International Transport Forum

Measuring New Mobility

Case Studies and Best Practices

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The International Transport Forum

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About the ITF Mobility Innovation Hub

ITF's Mobility Innovation Hub helps governments to develop innovative policies for better transport in the face of uncertainty and rapid change. It scans for transport-relevant developments at the horizon of public authority foresight, assesses their potential impacts and highlights best practices for deploying effective policies.

Case-Specific Policy Analysis Reports

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Abbreviations and acronyms

API	Application Programming Interface
BVG	Berlin Public Transport Authority
EFMDD	Equity-Focus Mobility Development District
EU	European Union
FHV	For-Hire Vehicle
FUA	Functional Urban Area
GBFS	General Bikeshare Feed Specification
GNSS	Global Navigation Satellite System
ICO	Information Commissioner's Office
IT	Information Technology
ITF	International Transport Forum
KOTSA	Korean Transportation Safety Authority
LADOT	Los Angeles Department of Transport
MaaS	Mobility as a Service
MAIS	Maximum Abbreviated Injury Scale
MDD	Mobility Development District
MDM	Mobility Data Marketplace
MDS	Mobility Data Specification
MOLIT	Ministry of Land, Infrastructure and Transport (Korea)
NTSB	National Transportation Safety Board (United States)
NUMO	New Urban Mobility Alliance
OECD	Organisation for Economic Co-operation and Development
OMF	Open Mobility Foundation
SDOT	Seattle Department of Transportation
SOZ	Special Operation Zone
SPZ	Standard Permitted Zone
TLC	Taxi and Limousine Commission (New York)
UBM	Universal Basic Mobility
UITP	International Association of Public Transport
WBCSD	World Business Council for Sustainable Development

Executive summary

What we did

This report helps policy makers to implement new mobility measurement and monitoring frameworks. This study draws lessons from ten case studies around the world and offers a set of practical recommendations to ensure effective data reporting and monitoring frameworks. The work is based on expert interviews and updated research following. This report builds on the first publication in the ITF's series on Measuring New Mobility, which outlined a classification framework for new mobility services and proposed a series of detailed performance indicators to help cities monitor and understand their impact.

What we found

New mobility services have emerged in many cities in recent years to become a small but important – and popular – component of urban passenger transport systems. Despite their widespread benefits, new mobility services, which include ride services and fleet-sharing platforms, can also produce negative social externalities if they are not managed effectively. Measuring these services helps local authorities to understand their benefits, monitor their negative impacts and guide policy interventions when they are necessary.

Many mobility services have existed for some time with many aspects measured and much known about them. But this is not necessarily the case for newer mobility services about which little is known or measured. Mobility services typically require some form of steering via different governing mechanisms to ensure that they contribute to both individual and societal outcomes. Good governance requires evidence, and good evidence is based on representative and high-quality data. Raw data alone is insufficient to provide the necessary evidence base essential for policy making. Data are only useful when processed into knowledge.

When public authorities seek to collect mobility service data to support their mandates, they typically do so with three use types in mind: planning and policy, supporting operations, or enforcement. These uses call for different information about activities and, therefore, different types, scopes and data sources.

For data to support policy and planning, public authorities must understand how the data they collect are generated and trust its accuracy. Data useful for measuring new mobility services may come from several sources and be gathered by a number of different mechanisms (observation, human incident reporting, automatic data logs from online platforms, surveys, etc.). Each of these sources comes with specific characteristics and potential limitations, both of which should be discoverable by public authorities via the use of accurate metadata.

At the highest levels, policy aims for transport authorities are similar (efficiency, equity, safety, sustainability and accessibility), yet public authorities at various levels play separate roles and are entrusted with different responsibilities. Accordingly, regulatory tasks, and the data which enable them to be implemented and evaluated, differ at the local/regional, national and even supra-national level. Likewise, data collection and measurement initiatives will also differ between levels of government and responsibilities.

When measuring and using data on mobility services, several biases enter into play that may impact the relevance of collected data and their efficacy in contributing to policy and decision making. Accounting for and addressing these biases helps authorities correctly gauge the extent to which data on new mobility services reflect an accurate understanding of those services and their contribution to overall policy objectives.

