TANGENT

POLICY RECOMMENDATIONS

D8.5

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Executive summary

This policy report presents a comprehensive guide aimed at public authorities, providing strategic insights into the integration of multimodal traffic management (MTM) into policy and planning processes. It underscores the critical intersection between multimodal traffic management and policy, emphasising the importance of such integration for sustainable urban mobility.

The TANGENT project, funded by the EU Horizon 2020 research initiative, set to revolutionise urban mobility through advanced Network and Traffic Management (NTM) tools. By leveraging multi-actor cooperation models, the project addresses the multifaceted challenges of urban mobility, enhancing both efficiency and sustainability. The project leveraged a layered technological framework to advance traffic and transport management through real-time data integration, forecasting, and multi-stakeholder coordinated management. The technological innovations and functionalities of the TANGENT Tool are organised into three primary operational layers: Monitoring & Visualisation, Forecasting, and Planning & Incident Management.

The report identifies significant policy gaps and provides strategic recommendations to bridge these gaps, drawing from the project's research and implementation efforts, its thorough analyses and collected stakeholder feedback. It also encapsulates key activities and results from the TANGENT Forum and Advisory Board engagements, emphasising their role in shaping the project's outcomes and advancing the field of traffic management.

Despite the benefits of MTM, significant barriers remain in its implementation, including capacity-building needs, lack of human and financial resources, data integration and harmonisation, resistance to change, and operational challenges. This deliverable provides strategic recommendations to overcome these barriers and ensure the successful adoption and utilisation of MTM practices.

Ultimately, this policy report aims to foster a holistic and integrated approach to traffic management, promoting sustainable urban development through innovative and cooperative traffic management systems.

The document is structured into four main chapters:

- An overview of the deliverable, addressing the intended audience and the overall structure.
- A reflection on multimodal network management, including the definition, overview of MTM technology within the TANGENT Tool, drivers and barriers to MTM implementation, and business models for the exploitation of the TANGENT tool.
- Identification of gaps and corresponding policy recommendations, along with the vision for MTM.
- A summary of the key conclusions from the deliverable.

Key words

Network traffic management, planning, regulatory framework, sustainable urban mobility planning, webinars, knowledge exchange

Table of Contents

List of Figures

List of abbreviations

Acronym	Meaning
AB	Advisory Board
AI	Artificial Intelligence
CAVs	Connected and Automated Vehicles
CCAM	Connected Cooperative Automated Mobility
COD	Computer Optimised Design
DRT	Demand Responsive Transport
EC	European Commission
EU	European Union
FCD	Floating Car Data
GA	Grant Agreement
IoT	Internet of Things
ISAD	Infrastructure Support for Automated Driving
NAPs	National Access Points
NPSE	Transport Project provider companies
NTM	Network and Traffic Management
MTM	Multimodal Traffic Management
OD Matrices	Origin-Destination Matrices
PT	Public Transport
RTTI	Real-Time Traffic Information
SUMP	Sustainable Urban Mobility Plan
TEN-T	Trans European Transport Network
TfGM	Transport for Greater Manchester
WP	Work Package

1 Introduction

1.1 Overview of the project and the deliverable

The TANGENT project, funded within the framework of the EU Horizon 2020 research initiative, aims to revolutionize urban mobility through the development of advanced Network and Traffic Management (NTM) tools. By leveraging multi-actor cooperation models, the project seeks to address the multifaceted challenges of urban mobility, enhancing both efficiency and sustainability. This report serves as a policy guide, offering insights and strategic recommendations to public authorities on integrating multimodal network management into urban mobility policies and planning processes. Multimodal Traffic Management (MTM) is at the core of this endeavour, focusing on the coordination and optimization of various transportation modes to improve urban transport systems. The report emphasizes the importance of MTM in tackling contemporary urban mobility issues and advocates for collaborative efforts among policymakers, city authorities, transport operators, and other stakeholders. The goal is to promote a holistic and integrated approach to traffic management, fostering sustainable urban mobility planning through innovative and cooperative traffic management systems.

1.2 Intended audience and Key stakeholders

This is a public deliverable, meant to maximise outreach and achieve broad dissemination of the project's results. The primary audience for this deliverable includes policymakers, local authorities, and practitioners involved in urban mobility planning and traffic management. Additionally, it is intended for researchers, industry stakeholders, and project partners who are engaged in developing cooperative traffic management systems.

1.3 Objectives of the deliverable

The purpose of this policy report is to provide detailed guidance to public authorities on the effective integration of multimodal network management into urban mobility policies and planning processes. MTM, which encompasses the coordination and optimization of various modes of transportation, plays a crucial role in enhancing the efficiency and sustainability of urban transport systems. The document highlights the importance of MTM in addressing contemporary urban mobility challenges and offers strategic recommendations for its implementation. Furthermore, it underscores the need for collaborative efforts among policymakers, city authorities, transport operators, and other stakeholders to ensure the successful adoption and utilisation of MTM practices. Ultimately, these insights aim to foster a holistic and integrated approach to traffic management that promotes sustainable urban development.

1.4 Structure of the deliverable

The deliverable is structured into four main chapters:

Chapter 1: presents an overview of the deliverable with the objectives addressing intended audience and the overall structure.

Chapter 2: reflects upon the multimodal network management taking into account the definition, overview of the MTM technology within TANGENT Tool, the drivers and barriers to MTM implementation for TANGENT, and the business models for the exploitation of TANGENT tool.

Chapter 3: focuses on the identified gaps and corresponding policy recommendations along with the vision for the MTM.

Chapter 4: summarises the key conclusions from the deliverable.

2 Understanding multimodal network management

This chapter explores how MTM supports mobility planning via drivers and barriers for the implementation. The chapter includes insights from the MTM Roadmap for 2030 and Beyond (2024) developed by the Multimodal Traffic Management Cluster (MTMC), brief insight covering the technological features and benefits within the TANGENT tool, and the WP1 policy workshop outcomes focusing on the exploitation aspect of the TANGENT tools.

2.1 Definition and key aspects of MTM

In the rapidly evolving landscape of urban transportation, Multimodal Traffic Management (MTM) has emerged as a vital tool for urban mobility planning. Urban mobility is no longer about managing a single mode of transport (such as private vehicles or public transit) but about integrating and optimising multiple modes—walking, cycling, public transit, and private vehicles—into a cohesive system. The role of MTM extends beyond real-time traffic regulation; it also serves as a strategic asset in long-term mobility planning by leveraging data collection, emerging technologies, and a user-centred approach.

The Multimodal Traffic Management Cluster (MTMC), a knowledge exchange and research coordination group representing 7 EU HORIZON projects (namely, TANGENT, ACUMEN, SYNCHROMODE, DELPHI, DIT4TRAM, ORCHESTRA, and FRONTIER) defines MTM as the coordinated control and optimisation of multiple transportation modes within a given network or area. MTM integrates various transportation modes, such as cars, buses, bicycles, pedestrians, and rail systems, to enhance the efficiency, resilience, safety, and sustainability of the transportation system for both passengers and freight.

