovative decision-making in mobility is delivered by a mixed ecosystem: public administrations, universities/researchers, consultancies/facilitators, civic tech providers (digital platforms and tools), NGOs/civil society groups, and grassroots initiatives. This creates diversity, but also fragmentation and uneven quality

Relevance for mobility decision-making innovation:

- Competition is often about access to public projects and attention, not only "selling a product"
- Smaller civic groups may struggle against better-resourced professional actors

Additional comments:

The analysis describes multi-stakeholder governance as common, but also highlights that inclusion can be selective and power can be uneven

2. Innovation contests and hackathons: competition can help, but can also kill collaboration

Overview:

Challenge competitions (and similar formats like hackathons) create a competitive arena to generate solutions quickly and attract many applicants. They can unlock new ideas and legitimacy for innovators, but they also introduce "winner/loser" dynamics that can reduce sharing, learning, and cooperation

Relevance for mobility decision-making innovation:

- Useful when the city needs many options fast and wants to stimulate participation
- Risk: the process becomes a showcase, not a long-term problem-solving mechanism

Additional comments:

This is the part where “co-creation” can accidentally turn into “The Hunger Games, but with PowerPoints”

Illustrative examples:

Ratkaisu 100 (Sitra) challenge competition; EU Social Innovation Competition (prize-based model)

3. **Selection criteria shape the market (bias toward tech-heavy, commercially viable solutions)**

Overview:

When cities fund or reward innovations via calls and competitions, criteria often emphasise scalability and financial sustainability. This tends to favour solutions that look “product-like” (often technology-driven) and may disadvantage slower, community-embedded social innovations

Relevance for mobility decision-making innovation:

- Determines which voices survive: grassroots commoning vs polished vendor solutions
- Can push the ecosystem toward “shiny tools” rather than inclusion and long-term change

Additional comments:

If funding rules reward speed and polish, you will get speed and polish - whether or not you get impact

4. **Procurement models and inter-city collaboration influence competition**

Overview:

Public procurement and shared services can change market dynamics. Cities can reduce costs and risk by pooling resources, using shared procurement agreements, or coordinating across regions. This can lower barriers for adoption—but can also concentrate contracts in a few providers if not designed carefully

Relevance for mobility decision-making innovation:

- Impacts who can enter (small local providers vs large firms that handle complex tenders)
- Enables replication of engagement tools and methods across jurisdictions

Illustrative examples:

Shared services / procurement agreements across regions; “smart procurement models” mentioned as part of more entrepreneurial public programmes

5. Digital platforms and decision-support tools: potential lock-in and uneven playing fields

Overview:

Participation and foresight processes increasingly rely on digital platforms (e.g., survey systems, Delphi tools, scenario games/simulation tools). This creates a "tools market" where providers compete on usability and analytics. It also creates risks of vendor lock-in and dependency if processes cannot run without a specific platform

Relevance for mobility decision-making innovation:

- Tools can raise efficiency and scale, but can also centralise control in the tool provider
- Open-source options exist, which can reduce lock-in and widen access

Illustrative examples:

Use of an online decision-support platform for Delphi; mention of open-source alternatives; scenario simulation/serious-game tool for scenario exploration

6. Data/AI capability becomes a competitive advantage (and a barrier)

Overview:

Data and AI can expand the information base for decisions and improve monitoring and feedback loops. But this tends to reward actors with data access, technical skills, and infrastructure. It can widen the gap between advanced cities/teams and those with limited capacity

Relevance for mobility decision-making innovation:

- Can create a "two-speed system": cities that can run AI/data programmes vs cities that cannot
- Competition may shift from "who has the best idea" to "who has the best data and models"

Additional comments:

The analysis discusses AI applications and multi-source data integration, but it does not provide a full competition analysis of AI vendors in the public sector—so concentration risks can only be stated at a general level

7. Policy-driven pilots create competition among cities (and attract innovators)

Overview:

Innovation policies implemented through pilot programmes (often approved in batches) can make cities compete to be selected and to perform well. Pilot status can attract resources, talent, and firms, and can generate spillovers to neighbouring areas

Relevance for mobility decision-making innovation:

- Shapes where innovation happens first and where it scales
- Can trigger clustering: innovators and projects concentrate in “pilot” areas

Illustrative examples:

A national innovative city pilot policy rolled out in batches, linked to competitiveness and spillover effects

8. Fragmentation vs portfolio logic (many small projects vs coordinated “portfolio of action”)

Overview:

Cities can either support many isolated initiatives (“confetti”) or orchestrate a portfolio that connects initiatives, stakeholders, and long-term goals (“portfolio approach”). Portfolio governance changes competition: it rewards initiatives that fit a shared mission and can connect to others, not only standalone winners

Relevance for mobility decision-making innovation:

- Reduces duplication and improves scaling pathways
- Changes incentives: from “win the grant” to “fit the mission and interoperate”

Additional comments:

“Ecosystem” thinking can drift into an over-emphasis on market forces if not balanced by public purpose and inclusion

9. Inclusion and equity are also “competition variables”

Overview:

Innovative decision-making is not neutral: methods and tools can systematically include or exclude vulnerable groups. If inclusion is weak, legitimacy and adoption suffer. The analysis stresses designing initiatives around the needs of vulnerable groups, but also notes uneven adoption across contexts

Relevance for mobility decision-making innovation:

- Incentives should reward inclusion performance, not only innovation novelty
- Otherwise, market dynamics push toward solutions optimized for the easiest audiences

Political influence

1. “Participation legitimacy” can make or break political support

- Observation:

Innovative mobility decisions become politically sensitive when citizens feel excluded or when participation looks symbolic

- Cause:

Participation is often initiated by public authorities and can drift into tokenism or selective inclusion, especially when power asymmetries exist

- Implication:

Politicians tend to support participatory approaches only if they can show that participation is credible, representative, and has visible impact on decisions

2. Inclusion conflicts: who is "in" becomes a political battleground

- Observation:

Disputes often focus less on the mobility measure itself and more on who gets to shape it

- Cause:

Legal/institutional settings can enable inclusion of some affected groups while bypassing others, and that missing actors reduce legitimacy and tacit knowledge

- Implication:

Opposition can form around fairness claims ("you ignored us"), and political leaders may face pressure to reopen decisions or redesign processes

3. Innovation branding vs public purpose (visibility politics)

- Observation:

Cities and regions can push innovation programmes because they signal modernity and competitiveness

- Cause:

Innovation-driven policies are associated with competitiveness narratives, pilot programmes, and "innovation city" status; social innovation work also warns about drifting into market/branding logics

- Implication:

Political attention can shift toward launching initiatives and showcasing pilots rather than ensuring long-term outcomes (equity, accessibility, liveability) and institutional learning

4. Power struggles across levels of government (who controls the agenda)

- Observation:

Innovation programmes often run through multi-level structures (national programme + local implementation), which creates political tension

- Cause:

Pilot policies are rolled out in batches and depend on both central approval and local delivery; local governments bear implementation burdens and impacts

- Implication:

Policy direction can be contested: higher levels push for scale and standardisation, while cities push back to protect local priorities and capacities

5. Departmental fragmentation inside city government (no single owner)

- Observation:

Innovative decision-making spans transport, planning, innovation/digital, climate, and participation units, so accountability is easily blurred

- Cause:

The analysis describes complex multi-actor governance arrangements and portfolio approaches that require orchestration; without a clear "orchestrator" role, coordination fails

- Implication:

Projects become "everyone's topic and nobody's job", leading to delays, inconsistent messaging, and weak follow-through after engagement events

6. "Pilot politics" and short-termism

- Observation:

Authorities can prefer pilots and experiments rather than committing to structural change

- Cause:

Innovation policy is often implemented via staged pilots and progressive diffusion; participatory cycles also require time and iteration, which clashes with political time horizons

- Implication:

Cities can get stuck in repeated pilots (safe, visible, low-commitment) without clear scaling rules, or scale prematurely to show results without robust evaluation

7. Expert and tool influence (method providers shape the debate)

- Observation:

Researchers, consultancies, facilitators, and digital-tool providers can strongly shape how problems are framed and which options look "reasonable"

- Cause:

The analysis emphasises scenario building, decision-support platforms, Delphi-style tools, and AI-enabled analysis as inputs to decision-making

- Implication:

Political choices can be steered indirectly through the selected method, data, and assumptions; legitimacy depends on transparency about these choices

8. Equity and vulnerable groups as politically charged priorities

- Observation:

Targeting vulnerable or under-served groups is politically sensitive: it can build legitimacy but also trigger contestation over priorities and resource allocation

- Cause:

The analysis discusses social innovation and the need to design initiatives around vulnerable groups, while also showing participation can be uneven

- Implication:

Politicians face a trade-off: equity-driven decisions may increase long-term trust, but can face short-term backlash if benefits are not widely understood or if participation is seen as unbalanced

Funding schemes

Typical funding sources (public + community + market)

Innovative decision-making in sustainable mobility is usually financed through a mix of:

- Public innovation and pilot funding (national/regional → local): used to launch pilot programmes, reduce uncertainty, and support experimentation before wider rollout
- Local government budgets (planning, mobility, participation, innovation): used to run engagement processes, facilitation, communications, and policy design activities
- Grants for social innovation and community initiatives: small grants can support grassroots projects and participation work that is not commercially viable
- Prize-based schemes and challenge competitions (e.g., social innovation competitions): funding is awarded to winners to stimulate ideas and visibility
- Procurement and service contracts: cities pay external providers (facilitators, researchers, consultancies, civic-tech platforms) to deliver engagement, analysis, and monitoring tools
- In-kind and volunteer contributions: community-led initiatives often rely on unpaid time, donated resources, and informal local support

What funding is typically needed (CAPEX vs OPEX)

Even when the "product" is a decision process, costs still split into upfront vs ongoing

CAPEX (upfront / setup):

- design of the engagement process (methods, governance, recruitment)
- tool setup or development (digital platforms, scenario/simulation tools)
- initial data collection and baseline analysis
- communications material and onboarding of participants

OPEX (ongoing / running costs):

- facilitation and moderation (workshops, forums, focus groups)
- participant management (logistics, incentives if used)
- continuous monitoring and evaluation (indicators, reporting, feedback loops)
- platform operation, maintenance, cybersecurity, and data governance compliance

Funding logic across phases (design → pilot → scale → institutionalisation)

- Design phase:

Mostly public budget + contracted expertise (researchers/facilitators) to set up scenarios, engagement formats, and the policy agenda

- Pilot phase:

Innovation/pilot programmes fund experimentation and learning; cities test methods and tools in real settings and refine them

- Scale phase:

Replication across areas or cities increases coordination costs; shared services and joint procurement can reduce duplication

- Institutionalisation phase (business-as-usual):

Stable funding shifts into recurring municipal budgets and long-term framework contracts for facilitation, platforms, and evaluation

- Key point:

Pilot programmes are a common way to move from "demonstration" to broader diffusion, often in staged waves

Procurement as a funding mechanism (and as a market shaper)

Public procurement is not neutral: it determines who can participate and which solutions survive

- City-led procurement can fund:
  - facilitation and participatory process delivery
  - digital engagement platforms and analytics tools
  - scenario-building / foresight methods and serious-game tools
  - monitoring and evaluation systems (indicator frameworks, dashboards)
- Risk:
  - procurement criteria often favour "polished, scalable" solutions and can unintentionally disadvantage slower, community-embedded social innovation

Strategic recommendations (cross-cutting)

- Fund the "orchestration capacity", not only the events:

Workshops and forums are easy to pay for; coordination, follow-up, and evaluation are what make them real

- Use stage-gated funding:

Release the next tranche only when learning outputs are produced (e.g., validated scenarios, agreed agenda, evaluation results)

- Avoid a "winner-only" logic for social innovation:

Prize competitions can help discovery, but cities still need grants and portfolio support to build continuity

- Design funding for inclusion:

If vulnerable or hard-to-reach groups are a priority, budget explicitly for outreach, accessibility, and sustained engagement—otherwise they will be the first to disappear

- Plan the "pilot-to-routine money bridge" early:

Decide upfront whether the end-state is a recurring budget line, a long-term contract, or a hybrid—otherwise pilots remain pilots forever

How to co-define the best governance scheme

Cities should not force all engagement and decision-making into one model. A mobility innovation programme can combine different schemes across topics, neighbourhoods, and maturity stages (idea →

pilot → routine). The key is to co-define a scheme that matches the public purpose, decision type, stakeholder power, capacity, and risk tolerance

1. **Start from "public purpose" and fairness, not from the method**

Define what the decision-making innovation must achieve (and what it must avoid). Keep it simple and measurable

- improve legitimacy and trust (avoid "token" participation)
- include affected groups (especially those usually missing)
- improve decision quality (better evidence + lived experience)
- support equity outcomes, not only "cool ideas"
- create learning that survives beyond one event