Measuring and collecting data on new mobility services may involve costs and trade-offs both for reporting parties (operators) and collecting parties (public authorities). Data reporting requirements should be proportionate to the impact that the targeted activity imposes on society, and other impacts may also need to be considered.

Not all authorities have the legal remit to require mobility operators to report data. Unlike micromobility services, licences for ridesourcing or procurement for carsharing rarely include comprehensive data-sharing provisions, and very few authorities have comprehensive data reporting requirements in place for ridesourcing services.

Setting performance thresholds is crucial to achieving public objectives. Some cities and regions have explicit equity targets but apply these unevenly across mobility services due to a lack of a common data reporting authority. Many cities place a maximum threshold on fleet size for shared micromobility services. Minimum fleet size thresholds are less common, however, which has led to service degradation in some instances.

Designing effective procurement or licensing processes is the cornerstone of an effective performance management programme for shared micromobility services. Public authorities need flexibility to adapt to rapid changes in new mobility offers and actors to minimise service disruptions and ensure that their constituents continue to benefit. In parallel, operators need to have a reasonable level of predictability regarding demands from public authorities. The most successful performance measurement programmes achieve a balance between these two objectives.

What we recommend

Limit reporting requirements to data that are essential for carrying out public authority mandates

Public authorities should limit the scope of data collection, especially compulsory data reporting, to data that establishes the evidence base regarding outcomes for which authorities have a specific mandate. This principle must underpin new mobility data measurement initiatives to enhance trust in public authority oversight and to limit risks linked to public authority overreach.

Co-ordinate new mobility data collection with existing data reporting and measurement efforts

Measuring new mobility services can best inform policy when the uptake and impact of these services are comparable to the impact of other incumbent services and when data collection strengthens relevant and actionable insight regarding overall mobility performance. This implies a level of co-ordination and coherence across mobility data measurement and collection initiatives that rarely exist.

Co-ordinate data reporting across all levels of government

Synergies exist between local, regional and national data reporting initiatives given that all three benefit from enhanced data compatibility and interoperability. At a minimum, this means ensuring that all public authority data reporting mandates use common and agreed terms and definitions. Enhanced

interoperability efforts should aim to ensure that authorities and stakeholders harmonise data collection syntaxes or ensure that the different syntaxes they use can be reliably mapped from one to another. National data collection initiatives and requirements should not add an additional level of complication or introduce new data interoperability requirements. Consistent data reporting mandates also benefit operators that provide services across multiple localities in the same region or country.

Develop public authority capacity to collect, process and analyse new mobility data

Many public authorities have insufficient technical skills or information technology (IT) resources to process the data received by service providers. Local authorities should seek to upskill staff either through training or new hires. They should also invest in adequate IT infrastructure and establish appropriate IT protocols. However, given the financial constraints of many authorities, the public sector faces difficulty in competing with the private sector to hire data analysts. For this reason, they may also benefit from using vetted third-party data processors. In the latter case, public authorities should ensure that staff can understand and manage relationships with third-party stakeholders.

Measuring new mobility in practice

New mobility services have emerged in many cities in recent years to become a small but important and popular component of urban passenger transport systems. Despite their widespread benefits, new mobility services, which include ride services and fleet-sharing platforms, can also produce negative social externalities if they are not managed effectively. The first publication in the International Transport Forum's (ITF) series on "Measuring New Mobility" (ITF, 2023a) provided a classification framework for the wide range of new mobility services according to service category and vehicle type. It proposed a series of detailed performance indicators to help cities monitor and understand the impact of new mobility services in five key transport policy areas: sustainability, safety, utilisation, accessibility and equity (Table 1). "Measuring New Mobility" also outlined guidelines for working with operators and third-party data aggregators to calculate those performance indicators (Box 1).