The key aspects that the MTM should consider (MTMC 2024) include:

- Integration of Modes: Coordinating different and new transportation modes to ensure seamless transitions and efficient use of the network.
- Dynamic Traffic Management: Using historical and real-time data and advanced technologies to manage both traffic flow and traffic demand, reduce congestion, and improve travel times across all modes.
- Sustainability: Promoting low-emissions transportation options and reducing the overall environmental impact of the transportation system.
- Safety: Enhancing the safety of all users, including Vulnerable Road Users (VRU), by implementing appropriate safety and risk-avoidance measures.
- Accessibility: Ensuring that all users, including VRUs and those with limited mobility, have access to reliable and convenient transportation options.
- Smart Infrastructures: Utilising smart infrastructure, such as intelligent traffic signals, real-time information systems, and connected vehicle technologies, to improve the efficiency and responsiveness of MTM systems.
- Exploitation of multi-source data: Effective use (collection, sharing, analysis) of high-quality real-time data from multiple sources (e.g. vehicle data, roadside sensors data, crowd-sourced data) for evidence-based and data-driven decision-making and optimisation of multimodal transportation networks and systems.

- Collaboration of stakeholders: Structured cooperation processes and governance models with the cooperation and coordinated decision-making of various stakeholders, each having different interests, priorities and operational requirements are needed for the successful implementation of advanced MTM solutions.

Multimodal traffic management is significantly influenced by three key factors: the advancement of new technologies, the availability and effective use of data, and policies. Technologies such as intelligent transportation systems, real-time data analytics, and connected vehicle platforms provide the technical backbone for managing diverse transportation modes efficiently.

Data availability and use are critical, as they allow for the collection, sharing, and analysis of high-quality real-time information from various sources, including vehicle data, roadside sensors, and crowd-sourced inputs. This data-driven approach enables urban planners and traffic managers to make informed decisions, optimize traffic flows, and improve overall system performance.

Policies play an overarching role by establishing the framework and setting the targets that relevant organizations must follow to ensure the success of MTM. Effective policies can promote sustainable transportation options, enhance safety, and ensure accessibility for all users, including vulnerable road users and those with limited mobility. They also facilitate collaboration among stakeholders, fostering a cooperative environment where shared objectives and key performance indicators, such as CO_2 emissions reduction, drive collective action and continuous improvement.

By addressing these factors, MTM systems can create a more cohesive, efficient, and resilient urban transportation network that meets the dynamic needs of modern cities.

2.1.1 Need of Multimodal Network Management for Urban Mobility

Traffic management for a multimodal network is a crucial tool for mobility planning, especially in metropolitan regions, allowing cities to collect and process vast amounts of data and apply advanced technologies to improve the movement of people across different modes of transport. The data-driven insights provided by MTM systems enable urban planners to make informed decisions, prioritize sustainable transport, and adapt to changing mobility needs. As cities continue to grow and evolve, MTM will play an increasingly important role in ensuring efficient, inclusive, and sustainable urban mobility, aligning with broader policy goals and addressing the real needs of users.

By integrating technologies like real-time traffic monitoring, predictive analytics, MTM provides the foundation for creating smart, resilient, and user-friendly urban transport systems that support long-term urban mobility planning.

2.2 Overview of MTM functionalities within the TANGENT Tool

The TANGENT project leverages a layered technological framework to advance traffic and transport management through real-time data integration, forecasting, and multi-stakeholder coordinated management.

Highlighting the technological innovations and functionalities of the TANGENT Tool, it is organised into three primary operational layers (referring to D6.5): Monitoring & Visualisation, Forecasting, and Planning & Incident Management.

2.2.1 Monitoring and Visualisation

The Monitoring and Visualisation module forms the foundation of the TANGENT Dashboard, providing users with live, real-time data and customizable visualisations.

Core Features:

- Dynamic Data Integration: Live traffic and public transport data are displayed through a combination of map layers, indicators, and tables, ensuring accessibility to a comprehensive overview of network conditions.
- Customisable Dashboard: Each city can adapt the dashboard to its specific requirements. Users can personalise data visualisation, such as traffic indicators or route performance, making it intuitive for operators.
- Interactive Tools: Users can filter data, switch between map views, and customise the display to highlight critical insights, such as congestion hotspots or multimodal interchanges.

Benefits/Applications:

- Offers a consolidated operational picture for traffic managers.
- Enhances decision-making by providing real-time situational awareness.

2.2.2 Forecasting and Anomaly Detection

The Forecasting module builds upon the monitoring capabilities to predict future traffic patterns and identify anomalies in real time.

Core Features:

- Prediction Horizon: Users can forecast traffic conditions ranging from 5 to 60 minutes into the future. This predictive capability enables proactive responses to potential congestion or incidents.
- Anomaly Detection: Embedded algorithms identify deviations from expected traffic patterns, such as sudden congestion or abnormal delays, allowing for early intervention.

Benefits/Applications:

- Extends the real time horizon with forecasts, supporting the proactive management of the network.
- Provides data elements necessary to preemptively manage disruptions.

2.2.3 Planning and Incident Management

Planning and Incident Management functionalities enable proactive and coordinated responses to traffic anomalies and incidents.

Response Plan Development:

- The TANGENT system supports the creation of predefined Response Plans for various incidents, from minor delays to major disruptions.
- Plans include measures like adjusting public transport schedules, changing traffic signal timings, and disseminating real-time information to the public.

Benefits/Applications:

- Supports strategic traffic flow adjustments, such as rerouting or adjusting traffic signal timings.
- Enhances network resilience by preemptively managing disruptions.

Incident Management Tools:

- The platform includes modules for Incident Management (IM) and Cooperative Incident Management (CIM), facilitating single-entity and multi-stakeholder responses, respectively.
- Users can monitor triggering conditions (e.g., congestion thresholds), initiate Response Plans in real-time and follow the resolution of situations in real time.
- Provides means to detect, cooperatively manage and accompany critical situations.

Simulation Features:

- The planning tools integrate simulation functionalities, enabling cities to test the effectiveness of different response scenarios in mitigating disruptions.
- Allows studying the impact of specific changes to the transport network and evaluating the expected impact from planned situations.

2.3 Drivers and Barriers to MTM implementation

2.3.1 Drivers to MTM implementation

One of the primary benefits identified is the collaborative potential that MTM offers for local stakeholders, especially in terms of shared Key Performance Indicators (KPIs), such as CO_2 emissions reduction. These KPIs facilitate informed decision-making among stakeholders, allowing them to forecast and adapt public transport routes in real time.