2. **Choose the decision type and match the tool to it**

Different decisions need different governance intensity

- Budget allocation (e.g., participatory budgeting): needs clear rules and accountability
- Policy choices with trade-offs (e.g., street space, access, safety): needs deliberation and evidence
- Idea generation (e.g., hackathons): good for options, weak for final decisions
- Behavioural and community initiatives (e.g., commoning, collective cycling): needs enabling support and recognition
- Monitoring and improvement (e.g., citizen science, apps): needs data rules and feedback loops

3. **Map stakeholders and power before you design "participation"**

Co-definition works only if you make power and constraints explicit

- who is affected vs who is organised and loud
- who controls budgets, permits, and implementation capacity
- who provides expertise/tools (and who owns the data/method)

who carries reputational and political risk if the outcome fails

4. **Decide the city's role: Enabler, Mediator, or Visionary (or a mix)**

Pick a clear posture; otherwise the process drifts

- Enabler: fund and support initiatives (including non-commercial ones)
- Mediator: connect actors, align conflicts, build an ecosystem
- Visionary: set a mission and steer a portfolio of initiatives toward it

A portfolio approach reduces "random projects" and makes initiatives reinforce each other

5. **Use a staged co-design cycle with explicit gates (don't improvise)**

A robust scheme is iterative and staged, with clear "go / pause / redesign / stop" points

- Phase A — Preparation: define scope, constraints, stakeholders, and risks
- Phase B — Looking ahead: explore trends and future scenarios (including ethical/social trade-offs)
- Phase C — Engagement: test relevance with citizens and stakeholders (not just one-off feedback)
- Phase D — Policy design: co-create agenda, actions, responsibilities, and timelines
- Phase E — Monitoring & evaluation: track indicators and improve while running

For each gate, agree in advance: what evidence is needed, who validates it, and what happens if results are weak

6. Make the process transparent: "what was decided, on what basis, by whom"

Participation builds trust only if decisions are traceable

- publish the question being decided (not just "we consulted")
- document evidence used, assumptions, and trade-offs
- show how recommendations were handled (accepted / modified / rejected + why)

7. Set data and digital-tool rules early (or the scheme becomes theatre)

If you use apps, platforms, AI, surveys, or citizen science, you need clear rules from day one

- privacy and cybersecurity safeguards
- who can access what data and for what purpose
- minimum transparency about methods/models used for analysis
- avoid tool lock-in where possible (or plan exit options)

8. Clarify "who pays for what" and avoid funding that biases outcomes

Funding design shapes who participates and what survives. Keep it explicit

- public side typically pays for: facilitation, outreach, inclusion work, tools, evaluation capacity
- external providers deliver: methods, platforms, analytics, scenario tools (via contracts)
- community initiatives often need: small grants + support services (not only prizes)

Use stage-gated funding: release the next tranche only when learning outputs and inclusion targets are delivered

9. Plan scaling and coordination across areas (avoid fragmented learning)

If pilots or engagement formats are replicated, coordination matters

- share lessons, tools, and evaluation metrics across districts/cities
- use joint procurement/shared services when useful (but watch concentration risk)
- keep minimum standards consistent, while allowing local adaptation

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4	https://www.nature.com/articles/s41599-025-04796-x
5	https://link.springer.com/content/pdf/10.1007/978-3-031-87726-1_2.pdf?pdf=inline%20link



ANNEX E

CONCEPTS AND SOLUTIONS FOR SOCIALLY OPTIMISED MOBILITY SYSTEMS

Project deliverable D1.1

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Author(s):

Fit Consulting M Meta, F Mauro

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ANNEX E – ICB's contribution to the governance of mobility solutions

MPACT

Governance of active modes and shared mobility

Step 2, Key Sectors for Collaboration and Funding Schemes

- three priority sectors: local commerces need to be involved in discussions on how to manage active modes. When cities try to foster a modal shift from cars towards active mobility, there is often a lot of criticism of local commerce, who are afraid that their shops will no longer be reachable. Moreover, they are afraid that cyclists will leave their bikes in front of their shops, hindering passage or visibility of the goods they sell. Involving them from the start is crucial to mitigate their concerns. They can be involved in designing the mobility plans and pinpointing the location of bike parking and mobility hubs.
- relevant funding mechanisms: Involving commerces is usually done via participation processes coordinated by the city and with local budgets
- co-financing and PPP: In Ghent, local NGO 'Fietsambassade' is co-funded by the city to take care of some bike-related tasks with public relevance: long-term bike rental for students, managing local bike parking, bike taxi,... See: https://fietsambassade.gent.be/nl

Step 3, Alignment Gaps and Needs across Government Levels

- Alignment gaps local-regio-national-EU: In the realm of shared mobility, Flanders, Brussels and Wallonia have their own vision, frameworks and funding mechanisms to deploy shared mobility. There is no alignment in the field. Living on the Flanders-Wallonia border, I cannot rent my 'Flemish' shared bike and leave it across the border in Wallonia.
- Institutional and regulatory barriers: In Belgium, the main barrier in the real of (shared) mobility is that this competence has been regionalised, without (up to my knowledge) mechanisms to harmonise decisions.
- Harmonisation tools: The only examples that I know of, is collaboration in the development of cycling highways. Increasingly, Flanders and Wallonia are removing missing links. This is mostly for cycling highways that are embedded in a larger EU-network and for which Interreg-funding is available. See the network here: https://fietssnelwegen.be/

Step 4, Best Practices

- One best practice: Brussels has made a remarkable transition from a 'micro mobility wild west' into a well-regulated system. This is thanks to a tender that put a cap on the number of operators and their fleet. Here is what I found in

EN: https://zagdaily.com/urban/brussels-revamps-its-mobility-landscape-with-new-tender-call/

- Why: I find it a best practice because they took pedestrians' feedback into account: Brussels was getting full of micro mobility clutter. Apparently, there have been consultations with the providers as well before launching the tender. This was to make sure that there would be sufficient response and that the demands from the government side were realistic.
- Success factors and conditions for transferability: setting realistic goals, stakeholder consultation

Governance of transport infrastructure and corridors (Note: this is not our internal focus at Mpact, so input is limited)

Step 2, Key Sectors for Collaboration and Funding Schemes

- three priority sectors: Not sure, but I would think that cross-sector collaboration between road freight on the one hand and rail / waterway freight is key to meet sustainability goals.
- relevant funding mechanisms: European Social Climate Fund for investments in zero-emission transport and micro-enterprises?
- co-financing and PPP: /

Step 3, Alignment Gaps and Needs across Government Levels

- Alignment gaps local-regio-national-EU: Sometimes, national interest might hinder development. The 'Iron Rhine' is an example of this: Belgium wants to reopen this to connect the Antwerp harbour with the German Ruhr area. It has to go over a bit of The Netherlands, which is not always very cooperative in this because it would harm 'their' port of Rotterdam.
- Institutional and regulatory barriers: Some projects are put on hold / reduced in size for environmental reasons, consider for instance the proposed cap on the number of flights at Schiphol Airport due to nitrogen emissions.
- Harmonisation tools: Not sure if they really exist when national interests are at play. A diplomatic "this for that" approach can work and was very common in Belgium in the 60s-70s-80s, i.e. the "waffle-iron politics": if Flanders received a budget for a large infrastructural project, Wallonia received a similar amount (whether they needed it or not, resulting in huge government debt).