Table 1. New mobility performance indicators in five policy areas

Policy area	Indicator
Sustainability	1.1 Vehicle-kilometres and passenger-kilometres travelled 1.2 Average vehicle lifespan 1.3 Alternative mode replaced and trip generation effects 1.4 Operational CO_2 emissions
Safety	2.1 Injury rate 2.2 Crash rate 2.3 Share of passenger-kilometres travelled on low-stress routes
Utilisation	3.1 Vehicle utilisation rate 3.2 Trip distance (or trip duration for round-trip services) 3.3 Total users
Accessibility	4.1 Access latency 4.2 Number of trips starting or ending near essential services and opportunities 4.3 Vehicles or trips available by area (spatially aggregated) 4.4 Trip purpose
Equity	5.1 Vehicle and trip availability in targeted service areas 5.2 Number of trips starting or ending in targeted service areas 5.3 Vehicle and trip availability for users with physical disabilities

Source: ITF (2023a).

The first report contributed to understanding the landscape of new mobility services and what an effective performance management programme should involve. This report takes the next step forward towards implementation. It surveys a sample of new mobility measurement programmes in cities around the world from a public authority perspective. It presents different approaches according to the type of service and the characteristics of the performance management programme. The results of the global review and the case studies are distilled into a series of practical guidelines and lessons learned that `public authorities can apply while looking to implement or improve their own new mobility measurement programmes.

The introductory chapter of this report reviews the motivations for public authority measurement of new mobility services, places them in the context of broader public authority mandates and investigates how these motivations may impact public authorities' approach to measurement. It then looks at several key

considerations related to the collection of new mobility service data by public authorities and the ways in which these considerations impact the design of data collection and data reporting initiatives. The chapter then introduces a framework for classifying new mobility measurement initiatives based on the types of services involved, the measurement approach and the governance function supported by the data collected.

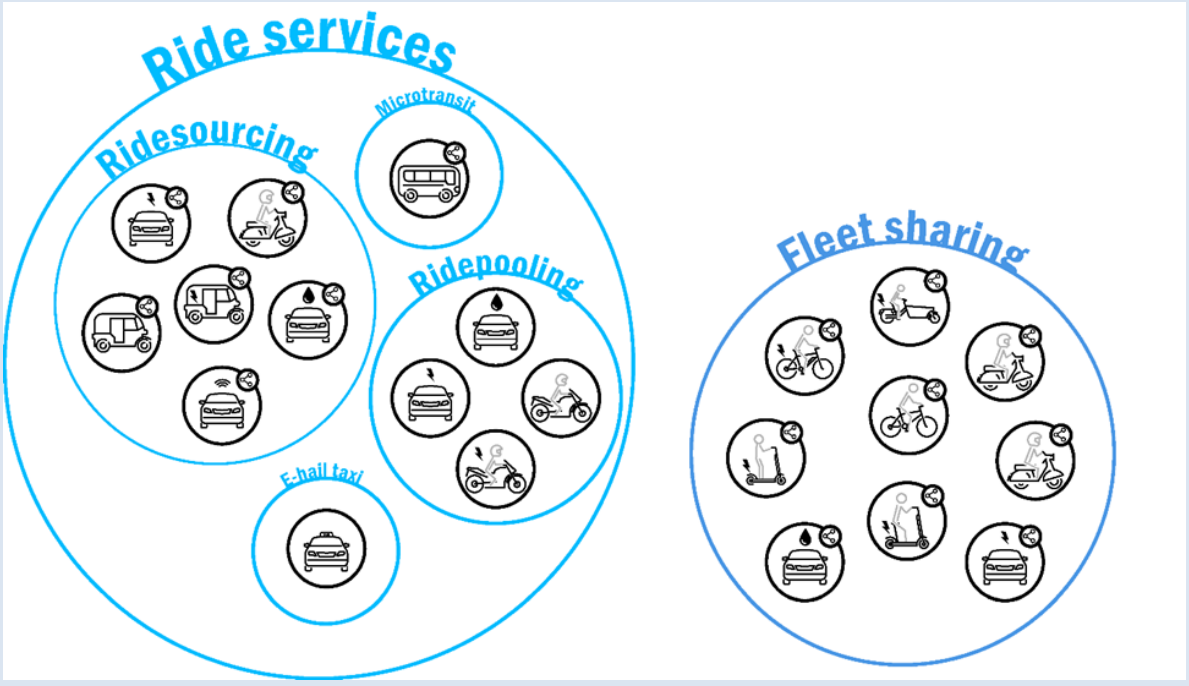
Box 1. Measuring new mobility: Definitions, indicators, data collection