The TANGENT data catalogue is instrumental in achieving this, offering several advantages:

- Use case partners can clearly articulate and structure the data they manage.
- The specific metadata profile (TANGENT metadata) assists in identifying data gaps and format compatibility issues, prompting improvements in data availability and harmonisation.
- The framework facilitates the inclusion of external data, enabling a comprehensive, accurate representation of datasets.

Moreover, MTM provides enhanced integration of various data channels, contributing to a standardised and improved data catalogue. This integration addresses new functionalities not previously available in Network Traffic Management (NTM), shifting the focus from isolated results to a process-driven approach that fosters better communication among stakeholders. This novel cooperative environment supports a consolidated operational view where KPIs and indicators are universally visible and accessible across the system. By enabling predictive scenarios for various transport modes through a multimodal approach, MTM enhances decision-making capabilities for multiple stakeholders.

Additionally, the visualisation aspects of MTM play a critical role in situational awareness, where real-time data integration enables a platform for continuous monitoring and adaptability. As more data sources are added, the system's usability expands, allowing for scalable solutions through the integration of multimodal transport data and intuitive user interface options. The user-friendly nature and customisable functionalities ensure that users can tailor the tool to meet specific requirements, promoting efficient interaction with the system.

Sustainable Urban Mobility Planning (SUMP) processes can also significantly facilitate the implementation of MTM solutions. The participative and cooperative nature of SUMPs with the establishment of working structures for multi-actor engagement, supports cooperation within MTM. Besides, the agreed-upon vision and strategic objectives provide a policy basis and common goals for the MTM solutions, facilitating consensus-reaching and decision-making.

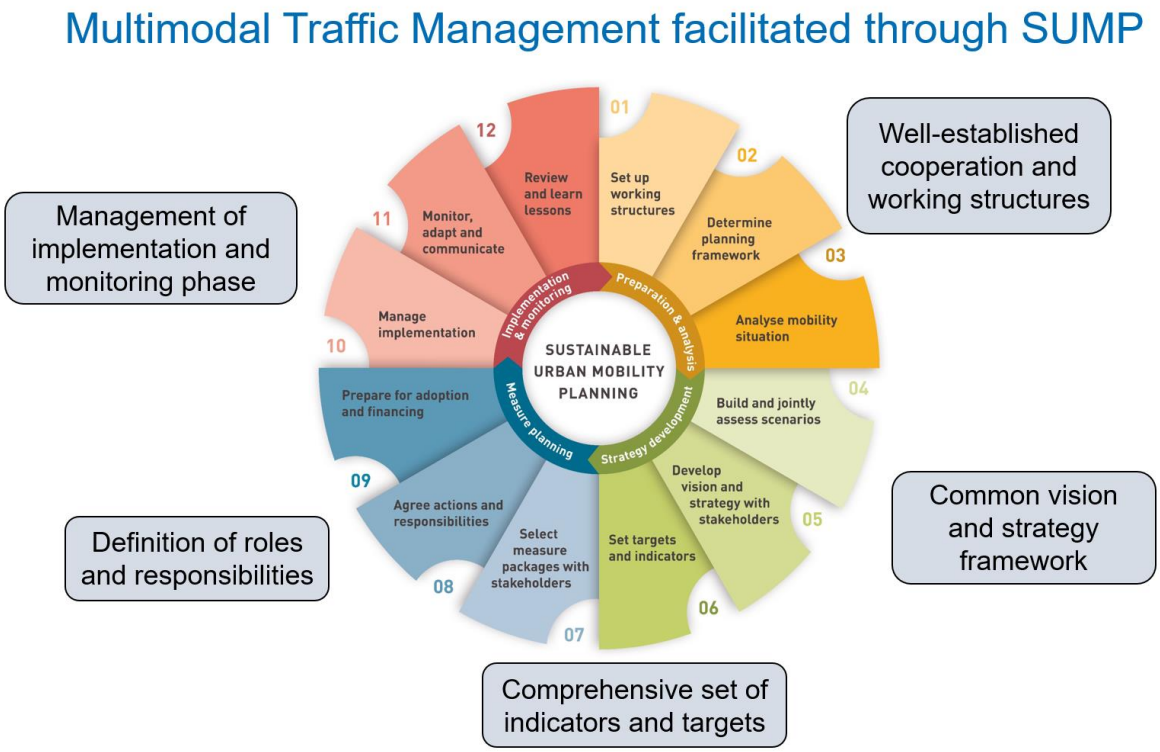

Figure 1: SUMP as supporting framework for MTM

2.3.2 Key Barriers to MTM Implementation

Despite these benefits, significant barriers remain in implementing MTM. The shortage of manpower and technical capacity among involved stakeholders can constitute a major obstacle, particularly for testing, maintaining, and validating data. Furthermore, the absence of robust multimodal datasets, including a lack of historical data for more informed decision-making, hampers accurate analysis.

Similarly, resistance to change, differences in working cultures or conflicts among involved actors, can create implementation barriers. Well-structured cooperation processes and strong leadership, aided by enforcement policies, are essential to overcome these situations. Operational challenges such as extended simulation times, time constraints in result exchange, and incompatibility with existing tools used by stakeholders for public transport and traffic management were also highlighted.

Transport modelling can represent another key challenge. In some cases, the limited availability and quality of transport models, results in a significant increase in the effort and resources required for the MTM implementation. Key barriers to scaling MTM solutions include ensuring data availability and quality, maintaining consistent support from stakeholders and data owners, and addressing potential deprecation of functionalities. This latter issue demands periodic recalibration and validation of core models to keep functionalities relevant.

Financing for ongoing research, data access and integration, political risks tied to governance and funding, and willingness to support MTM approaches beyond project timelines are also critical challenges to the widespread adoption of MTM solutions. Upscaling MTM requires careful consideration of these complexities to ensure that tools meet city-specific needs and can be sustained in the long term.

2.4 Business models for the exploitation of TANGENT Tools

2.4.1 Commercialisation of the Use Cases and Exploitable Results

The TANGENT tools, particularly the Key Exploitable Results (KERs) on data harmonisation and fusion, offer extensive commercialisation potential across different sectors, including logistics and transport. These tools can be configured for various mobility sectors, providing solutions that enable efficient sharing and utilisation of heterogeneous data sources. For instance, a significant commercialisation use case includes integrating the tool with digital twin environments. This approach enhances configurability, allowing for customisable scenarios and incident planning tools tailored to specific city needs. By establishing a toolkit of scenario-based solutions, TANGENT tools could be replicated in similar urban areas, enabling easier deployment across various cities.