Step 4, Best Practices

- One best practice: /
- Why? /
- Success factors and conditions for transferability /

Governance of public transport

Step 2, Key Sectors for Collaboration and Funding Schemes

- three priority sectors: car sharing and shared micro mobility because they complement each other; see the case of Bremen which was recently presented in a SN[2] webinar: https://www.interregnorthsea.eu/sn2/events/webinar-the-impact-of-car-sharing. With MaaS in mind, both sectors will have to collaborate regarding data sharing to smoothen the customer experience.
- relevant funding mechanisms: most funding for data-integration seems situated on the EU level, see an overview here: https://interoperable-europe.ec.europa.eu/eu-digital-funding-opportunities
- co-financing and PPP: /

Step 3, Alignment Gaps and Needs across Government Levels

- Alignment gaps local-regio-national-EU: In Belgium, as mobility is a regional competence, there is little schedule alignment between the Flemish and Walloon regions, making cross-operator PT connections suboptimal. Moreover, there is no ticket integration between the Flemish and Walloon operators, meaning that you have to buy separate tickets for both providers - in my city, Ronse, where both providers are active, this does not give a pleasant user experience.
- Institutional and regulatory barriers: The main barrier is the lack of 'oversight bodies' to coordinate schedule and price alignment in regional and national border areas.
- Harmonisation tools: A notable exception in Belgium is the BruPass XL: an integrated transport ticket within Brussels and the surrounding municipalities; it can be used on the train + the networks of the three regional operators in Brussels: https://www.belgiantrain.be/en/products/train-and-other-transport/brussels?gad_source=1&gad_campaignid=20966160884&gbraid=0AAAAD03CyWYIgQgzVLHImMCN-C_ek6jd&gclid=Cj0KCQjw1ZjOBhCmARIsADDuFTAS3979U5LSo3zfEcDNlcb_Hl0zxGF4ypTHHJiIwr9PezJiS19jmLYaAnZlEALw_wcB

Step 4, Best Practices

- One best practice: /
- Why? /
- Success factors and conditions for transferability: /

Governance of mobility hubs

Step 2, Key Sectors for Collaboration and Funding Schemes

- three priority sectors: (1) Neighbourhood associations: developing mobility hubs means that you take away spots for car parking. This can cause resistance, so it is important to have the neighbourhood on board, for instance via co-creation and participation

activities. (2) (vulnerable) user groups: hubs have to be universally accessible, for people in a wheelchair as well as people travelling with prams or luggage. They should be involved in the discussions on where to locate the hub, which services to include, and how to make it universally accessible.

- relevant funding mechanisms: mostly funded by local money. The DUT-funded SmartHubs project did a participation trajectory with residents of Cureghem, one of the most disadvantaged neighbourhoods in Brussels: https://www.smartmobilityhubs.eu/
- co-financing and PPP: Difficult. When discussing the SmartHubs-model, the Brussels administration said that it is too time-consuming and costly to roll out on a large scale. Interestingly, Leuven has an online participation platform via which residents can give online on new development projects and vote on certain statements: https://participatie.leuven.be/nl-BE/

Step 3, Alignment Gaps and Needs across Government Levels

- Alignment gaps local-regio-national-EU: As mobility is a regionalised matter in Belgium, each region is developîng its own strategy and branding for hubs. Moreover, the railway operator, which links the three regions together, is not very keen on participating in the hub story. By consequence, the hubs are very recognisable when staying in your own region, but not when travelling elsewhere.
- Institutional and regulatory barriers: The decentralised mobility is a barrier (see earlier) as it gives priority to an 'institutional logic' and not to a 'user logic' - users cross borders, whether you like it or not. The dots are not sufficiently well connected for the moment.
- Harmonisation tools: a MaaS tool can link all PT, shared mobility, and hubs together into a single, nationwide or EU platform. Yet, such an 'app to rule all apps' has not yet seen the light. There are, on a EU scale, no agreements on which data standards to use for communication towards the end-user, which is making many providers reluctant to adapt certain standards, like the TOMP-API. Yet, examples from Norway show that integration of planning and booking is possible: see the ENTUR platform: https://entur.no/

Step 4, Best Practices

- One best practice: See comments in document
- Why? I still think that Flanders has, in theory, one of the most advanced models to organise the development of mobility hubs: there is funding, a branding, division of responsibilities, agreement on what services are needed at a hub (mobility + non-mobility). The local municipalities have a role as well: they can define where the neighbourhood and local hubs are located, see here: https://www.vlaanderen.be/basisbereikbaarheid/combimobiliteit/hoppinpunten/locaties-hoppinpunten. This makes sense because they know the local situation best; the transport region (intermediate), in which multiple cities are represented, define where the regional and interregional hubs are located: this makes sense because these dots tie the broader network together.

- Success factors and conditions for transferability: regional coordination, budgets, approved branding and agreement on the concept.

PAVE

Governance of CCAM

2. Identify Key Sectors for Collaboration and Funding Schemes

Effective CCAM governance requires coordinated action across sectors that play complementary roles across different deployment and governance models. Mobility and transport operators—including public transport authorities and operators, mobility platforms, and fleet operators—are central to designing, operating and scaling CCAM services, particularly in operator-led and pilot-to-scale models. The automotive and technology industry, including OEMs, tech providers, and connectivity and data actors, is responsible for vehicle platforms, automation stacks, safety validation, connectivity, and systems integration.