The first report in the ITF's "Measuring New Mobility" (ITF, 2023a) series begins by giving a broad overview of existing and emerging new mobility services. It then provides a classification of new mobility services by service concept:

1. Ride services (including ridesourcing and ridepooling) are "services that provide the traveller with access to rides where the traveller is the passenger and not the operator of the vehicle."
2. Fleet sharing (including e-scooter sharing and bikesharing) refers to services that provide temporary access to the vehicles owned by a platform but that the customer operates.

The report also provides a new mobility vehicle taxonomy covering 27 different vehicles, from electric unicycles to minibuses. Connections between service concepts and vehicle types are identified. Figure 1 below shows the most common types of vehicles used in a variety of service concepts.

Figure 1. New mobility services and their vehicle types



Source: ITF (2023a).

The report proposes 17 policy-relevant indicators to measure the performance of these diverse new mobility services. The indicators are intended as the foundation for an effective and comprehensive new mobility measurement programme tied to specific policy actions. The indicators are organised by five policy areas: sustainability, safety, utilisation, accessibility and equity. Standard calculation

methodologies, data needs, recommended reporting frequencies and implementation examples are provided for each indicator.

The report concludes with a chapter on data reporting. It discusses typical formats for new mobility data in detail, including the Mobility Data Specification (MDS) and General Bikeshare Feed Specification (GBFS), followed by a comparison of four common data acquisition models: compulsion, conditionality, co-operation and commercial terms.

In summary, the first "Measuring New Mobility" report provides a general review of the new mobility landscape. It offers tools for performance management, thus setting the stage for this second report on implementation and case studies.

Measurement not just for the sake of measurement

The first thing to consider when seeking to measure new mobility is the link between data and governance. Much travel does not involve a service *per se* – e.g. walking, cycling, driving – and while these modes dominate, data regarding these activities are harder to obtain and are collected infrequently – if ever. However, travel involving a mobility service, especially public transport, is significant in many contexts. Some of these mobility services have been around for a while, and much is measured and known about them. Others are newer and little about them is known or measured. These mobility services typically require some form of steering via different governing mechanisms to ensure that they contribute to both individual and societal outcomes.

Good governance requires evidence, and good evidence is based on representative and high-quality data. To deliver on their mandates, public authorities must collect data to build the knowledge and insights which underpin policy decisions. However, raw data alone is insufficient to provide the necessary evidence base essential for policy making (Figure 2). Data are only useful once processed into knowledge. This implies that data collection must contribute to developing the evidence and knowledge necessary to accompany and carry out governance functions.

Figure 2. From data to knowledge

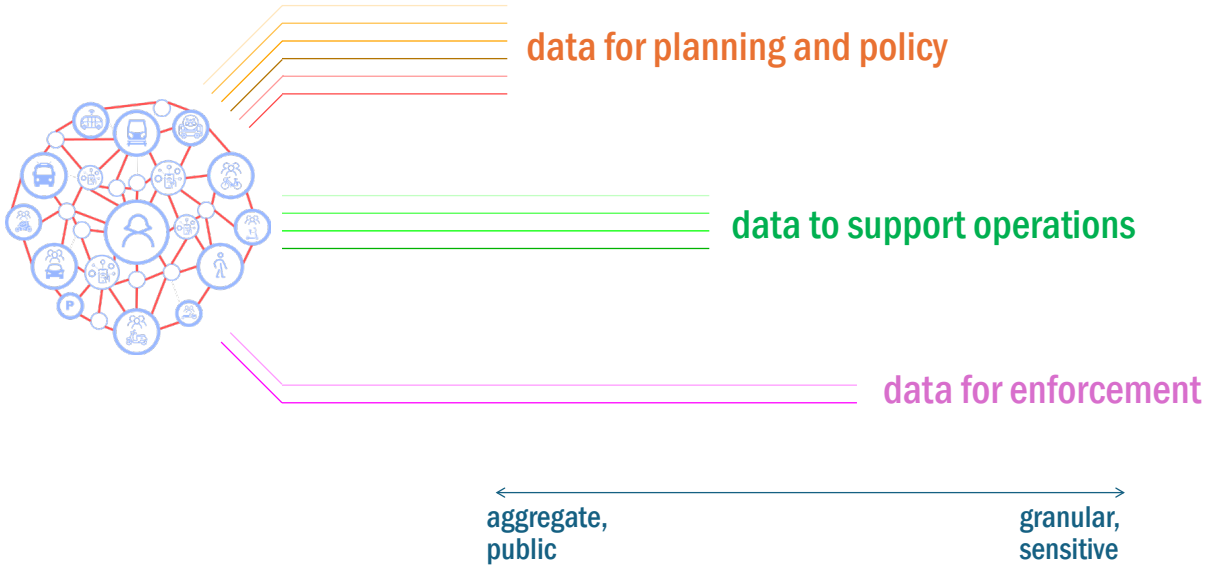
Source: ITF (2023b) based on de Streel, Krämer and Senellart (2021).