Moreover, historical data visualisation capabilities within TANGENT present an attractive use case. By enabling stakeholders to review and analyse past events (e.g., incidents from days or weeks prior), the tool offers valuable insights for urban planning and operational adjustments. For cities with established collaboration practices and KPI tracking mechanisms, TANGENT tools provide additional utility by facilitating optimisation modules that supplement existing simulation tools with ad-hoc functionalities.

In situations where cities may not wish to overhaul their current systems, TANGENT's engagement with key project partners, such as A-to-Be and AIMSUN, allows for incremental integration. These companies can potentially embed TANGENT's core functionalities into their respective tools, offering cities an opportunity to adopt MTM capabilities without significant system restructuring.

2.4.2 Exploitation Drivers and Prerequisites for MTM Implementation

Stakeholder engagement remains a central driver of TANGENT tool exploitation. However, a lack of stakeholder involvement can also become a barrier. Maintaining active engagement with local and regional stakeholders is essential for the success and continuity of MTM solutions.

For cities looking to implement TANGENT's MTM solutions, several prerequisites are critical. Firstly, a well-defined strategic vision of the city's goals, potential conflicts, and operational needs is essential. Data catalogues that offer structured data and updated transport models must be available to support MTM operations. Additionally, cities must consider socioeconomic factors, which may influence the extent to which MTM solutions can be customised to local contexts. Digital infrastructure, such as robust data-sharing platforms and transport modelling tools, is also crucial for the successful implementation of TANGENT solutions.

The governance structure within the city, along with stakeholder involvement, serves as another fundamental prerequisite. Effective governance models can help navigate political challenges and secure the necessary funding to support MTM operations beyond the initial deployment phase. Continuous collaboration with stakeholders ensures that the MTM solutions align with city priorities and can be scaled over time.

3 Policy and Regulations: Gaps & Recommendations

This chapter outlines TANGENT's policy and regulatory recommendations for MTM implementation. These are drawn from the project's research, case studies, stakeholder consultations, and workshops, including a Policy Workshop at TANGENT's Final Event in Brussels which discussed policy implications and key recommendations based on the project's findings.

3.1 Gaps in existing policies and regulations

Data Sharing Standards and Accessibility
There is a significant gap in established local standards for data sharing, which affects cooperation between public and private actors:

- Inconsistent Standards Across Operators: Public transport and city planners often lack well-recognized data standards. Variability in standards complicates procurement processes, with operators facing challenges integrating systems across multiple vendors.

- Lack of mature National Access Points (NAPs): In many European cities, National Access Points (NAPs) for data sharing are underdeveloped. A mature NAP is essential for seamless data sharing across cities and between stakeholders, yet funding and operational models remain inconsistent.

- Barriers for Private Operators in Data Sharing: Private entities, especially in logistics and micro-mobility, are often hesitant to share data due to concerns about business confidentiality and the lack of incentives. Current regulations do not adequately address how these entities can safely share data without risking competitive advantage.

Governance and Role Allocation
A clear role definition in data governance is lacking, which creates challenges in data management:

- Unclear Roles in Data Ownership and Management: insufficient guidance on who should manage, store, and control access to data in MTM systems can create barriers in determining accountability for data accuracy, security, and compliance with regulations like GDPR.

- Need for a Central Coordinating Entity: Cities benefit from a central authority responsible for managing MTM data governance, ensuring that data collection, storage, and sharing protocols are standardized. An example is the Netherlands' National Data Warehouse where Dutch authorities collaborate on the collection, integration, storage, and distribution of mobility data. The data from and about road traffic is collected to monitor its quality, it is enriched, stored, and made available. This top-down approach allowed many stakeholders and bodies to join the platform.

Security and Privacy Concerns
Data security emerged as a top concern, especially for private stakeholders:

- Insufficient Cybersecurity Measures: While data privacy (e.g., GDPR compliance) is prioritised, there is often less focus on robust cybersecurity for shared data platforms, which poses risks in MTM implementations.
- Need for Privacy Standards for Sensitive Data: Data governance policies must address the handling of sensitive data, particularly business-sensitive data, to foster trust and ensure privacy without inhibiting data sharing.

3.2 Recommendations to address identified gaps

3.2.1 Establishing Robust Data Governance Frameworks

Challenge Addressed: Lack of interoperable and reliable data-sharing mechanisms among stakeholders.

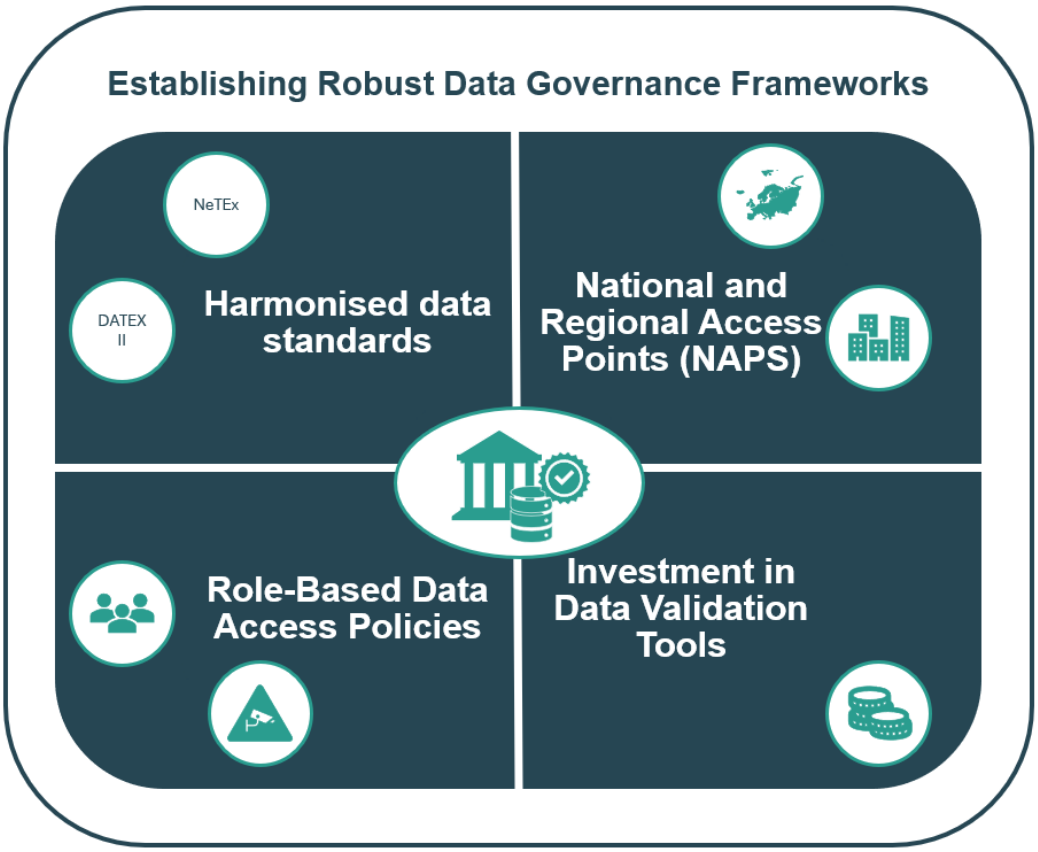

Figure 2: Recommendations establishing robust data governance frameworks

Recommendations:

- Harmonised Data Standards: Develop a universal data-sharing protocol that aligns with EU standards such as DATEX II and NeTEx for traffic and public transport data. This ensures seamless interoperability and consistent quality across different jurisdictions. Policymakers should work to establish unified data standards across the EU that align with ITS directives, specifically for MTM. This would streamline procurement and support interoperability across multiple vendors and operators.