Public authorities and regulators at EU, national and city level play differentiated but interdependent roles. EU and national levels primarily focus on vehicle safety, type approval, liability frameworks and regulatory harmonisation, while cities and transport authorities are responsible for service integration, street operations, curb space management and public space allocation. Urban planning, climate and societal actors are essential to ensure that CCAM contributes to accessibility, safety, sustainability and liveability objectives, particularly within city-led planning and soft-law governance models. Data and oversight actors, including regulators, auditors and trusted third parties, are critical wherever governance relies on data-led and performance-based regulation.

Funding schemes should reflect both these sectoral roles and the different stages of deployment. In practice, CCAM requires a combination of EU and national research, innovation and demonstration funding for pilots and learning phases; public funding for planning capacity, oversight systems and enabling infrastructure; and private investment for fleets and service operations. For mature services, stable funding mechanisms are needed, such as fare revenues, public service contracts, or hybrid models. A key horizontal challenge across Europe is avoiding a funding gap between publicly supported pilots and financially sustainable regular operations, crucial for scaling up.

3. Identify Alignment Gaps and Needs Across Governance Levels

CCAM governance faces persistent alignment gaps across governance levels. Vehicle safety, type approval and testing frameworks are typically defined at EU or national level, while cities must manage real-world impacts such as congestion, curb space, public space use and integration with public transport systems. This division of responsibilities often leads to friction between higher-level regulatory certainty and local operational realities.

A recurring issue is the “pilot-to-operation gap”: in phased experimentation and sandboxing models, regulatory pathways from testing permits to stable operating licences are often unclear or underdeveloped, creating uncertainty for authorities, operators and investors. In operator-led deployment models, platforms may scale services faster than local authorities can adapt regulatory categories, service rules and enforcement tools, leaving cities reactive rather than strategic. In city-led planning approaches, CCAM is frequently referenced in SUMPs and smart-city strategies, but without binding instruments to translate objectives into permits, contracts, data requirements or operating conditions. Finally, data-led regulation depends on clear authority to mandate reporting, define KPIs and enforce corrective actions, yet data governance powers are often fragmented or inconsistently allocated across governance levels.

Addressing these vertical alignment gaps requires clearer allocation of responsibilities, structured coordination mechanisms between EU, national and local levels, and explicit "handover rules" linking EU-level objectives and regulatory frameworks to local implementation instruments.

4. Provide Best Practices for the Governance Model

There is no single optimal governance model for CCAM. Best practice lies in combining different governance approaches into a coherent and staged framework aligned with public objectives. Governance should start from public purpose rather than technology, clearly defining what CCAM is expected to deliver—such as improved safety, accessibility, support for public transport and sustainability—and which outcomes are unacceptable.

Strategic, city-led planning should be combined with data-driven, performance-based oversight, ensuring that real-world deployment aligns with policy goals and can be corrected where needed. Phased, stage-gated deployment pathways should be adopted, with predefined success criteria, transparent scale-up decisions and clear accountability. Operator-led innovation should be enabled within clear public boundaries, including minimum requirements on safety, data sharing, transparency, liability and impact management. Cities should be strengthened as market shapers—not only regulators—through planning priorities, operating zones, permit conditions, procurement models and integration with public transport and MaaS.

The transition from pilot to operation should be planned early, with governance and funding aligned to the intended long-term service model. At the same time, governance should support European scalability while allowing local adaptation, including through coalitions of transport authorities, harmonised requirements and joint procurement to reduce fragmentation. Finally, safeguards are needed to protect competition and prevent lock-in, ensuring proportionate entry rules, non-discriminatory access to public assets and fair data governance.

European practice already illustrates these principles, including:

- city-led integration of CCAM into SUMPs in SHOW project cities;
- phased experimentation with strong local steering in Helsinki's autonomous minibus trials;
- operator-led deployment under public supervision in Hamburg through MOIA;
- emerging data- and performance-based governance at EU level through ADS type-approval rules and coordination actions such as FAME and CCAM Ambassador.

POLIS

Governance of infrastructure for logistics to enhance collaboration (Micro-hubs focus)

2. Identification of Key Sectors for Collaboration and Funding Schemes

Three priority sectors:

- Commerce – retail (highest dependency on success of micro-hubs)
- Commerce – perishables/food/food delivery
- Vehicle OEMs (LEV, vans, cargobike) as well as providers of vehicle superstructures (city container, cooling etc.) (remaining issue of scaled vehicle solutions)

Relevant funding sources:

- Currently not foreseen in NRPPs

- CEF would also not allow for this kind of small-scale funding
- Regional funds are fully merged into the NRPPs (if current plans go ahead)
- There would be potential in the Urban facility, and in funding for rural areas, as access to services and goods in low-density areas is of concern.

Co-financing/PPPs: Antwerp example for perishables hub managed by principal shipper but open for others (improved business model).

3. Identification of Alignment Gaps and Needs Across Governance Levels

Given the intercity nature of logistics movement, it is not efficient nor desirable that each city develops its own concept for micro-hubs. The question is at what scale the coordination/harmonisation/standardisation happens.

Use of the micro-hubs should be supported by local regulations, ensuring that there are no parallel, unorganised logistics flows that undercut the operational and business model of the micro-hubs.

The harmonisation could happen for different aspects.

- Physical aspects
- Availability of charging infra
- Digital platfoms (reservation, access, ...)

Harmonisation tools should be driven by the logistics sector (e.g. VIL in Flanders) with sufficient reach and independence of interest of specific operators or stakeholders.

Regional covenants could provide the framework for coherent deployment of micro-hubs across cities.

4. Provision of Best Practices per Governance Model

https://www.interregnorthsea.eu/molo-hubs/download-center

https://www.interregnorthsea.eu/molo-hubs/pilots

Governance of Vertical and Horizontal governance integration

2. Identification of Key Sectors for Collaboration and Funding Schemes

Three priority sectors:

- Public-public cooperation focus
- City-regional-national level authorities
- Sectoral integration: transport, energy, land use planning, tourism
- Large transport generators: ports, airports, hospitals, universities, industrial zones

Relevant funding sources:

- This is unlikely to be funded at European level
- Efficiency gains could help, but the plan is that these integrated governance platforms create project pipelines, so in the end will need funding.
- Specific local/regional taxation for mobility measures could be foreseen.

Co-financing/PPPs:

- Aarhus local tax for transport investment.

Noord-Brabant ASML contract

3. Identification of Alignment Gaps and Needs Across Governance Levels

Misalignement issues:

- Misalignment of competences: overlaps or gaps between governance levels
- Timeline misalignment: timeframes of project implementation are different (e.g. land use with impacts for centuries, rail investment with decades of project planning and construction, ...)
- Budget misalignment: availability of budget does not align with real needs or urgencies.