Data collection by public authorities, especially when it involves compulsory data reporting to public authorities, should be limited in scope to data that establishes the evidence base regarding outcomes for which authorities have a specific mandate. This principle must underpin new mobility data measurement initiatives so that trust in public authority oversight is enhanced and to limit risks linked to public authority overreach.

Link data collection to policy objectives and mandates

A second element to consider is the match between data collection efforts by public authorities and the uses of these data. When public authorities seek to collect mobility service data in support of their governance mandates, they typically do so with three use types in mind. These data can inform planning and policy, support operations or contribute to enforcement actions (Figure 3). These uses call for different information about activities and, therefore, types, scopes and sources of data. ITF (2021) goes into more detail into these three areas, but when it comes to measuring sustainability, safety, utilisation, accessibility and equity with regards to new mobility services – or mobility generally – the main goal is to inform better policies.

Figure 3. Primary uses for mobility service data provided to authorities



Data in support of planning and policy making

All the indicators outlined in ITF (2023a) and listed in Table 1 enable or improve the capacity of public authorities to carry out their transport planning and policy-making activities, even though some (e.g. vehicle counts in certain areas of access latency) may also serve to support enforcement actions in conjunction with specific regulatory requirements. These indicators could also directly contribute to policy outcomes by establishing the basis for micro-subsidies for socially beneficial but loss-making trips (see Box 2)

The measurement and collection of planning and policy-relevant data serve multiple public authority needs. These data can facilitate the development of origin-destination matrices, which offer insights into

travel patterns, including how, when and where people travel. This information assists governments in implementing policies and infrastructure projects. For instance, it can reveal where new cycling lanes or public transport facilities are needed, identify areas with insufficient or excessive parking and suggest where road expansions or reallocations might be beneficial. Additionally, data supporting planning may encompass information on accessibility and availability of mobility services. Reports from mobility operators and other stakeholders can also inform government planning in non-transport areas, such as evaluating the coverage of health and education services or the availability of green spaces (ITF, 2021).

In the broadest sense, these data enable authorities to:

- detect problems, inform where to focus attention and funding, and what to prioritise
- find what works, what works better and the situational factors influencing effectiveness
- increase the use of better practices and improve or reduce the use of less effective or harmful ones (Metzenbaum, Nightingale and Katz, 2021).

They also allow authorities to:

- undertake predictive or exploratory analysis to inform planning, priority-setting and the timing of actions and locations for actions
- carry out statistical analysis of causal factors influencing conditions and outcomes, diagnosing problems, and identifying opportunities to inform or modify interventions
- identify, develop and implement actions to improve results (Metzenbaum, Nightingale and Katz, 2022).