- National and Regional Data Access Points (NAPs): Investment in developing mature, functional NAPs across all EU member states is essential. Encourage cities to strengthen their NAP infrastructure to support data collection, sharing, and integration at regional and cross-border levels. This would streamline access to real-time data for all stakeholders.

- Role-Based Data Access Policies: Implement data access frameworks that define clear roles for public and private stakeholders, specifying who can access which type of data and under

what conditions. This ensures security and compliance with GDPR requirements. This approach would help balance privacy concerns and data accessibility.

- Investment in Data Validation Tools: Provide funding and support for developing and deploying AI-based tools that validate and standardise incoming data to ensure quality and reliability. Such functionalities have the potential to significantly facilitate data processing, validation and harmonisation efforts, and improve the accuracy and reliability of the resultant models.

3.2.2 Enhancing Stakeholder Collaboration and Engagement

Challenge Addressed: Insufficient multi-stakeholder cooperation, causing fragmented decision-making and inefficiencies.

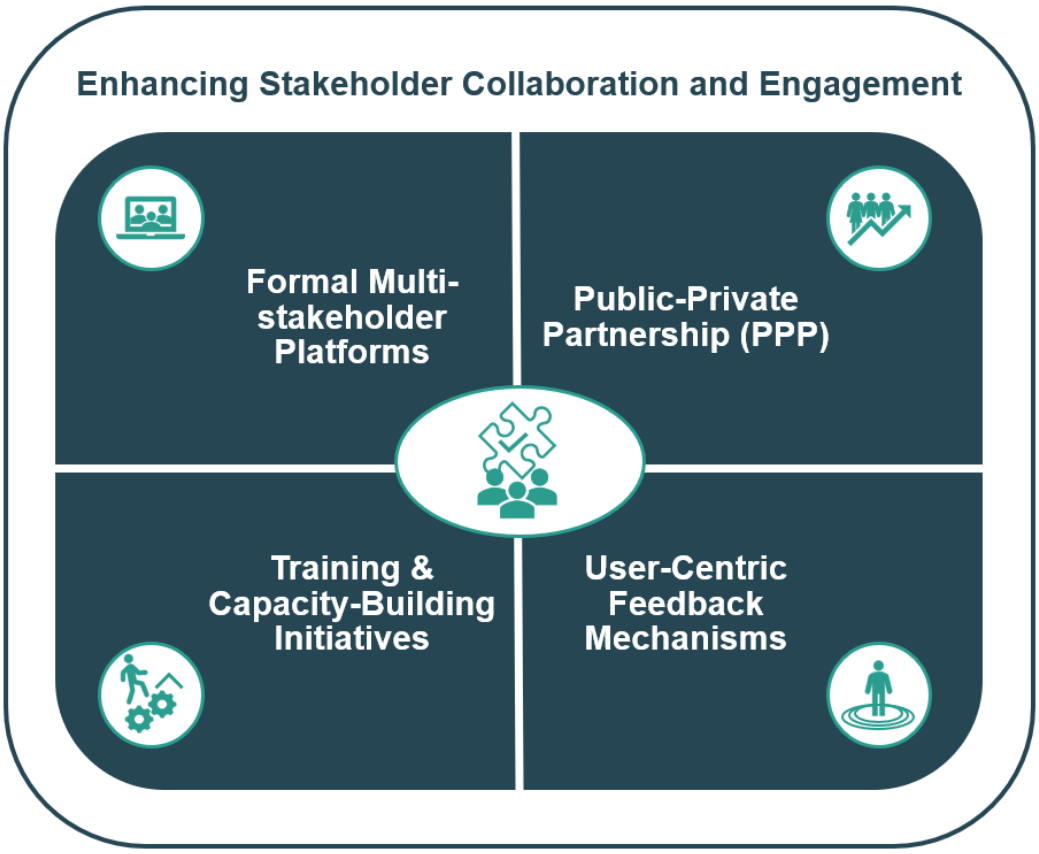

Figure 3: Recommendations for enhancing stakeholder collaboration and engagement

Recommendations:

- Formal Multi-Stakeholder Platforms: Establish formalised platforms for collaboration on MTM, where public agencies, private transport operators, and technology providers can align goals, share insights, and resolve conflicts. These platforms should operate under the guidance of a central coordinating authority. A central governance entity within cities or regions could manage data sharing, resolve disputes, and enforce standards. SUMP processes, with its cooperative planning approach and establishment of working structure, serve as a good example for the creation of such platforms.

- Public-Private Partnership (PPP) Frameworks: Develop policy-driven PPP frameworks to incentivise private stakeholders to participate actively in MTM (Multimodal Traffic Management). PPP agreements should clarify obligations, benefits, and risk-sharing mechanisms.

- Training and Capacity-Building Initiatives: Launch training programs for traffic management professionals and stakeholders to improve their understanding of multimodal systems and governance tools and raise awareness of its expected impacts and benefits. This will foster a shared knowledge base, improving overall system efficiency.

- User-Centric Feedback Mechanisms: Develop platforms to gather real-time feedback from citizens regarding MTM tools and policies. This user-centric approach ensures that solutions align with public needs and promote inclusivity.

3.2.3 Facilitating Technology Adoption and Innovation

Challenge Addressed: Limited integration of advanced technologies, such as AI and IoT, or standard infrastructure classifications in MTM systems.