Harmonisation tool

- The SUMP at FUA level can help to better align policy levels

(see CH4LLENGE manual on institutional cooperation).

Other examples:

- Infrastructure packages such as the West Sweden package
- Antwerp Ringland agreement

4. Provision of Best Practices per Governance Model

https://www.devex.com/organizations/ringland-the-ring-society-het-ringgenootschap-253131

https://urban-mobility-observatory.transport.ec.europa.eu/news-events/news/measuring-progress-dresdens-sump-2019-05-07_en?prefLang=lt

https://www.dobramesta.cz/download/1179

Governance of UVAR

2. Identification of Key Sectors for Collaboration and Funding Schemes

Three priority sectors:

- Professional drivers (local/national)
- Non-resident professional drivers – a specific issue in UVARs are road users that are not local – an essential aspect of a European Union with open boarders for people, goods and services
- Business stakeholders (Freight, coach, new mobility services...) as documented by the EGUM in its 2025 reports.

Relevant funding sources:

- UVARs will not be funded by EU instruments.
- Local funding sources can be related to collected fines that stem from non-compliance to the UVAR.

- Integration with other ITS use cases can capture more value from the costly equipment needed to manage UVARs.

PPPs:

- As this is a regulatory tool, the UVAR management is in public hands.

Involvement of the private sector includes subsidies for the replacement of old polluting vehicles (cfr Amsterdam, Brussels).

3. Identification of Alignment Gaps and Needs Across Governance Levels

For UVARs, the main issue is the difference in acceptance of the measures between the core urban area and the surrounding municipalities.

The benefits of the UVAR are not equally distributed in the FUA.

The Dynaxibilty project has published a study about that issue. https://programme2014-20.interreg-central.eu/Content.Node/Dynaxibility4CE/UVAR-Topic-Guide-Annex-EN.pdf

UVARs are also depending on national level legislation that allow the local level to take the traffic regulatory measures linked to the UVAR.

Finally, the enforcement of the UVAR needs a coherent approach and alignment of the enforcement data exchange chain. Currently this is not there for access to vehicle characteristics and ownership information of non-resident vehicles.

Alignment can improve through:

- Regional packages that include UVAR or toll dimension (Norwegian Packages/Oslo, Trondheim, Gothenburg West Sweden packages…)

SUMP FUA level, that combines regulatory measures with adapted mobility solutions.

4. Provision of Best Practices per Governance Model

www.polisnetwork.eu/wp-content/uploads/2019/06/gothenburg-and-the-west-swedish-agreement.pdf

https://en.wikipedia.org/wiki/West_Link

https://medurbantools.com/portfolio_page/low-emissions-zone-amb/

Governance of Innovative decision-making in mobility

2. Identification of Key Sectors for Collaboration and Funding Schemes

Three priority sectors:

- Private and new mobility service providers: data exchange to understand demand, offer, origin, destination etc.
- Parking sector: as manager of space, already using regulatory and pricing policies, and as well-established mobility service provider, there is a lot of potential.
- Visitors/tourism: an under-served audience in view of services, information

Funding sources:

- Horizon Europe, Interreg

PPPs:

- With private parties mention in above
- Through data exchange

Examples: Antwerpen Mobility market place, Easyways Noord-Brabant

3. Identification of Alignment Gaps and Needs Across Governance Levels

POLIS has discovered a misalignment in view of digital capacities and skills between the public and private sector in the mobility sphere.

The private sector (NMS) is digital-by-default and relies on its entire business and operational model on data and digital connectivity. On the public side, the regulating departments do not necessarily have the same capacities. This imbalance creates challenges: local and regional authorities are not sufficiently equipped to monitor regulatory compliance, the NMS providers do not find sufficient ground for their advanced digital capacities.

The integration potential of the NMS into the overall mobility system, but also into (local) MaaS platforms can be missed due to this kind of misalignment.

Digital platforms can be part of the solution for these issues, as well as local agreements to use data (in processed form) from the private sector in city level tactical and strategic decision making.

4. Provision of Best Practices per Governance Model

Suggestion to use SUMP awards winners as source of information.

TTS

Governance of MaaS

2. Identify Key Sectors for Collaboration and Funding Schemes

Cross-sector collaboration:

1. **ICT / Digital Platforms** — MaaS governance requires strong integration with the digital economy sector. Telecom operators (5G for real-time data), fintech companies (payment integration), and platform developers are essential partners. In Italy, the collaboration between transport operators and digital payment providers (e.g., the integration of contactless EMV payments in Milan and Rome PT systems) demonstrates how ICT partnership accelerates MaaS readiness.
2. **Energy / Electric Mobility** — The convergence of MaaS and electric vehicle charging infrastructure creates governance synergies. Shared electric vehicles (cars, scooters, bikes) within MaaS platforms require coordination with energy grid operators and charging point operators (CPOs). EU Regulation 2023/1804 (AFIR) creates new obligations that intersect with MaaS data-sharing requirements.
3. **Tourism** — Multimodal mobility packages for tourists represent a high-value MaaS use case with relatively lower governance complexity (no commuter subsidies involved). Italian cities like Florence and Venice have experimented with tourist-oriented mobility passes that combine PT, shared mobility, and cultural access — a model that could scale within a proper MaaS governance framework.

Funding schemes:

- **Horizon Europe** Cluster 5, Destination 6 (CCAM and new mobility services) — directly relevant for MaaS governance research and innovation
- **CEF Transport** — Digital strand, supporting ITS and multimodal data integration
- **ESF+ and ERDF** regional programmes (2021-2027 programming) — several Italian regions (Lombardia, Emilia-Romagna, Lazio) have included MaaS pilots in their operational programmes
- **PN Metro Plus e Città Medie Sud 2021-2027** — €3 billion national programme currently in full implementation phase, funding digital agenda and sustainable urban mobility in 14 metropolitan cities and 39 medium-sized southern cities

3. Identify Alignment Gaps and Needs Across Governance Levels

EU <-> National level gaps:

- The EU's Delegated Regulation 2024/490 on multimodal data mandates data publication through NAPs, but does not prescribe MaaS governance models. This creates a gap: data is mandated to be available, but the institutional framework for using that data within MaaS platforms is left entirely to Member States.
- Key recent development: Italy transposed the ITS Directive (Directive 2023/2661, amending Directive 2010/40/EU) via DM Infrastrutture e Trasporti of 26 January 2026, published in Official Gazette (GU) n. 40 of 18/02/2026. The decree does not use the term "MaaS" but substantively regulates MaaS under the label "*servizio digitale di mobilità multimodale*" (Art. 4, punto 34), defined as a service providing multimodal traffic and travel data (location, schedules, availability, tariffs) that "may include features enabling booking, payment or ticketing". The decree:
    - Mandates open data provision via NeTEx, SIRI and OpRa Italian profiles for PT, sharing, parking, EV charging, and real-time vehicle positions — the foundational data layer for MaaS;
    - Explicitly promotes "the adoption of systems enabling integrated booking and payment of mobility services, at local, regional and national level, interoperable with sharing, parking and taxi services";
    - Includes a dedicated section in Allegato B on "*Servizi digitali di mobilità multimodale*" with specifications on data availability, cross-border exchange, timely updates and standardised interfaces.
- This means Italy now has a regulatory foundation for MaaS governance, even though it does not use the MaaS terminology. However, the implementing decrees defining specific technical requirements and access conditions are still pending, creating a transitional gap. The specific governance model for MaaS (who orchestrates, who regulates platforms, how clearing works) remains undefined.
- The upcoming EU MDMS (Multimodal Digital Mobility Services) regulation could further fill this governance gap, but its scope and timeline remain uncertain.

National <-> Regional/Local gaps:

- In Italy, PT governance is split between the State (railways, national regulation via ART), Regions (regional and suburban PT contracts), and Municipalities/Metropolitan Cities (urban PT, shared mobility permits). There is no coordinating mechanism for MaaS across these levels.
- Ticketing and payment systems are managed independently by each local PT authority, creating a fragmented landscape of ~100+ incompatible systems.

Proposed harmonisation tools:

- Establishment of a national MaaS coordination framework under ART, defining minimum interoperability requirements for MaaS platforms
- FRAND-based data licensing principles for commercial mobility data, harmonised at the national level
- Use of the Italian NAP as a governance anchor point for MaaS data exchange
- Regulatory sandboxes for MaaS at the regional level, following the model of the EU AI Act's regulatory sandboxes

4. Provide Best Practices for the Governance Model

Best Practice: Helsinki Region / HSL (Finland)

4. **Context:** Helsinki's HSL (*Helsingin seudun liikenne*) has been a pioneer in MaaS governance since 2016, operating alongside private MaaS providers (notably Whim/MaaS Global) in a regulated multi-actor ecosystem.
5. **Stakeholders:** HSL (regional PT authority), MaaS Global (private MaaS operator), Finnish Transport and Communications Agency (Traficom), City of Helsinki, private mobility operators (taxis, shared bikes, e-scooters).
6. **Governance tools:** Finland's Act on Transport Services (2017, with gradual entry into force from 1 July 2018) established a legal obligation for transport operators to share ticketing interfaces and data through open APIs. HSL developed its own MaaS-compatible platform while allowing private operators to integrate public transport tickets through open APIs. Traficom acts as the national regulator ensuring fair access conditions.
7. **Results:** Finland is widely recognised as a pioneer and one of the most mature MaaS markets in Europe (OECD/ITF, ERTICO, European Commission), with multiple competing MaaS platforms coexisting under a common regulatory framework. The open-API mandate created a level playing field while preserving commercial incentives for innovation.
8. **Transferability factors:** Requires strong national regulatory commitment (transport data/API legislation), a competent regional PT authority willing to open its systems, and political acceptance of private MaaS operators coexisting with public transport. Applicable to Italian metropolitan areas with strong PT authorities (Milan/ATM, Rome/ATAC, Turin/GTT) if supported by national legislation

Governance of CCAM

2. Identify Key Sectors for Collaboration and Funding Schemes

Cross-sector collaboration:

1. **Insurance / Liability** — CCAM fundamentally changes the liability landscape. Collaboration with the insurance sector is essential to develop new liability frameworks (product liability vs. driver

liability), data-sharing protocols for accident investigation, and risk assessment methodologies for automated driving systems. Italy's IVASS (insurance regulator) should be involved in CCAM governance design.

2. **Telecommunications / Connectivity** — V2X communication, 5G/6G networks, and edge computing are infrastructure prerequisites for CCAM. Governance must coordinate between transport and telecom regulators (in Italy: MIT and AGCOM). The EU's Gigabit Infrastructure Act (2025) creates new opportunities for integrated corridor deployment.
3. **Urban Planning / Construction** — CCAM deployment requires physical infrastructure adaptation (road geometry, signage, intersection design, dedicated lanes, pick-up/drop-off zones). Collaboration with urban planning authorities and construction sector actors is essential. Italy's experience with ZTL (limited traffic zones) management provides a governance model for designating CCAM-permitted areas.

Funding schemes:

- **Horizon Europe** CCAM Partnership — dedicated to cooperative, connected and automated mobility
- **CEF Transport** — corridor digitalisation and C-ITS deployment
- **Digital Europe Programme (DIGITAL)** — AI, data, and digital infrastructure relevant to CCAM
- **InvestEU** — for private sector co-investment in CCAM infrastructure
- **National and regional structural funds** (ERDF 2021-2027) — investments in road safety and transport digitalisation

3. Identify Alignment Gaps and Needs Across Governance Levels

EU <-> National level gaps:

- EU Regulation 2019/2144 (General Safety Regulation) and the UNECE framework provide type-approval for automated vehicles, but the operational governance (where, when, and how AVs can operate in cities) is left to Member States and cities. Italy's "*Decreto Smart Roads*" (DM 70/2018) only addresses testing, not regular operations.
- The absence of a comprehensive Italian CCAM law (comparable to Germany's StVG amendment or France's Ordonnance 2021-443) creates legal uncertainty for operators planning cross-border or multi-city deployments.

National <-> Local gaps:

- Italian cities lack clear authority to regulate CCAM deployment within their jurisdictions. The legal basis for granting or denying CCAM operating permits at the municipal level is unclear.
- SUMP (PUMS in Italian) requirements do not yet include CCAM-specific planning guidance, despite the European Commission's recommendation to integrate CCAM into urban mobility planning.