Unlike data in support of operations or enforcement, data for planning and policy do not concern individual behaviours but rather how communities travel. This means that collecting personally identifiable, real-time or low-latency data is not necessary nor warranted in most cases and should be avoided by design in any new mobility measurement initiative. If necessary for enforcement actions, its collection should be framed with clear objectives regarding its use, re-use, retention and destruction after aggregation (ITF, 2021). Exceptions should be clearly justified and publicly explained, demonstrating that the purpose cannot be fulfilled with more aggregated or de-identified data. If personal data is collected, it must be managed in compliance with legal and other privacy obligations.

Public authorities must understand how the data they collect were generated and trust in its accuracy so that it can purposively support policy and planning. Data useful for measuring new mobility services may come from a variety of sources and be gathered by several different mechanisms (observation, human incident-reporting, automatic data logs from online platforms, surveys, etc.). Each of these sources comes with specific characteristics and potential limitations, both of which should be discoverable by public authorities via the use of accurate meta-data. Data auditing mechanisms and accuracy checks should also form part of the standard monitoring and data reporting pipeline (ITF, 2021).

Box 2. Using mobility service data to support micro-incentives and micro-subsidies

Operators of digitally enabled shared mobility services collect, monitor and use data generated by users of their services for better service delivery and operational planning. These data can also serve to support behavioural nudges and micro-incentives for specific outcomes with the essential caveat that such uses of personal data must be with the knowledge and consent of users. Leveraging granular trip data for micro-incentives must preserve privacy but can also unlock beneficial outcomes.

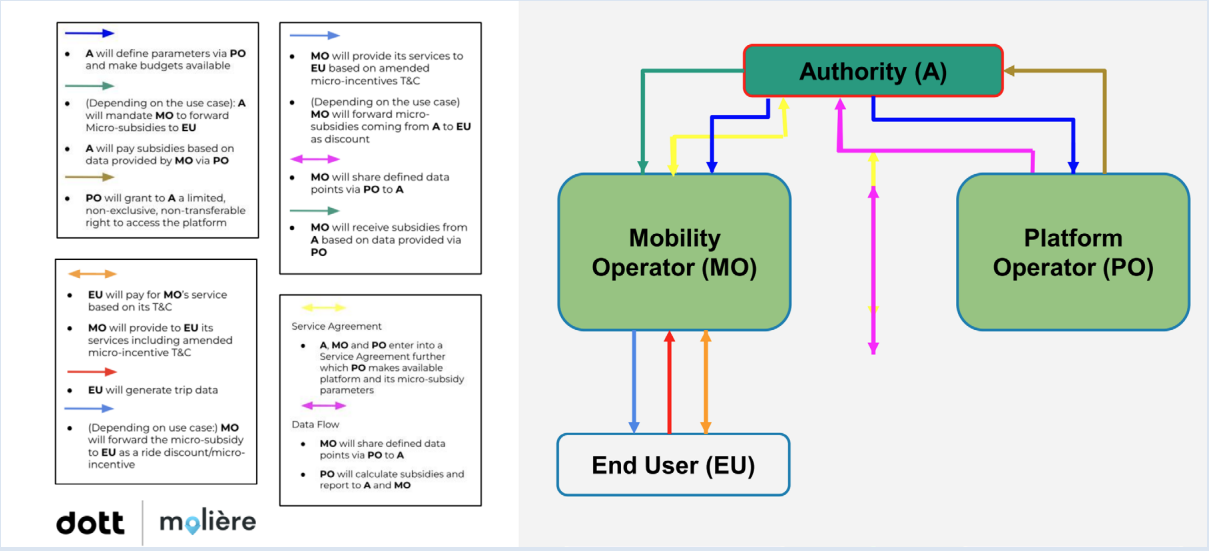
The EU-funded Molière project has explored using such data to nudge beneficial behaviour for micromobility as one of several use cases of applying GNSS technologies for Mobility Data Marketplaces (MDM). As part of the Molière project, micromobility operator Dott trialled the use of differential pricing for their shared e-bikes and e-scooters in Brussels to test the impact of micro-incentives to improve service accessibility in socio-economically disadvantaged areas that are also underserved by public transport. The trial also served as proof-of-concept for establishing a micro-subsidy platform for cities to incentivise socially beneficial but loss-making trips.