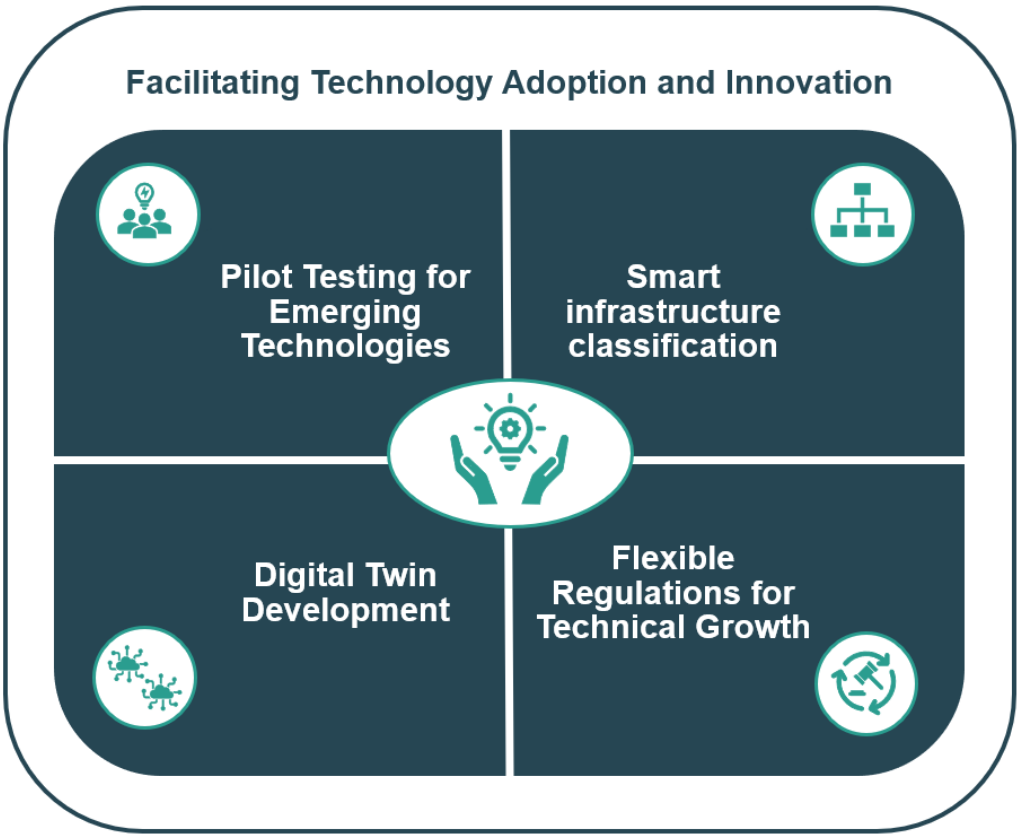

Figure 4: Recommendations facilitating technology adoption and innovation

Recommendations:

- Pilot Testing for Emerging Technologies: Provide a regulatory framework for cities to pilot new technologies, including AI-based predictive tools, autonomous vehicle integration, and adaptive traffic signal systems. These pilots should assess scalability, cost-effectiveness, and impact on urban mobility. Engaging with local transport authorities to test MTM tools on-site before full

implementation allows solutions to be tailored to local conditions. This hands-on approach would improve the tool's efficacy and ensure it meets local expectations.

- Smart infrastructure classification: Classification of smart infrastructure through standardised approach, such as TANGENT's SICI, can assist in infrastructure management by providing guidance for planning future infrastructure improvements and investments to accommodate higher levels of automation and advanced use cases.

- Digital Twin Development: Encourage and support cities in the development of digital twins for simulating multimodal scenarios, which helps in better planning and proactive traffic management.

- Flexible Regulations for Technological Growth: Design adaptive policies that allow for the integration of new technologies without disrupting existing traffic management systems. For instance, regulations should accommodate the gradual adoption of connected and automated vehicles.

3.2.4 Aligning MTM with Policy and Planning Frameworks

Challenge Addressed: Misalignment between MTM strategies and local/regional policies can cause conflicting action plans and inefficiencies in implementation.

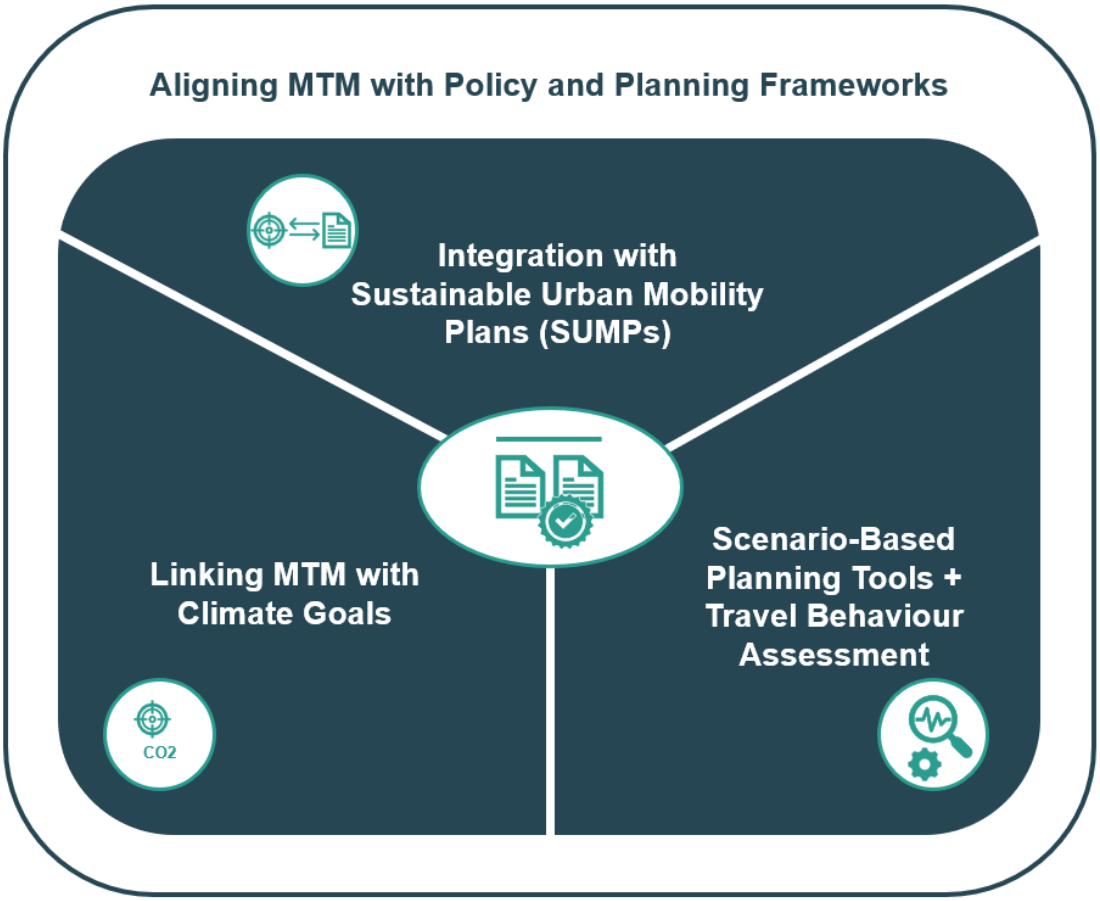

Figure 5: Recommendations for aligning MTM with policy and planning frameworks

Recommendations:

- Integration with SUMPs: Incorporate MTM objectives into SUMPs to ensure that multimodal strategies align with broader urban mobility goals, such as reducing emissions and enhancing public transport usage. SUMP processes, which emphasize long-term sustainable urban mobility planning, should integrate MTM data and tools to support transport planning as well as real-time management. The data collected through MTM can provide valuable insights into modal shifts, congestion patterns, and user preferences, guiding SUMP initiatives.