Proposed harmonisation tools:

- A national CCAM framework law that allocates clear responsibilities across governance levels (State for type-approval and safety, Regions for corridor planning, Cities for operational permits and integration with PT)
- CCAM-specific SUMP guidelines issued by the Ministry of Transport, building on the EU SUMP framework
- Multi-stakeholder CCAM governance tables at the metropolitan/regional level, following the model of Italy's "Conferenza di Servizi"
- Cross-border pilot corridors (e.g., Brenner corridor Austria-Italy) with harmonised governance protocols

4. Provide Best Practices for the Governance Model

Best Practice: Hamburg (Germany)

- **Context:** Hamburg has been one of Europe's leading cities for CCAM governance, integrating autonomous driving pilots into its broader ITS Strategy and serving as a test site for the HEAT project (Hamburg Electric Autonomous Transportation) and Volkswagen's autonomous driving programme.
- **Stakeholders:** City of Hamburg (transport authority), HOCHBAHN (PT operator), Volkswagen/MOIA (private mobility), German Federal Ministry for Digital and Transport, Hamburg Port Authority.
- **Governance tools:** Germany's Autonomous Driving Act (StVG amendment, 2021) provided the national legal framework. Hamburg added a city-level governance layer through its ITS World Congress legacy programme, creating a dedicated "ITS Coordination Office" within the transport department. The city uses its SUMP as the strategic anchor and has defined specific "AV zones" where autonomous vehicles can operate under city-managed permits.
- **Results:** Hamburg successfully integrated CCAM pilots into regular PT operations (HEAT shuttle as a first/last mile PT service), established a replicable city-level governance model, and created a public acceptance framework through extensive citizen engagement.
- **Transferability factors:** Requires a national legal framework for CCAM operations (which Italy currently lacks), a city-level coordination function with dedicated staff, and integration into existing PT planning processes. The "AV zone" approach could be adapted for Italian cities using existing ZTL management frameworks. Applicable particularly to Italian cities with strong ITS infrastructure (Turin, Milan, Bologna).

Governance of Mobility Dataspaces

2. Identify Key Sectors for Collaboration and Funding Schemes

Cross-sector collaboration:

1. **Data Economy / Cloud Infrastructure** — Mobility dataspaces require enterprise-grade data infrastructure. Collaboration with cloud providers, data intermediaries (as defined by the Data Governance Act), and Gaia-X/IDSA ecosystem actors is essential for building technically sound and legally compliant data exchange platforms.
2. **Cybersecurity** — Mobility data (especially real-time vehicle and traffic data) has significant security implications. Collaboration with the cybersecurity sector (in Italy: ACN — *Agenzia per la Cybersicurezza Nazionale*) is necessary for defining security-by-design principles in dataspace governance. The NIS2 Directive imposes new obligations on transport operators that intersect with data-sharing governance.
3. **Environmental Monitoring / Climate** — Mobility data is increasingly important for emissions monitoring, air quality management, and climate policy. Cross-sector collaboration with environmental agencies (in Italy: ISPRA, ARPA regional agencies) can create additional demand for mobility dataspaces and justify public investment in data governance infrastructure.

Funding schemes:

- **Digital Europe Programme** (Work Programme 2025-2027, €1.3 billion) — European Data Spaces deployment, including mobility-specific calls currently open
- **CEF Digital** — National Access Points and cross-border data exchange infrastructure (calls open until 2027)
- **Horizon Europe** Cluster 5 + Cluster 4 (digital/industrial) — data governance R&I, with 2026-2027 Work Programme calls through September 2027

3. Identify Alignment Gaps and Needs Across Governance Levels

EU <-> National level gaps:

- The EU Data Governance Act (DGA), Data Act, and ITS Directive create a complex regulatory landscape for mobility data. Italy's recent transposition of the ITS Directive (DM 26/01/2026, GU n. 40 of 18/02/2026) establishes legal obligations for multimodal data provision via NeTEx/SIRI/OpRa standards and defines "*servizi digitali di mobilità multimodale*" as a regulated category (Allegato B). However, the operational implementation (who hosts the data intermediary, how access conditions are set, who enforces compliance) is still largely undefined as implementing decrees are pending.
- The European Mobility Data Space (EMDS) is being developed at the EU level, but its relationship with existing national data infrastructure (NAPs) and national regulatory authorities is not yet clear.

National <-> Local gaps:

- Italian municipalities and metropolitan cities generate significant mobility data (traffic counts, parking occupancy, PT real-time data, shared mobility data from licensed operators) but have no obligation or incentive to share this data through the NAP or any national platform.
- Local data governance practices vary widely: some cities have open data policies (Milan, Turin, Bologna), others have minimal data publication.

Proposed harmonisation tools:

- National data governance guidelines for mobility, issued jointly by the Ministry of Transport and the Ministry of Digital Transition (now Department for Digital Transformation)
- Mandatory local data contribution to the national mobility dataspace, building on the new ITS Directive transposition obligations (DM 26/01/2026, which mandates NeTEx/SIRI/OpRa data provision for PT, sharing, parking, EV charging) and extending these requirements to real-time operational data
- Alignment with the Italian National Strategy for Digital Data ("Strategia Cloud Italia" and related policies)

4. Provide Best Practices for the Governance Model

Best Practice: Fintraffic Traffic Data Ecosystem (Finland)

- **Context:** Finland's Fintraffic (state-owned transport infrastructure and data company) operates a national mobility data ecosystem that serves as one of Europe's most advanced examples of mobility data governance. It functions as a public-sector data intermediary, managing controlled access to both open and restricted mobility data.
- **Stakeholders:** Fintraffic (state company, data intermediary), Traficom (regulator), Finnish Transport Infrastructure Agency, private data users (navigation apps, logistics companies, MaaS operators), municipalities, PT operators.
- **Governance tools:** The Finnish Act on Transport Services mandates data availability and open interfaces. Fintraffic operates a "Digitraffic" open data platform alongside controlled-access data services with usage agreements. The governance model combines: (1) mandated open data publication, (2) registered-access services with usage policies, (3) commercial data products built on the public infrastructure. Fintraffic acts as a "trusted third party" (data intermediary in DGA terminology) ensuring compliance with data governance rules.
- **Results:** Finland's mobility data ecosystem is consistently cited by ERTICO, NAPCORE and the European Commission as a benchmark among European National Access Points. It demonstrates that a public-sector data intermediary can create a sustainable governance model that balances open access with commercial incentives and privacy protection.
- **Transferability factors:** Requires a dedicated public-sector entity with the mandate and technical capacity to operate data infrastructure. In Italy, this role could be played by an evolved version of the CCISS/Viaggiare Informati platform or by a new dedicated entity under the Ministry of Transport. The key success factor is the combination of regulatory mandate (obligatory data sharing) with a technically competent public intermediary — neither element alone is sufficient.