  Furthermore, cooperative MTM can significantly strengthen SUMP's implementation phase, encouraging continued engagement with stakeholders, joint monitoring and strategic assessment of the MTM efforts.

- Scenario-Based Planning Tools: Use scenario-based planning to forecast the impacts of policy changes or major events on traffic systems. This allows policymakers to adjust strategies proactively. MTM solutions should incorporate scenario libraries and simulation tools for transport planning, enabling cities to anticipate the impact of infrastructure developments or policy changes on real-time mobility.

  To support this, travel behaviour assessment on a regular basis (developing travel choice models via preference data collection through methodologies such as structured survey) is also crucial, where precise modal split predictions can help policymakers and transportation planners promote sustainable alternatives. Besides, through the understanding of user priorities, precise modelling of travel behaviour can be achieved and guide precise network optimisation and suitable traffic management strategies. Evaluating new services and traffic management strategies helps identify commuter behaviour drivers and design effective strategies. In TANGENT cities, travel cost and total duration are the main determinants of transport mode choice. Other significant factors include age, income, and degree of satisfaction with current LOS of public transport.

- Linking MTM with Climate Goals: Align MTM strategies with local and EU-level environmental policies, such as the Green Deal, to contribute toward achieving carbon neutrality. In addition, integrating a cost-benefit analysis within MTM tools can help quantify the benefits of MTM in transport planning, ensuring that investments support long-term sustainability.

3.2.5 Financing and Resource Allocation

Challenge Addressed: Lack of sustainable funding for long-term MTM development.

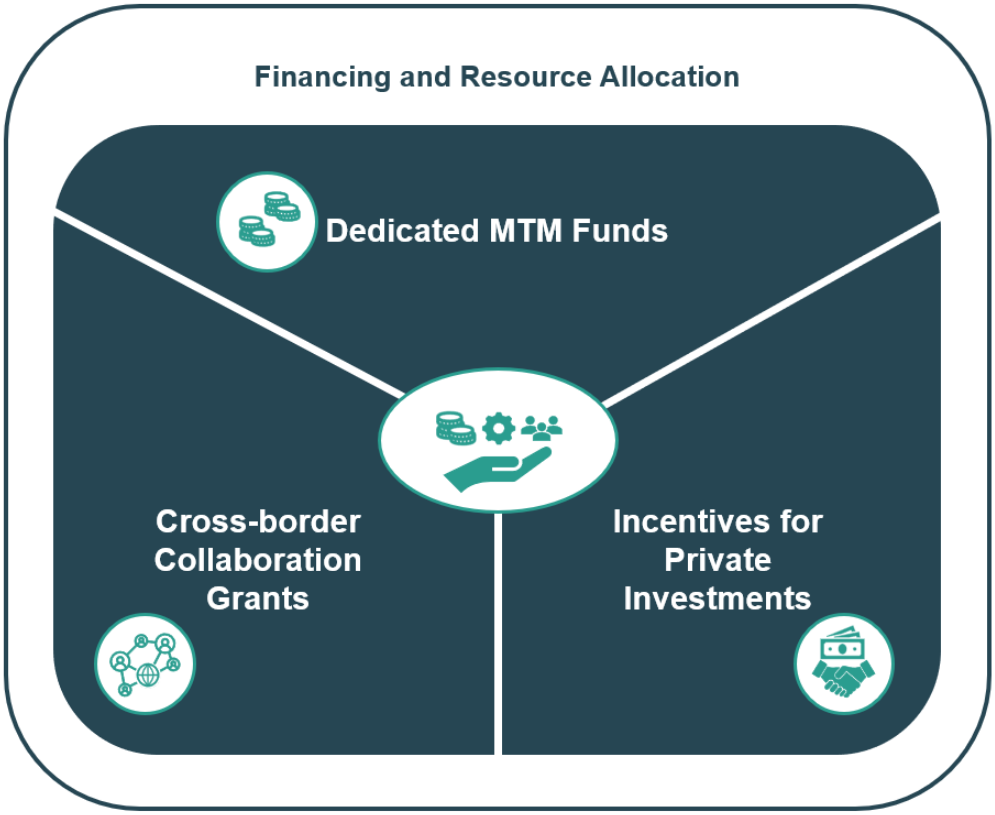

Figure 6: Recommendations towards financing and resource allocation

Recommendations:

- Dedicated MTM Funds: Advocate for EU and national funding programs specifically targeting the development of data spaces for municipalities and regions, and MTM solutions, ensuring resources for both initial deployment and ongoing maintenance.

- Incentives for Private Investments: Offer tax benefits or subsidies to private stakeholders investing in MTM-related infrastructure, such as data platforms or IoT networks. To encourage private actors to share data, incentives such as subsidies, tax benefits, or simplified data-sharing agreements could be implemented. Additionally, defining clear data-sharing protocols can minimize competitive risks for private operators.

- Cross-Border Collaboration Grants: Encourage cities to apply for cross-border collaboration grants to fund interoperable MTM systems, particularly in regions with high levels of international mobility.

3.2.6 Monitoring and Evaluation Frameworks

Challenge Addressed: Lack of clear metrics and processes to evaluate MTM success.

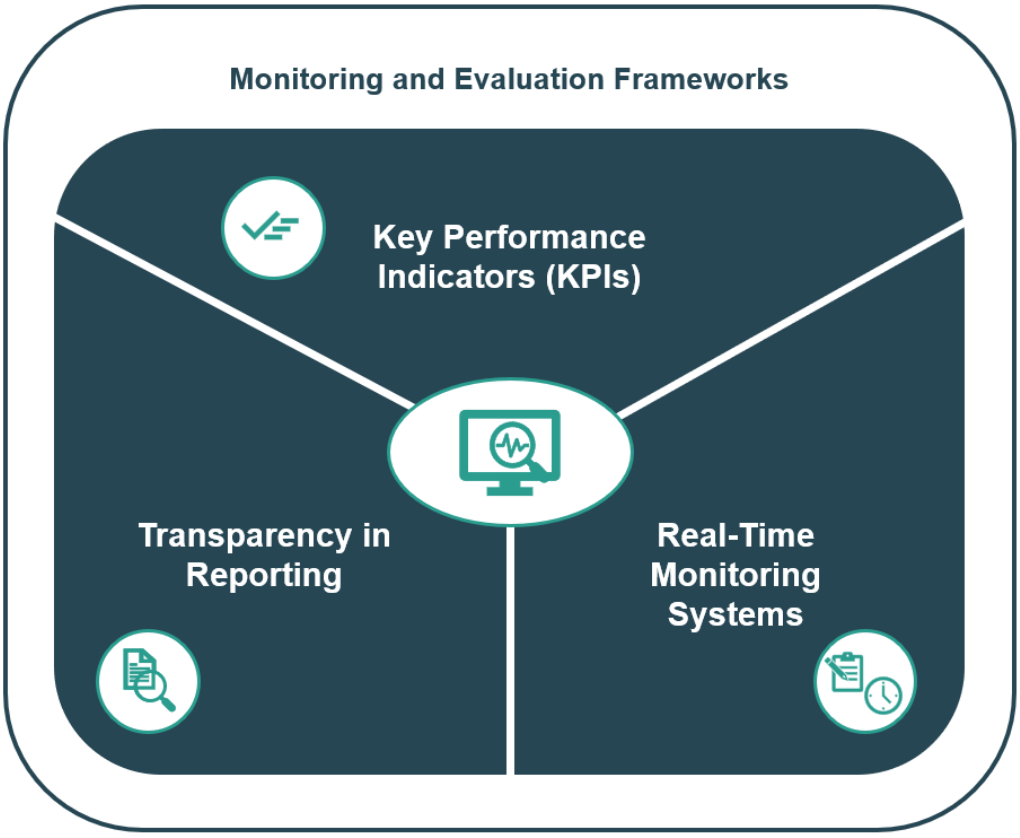

Figure 7: Recommendations for monitoring and evaluation frameworks

Recommendations:

- Key Performance Indicators (KPIs): Develop and mandate the use of KPIs, such as congestion reduction, modal shift rates, road safety and CO2 emission levels, to assess the impact of MTM strategies. The definition of suitable indicators should respond to specific strategic objectives and local policy goals as defined in applicable mobility plans (SUMPs).

- Real-Time Monitoring Systems: Equip traffic management centres with real-time monitoring tools to continuously evaluate the performance of MTM interventions. Configurable MTM tools should be designed to allow easy modifications based on local policy changes, user needs, and evolving transportation goals. This flexibility would help MTM solutions remain relevant despite dynamic urban environments and allow possibilities for them to be transferred to different cities.

- Transparency in Reporting: Establish transparent reporting mechanisms to share evaluation results with stakeholders and the public, fostering trust and accountability.

3.3 Vision for multimodal network management in urban planning

New data sources and their challenges

- The future of multimodal network management in urban planning is poised to be transformative, driven by the integration of new data sources and advanced technologies. One of the key aspects is the incorporation of Floating Car Data (FCD), which provides real-time information on traffic conditions and vehicle movements. This data, combined with other sources, will enhance the accuracy and reliability of traffic management systems.

- To facilitate this integration, new models will be developed to harmonize data and overcome interoperability issues. These models will ensure that data from various sources can be seamlessly combined and used effectively. Additionally, methodologies and functionalities will be designed to process larger volumes of data, addressing the technical and operational requirements of modern urban environments.

- Further research will focus on evaluating the consistency and accuracy of these data sets, ensuring that the information used for decision-making is reliable. This will be crucial for scaling up the multimodal character of the solutions, including the integration of active modes such as walking and cycling.

- Model training for network-wide predictions will be based on newly integrated data sources, allowing for more accurate forecasting and planning. This will be complemented by further testing and enhancement of Multimodal Traffic Management (MTM) solutions, ensuring they are robust and effective in various scenarios.

Further testing and enhancement of MTM solutions

- One of the goals is to reduce processing times for optimization modules, enabling faster and more flexible assessments of solutions. This will be particularly important for evaluating new scenarios and use cases for cooperative traffic management, allowing for the validation and optimization of MTM response plans at the local level.

- Large-scale pilots and demonstrations will play a critical role in showcasing the potential of these solutions and facilitating knowledge exchange. This will include possible integration with freight and logistics solutions, expanding the scope and impact of MTM.

- Finally, the expansion of MTM, digital infrastructure, and digital twin solutions will be a significant focus. The project has demonstrated the potential for upscaling these solutions, integrating real-time traffic data to optimize city planning and traffic flow. This vision of the future will see cities leveraging advanced technologies to create more efficient, sustainable, and responsive urban mobility systems.

MTM solutions as enablers of new mobility planning practices

- Regularity of data collection and monitoring to steer collaborative mobility planning between public and private stakeholders, establishing cooperation structures that enable strategic alignment and preparation of MTM response plans and operational coordination.
- Strengthen SUMP implementation and monitoring phases, steering stakeholder engagement and cooperation through the implementation phase, based on continuous data collection and traffic management efforts.
- Establish clearer governance frameworks that define roles and responsibilities among stakeholders, particularly during incidents, based on the roles and tasks considered for

TANGENT's case studies. This could involve developing policies that ensure all operators respond consistently and effectively to disruptions.

Capacity building and support for broad uptake of MTM solutions

Provide training for transport operators and city authorities on the use of new tools and data systems to ensure smooth adoption and maximize the benefits of traffic management innovations, understanding the challenges of a transition towards new working practices and technological environment.

4 Conclusion

In summary, the integration of advanced traffic management services and functionalities, implementation of large-scale pilot projects, and the enhancement of digital infrastructure for Multimodal Traffic Management (MTM) solutions have significant potential to revolutionise urban mobility systems. Accelerating processing times will facilitate more agile and adaptive traffic evaluations, enabling the assessment of innovative scenarios and the validation of localised MTM response strategies. These advancements will not only improve traffic performance and road safety but also play a pivotal role in promoting the sustainability and resilience of mobility systems.

The importance of regular data collection and monitoring cannot be overstated. By steering collaborative mobility planning between public and private stakeholders, we can establish robust cooperation structures. These structures will be essential for the strategic alignment and preparation of MTM response plans and operational coordination. Strengthening the implementation and monitoring phases of Sustainable Urban Mobility Plans (SUMPs) through continuous data collection and stakeholder engagement ensures a cohesive approach to urban mobility management.

Clear governance frameworks that delineate roles and responsibilities among stakeholders, particularly during incidents, are critical. Developing policies to ensure consistent and effective responses to disruptions, as demonstrated in TANGENT's case studies, will enhance the resilience of urban transport systems. Moreover, capacity building through targeted training for transport operators and city authorities will facilitate the smooth adoption of new tools and data systems, maximising the benefits of traffic management innovations.

Overall, the project's vision of leveraging advanced technologies to create more efficient, sustainable, and responsive urban mobility systems is both promising and achievable. By continuing to support the broad uptake of MTM solutions and fostering a culture of continuous improvement and cooperation, the pathway for smarter, more connected cities that meet the mobility needs of different stakeholders can be paved.

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