Evaluating the incentivised rides (ranging from a 30% discount to a 70% discount) against control zones with no incentive, the trial resulted in an 2.56% increase in rides at an average cost of EUR 1.77 per ride (EUR 0.92 for e-scooters and EUR 2.90 for e-bikes). These results are promising given the fact that the trial did not include a dynamic fleet adjustment component. The trial also demonstrated the technical feasibility of applying such micro-incentives at a relatively low cost.

There are long-standing justifications for subsidising socially beneficial services who would otherwise operate at a loss – including public transport. Public transport subsidies are typically granted to operators with the condition that they must conform to public service obligations. These subsidies may sometimes be linked to different types of travellers (based on age, income or other criteria) but are rarely granted on a trip-basis (e.g. origin-destination, time of day, type of vehicle, area of travel, distance or duration). The kind of data generated by digitally enabled mobility services can be used to establish targeted micro-subsidies for particularly beneficial trips.

The Molière project explored use cases where higher-level objectives (e.g. reduction of car dependency, better allocation of public space, increase of public transport or active travel) could be used to establish specific micro-subsidy programmes that would leverage key performance indicators to set the subsidy level and monitor programme outcomes. The main technical challenge is to ensure that public authorities have access to trusted and auditable data feeds that ensure delivering and overseeing the expenditure of public funds to support certain types of trips. Existing data formats, like the application programming interface (API) endpoints of the Mobility Data Specification, provide such trust and can ensure the necessary oversight.

Figure 4. Illustrative examples of different types of data flows and public subsidy provision



Source: Gutiérrez et al. (2023); Schlebusch (2023).

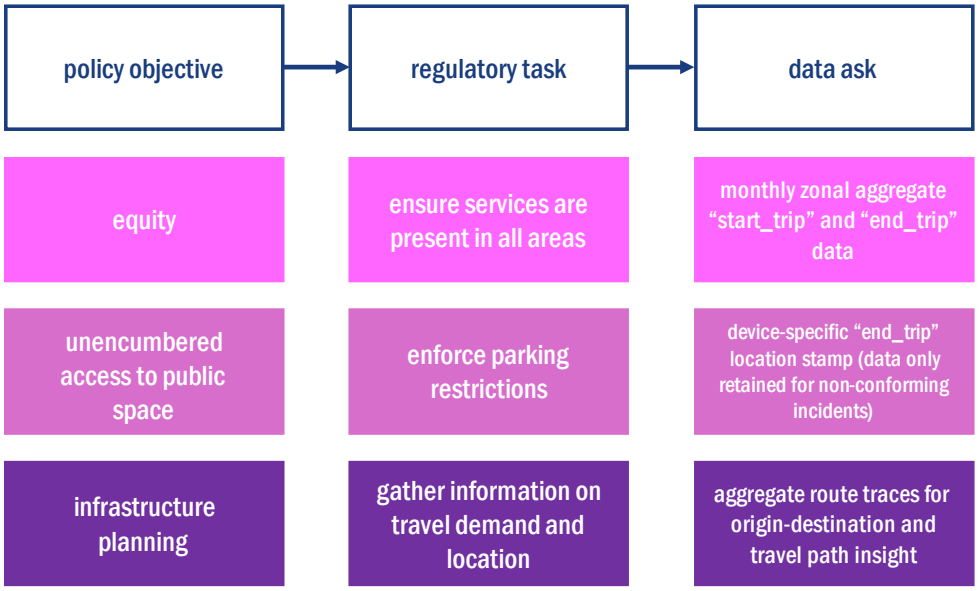
Different levels of government have different responsibilities and measure different things

Public authorities should develop new mobility measurement initiatives in line with clear and transparent public policy aims. As noted at the outset of this report and in ITF (2021, 2023a), this means establishing top level policy priorities, identifying specific "tasks" that enable the achievement of those policy priorities and formulating specific data "asks" that enable those tasks to be carried out successfully (Figure 5). Some public authorities have established specific top-level objectives addressing the governance of new mobility services. For instance, the Seattle Department of Transportation (SDOT) established a comprehensive new mobility "Playbook" (SDOT, 2017) in which they identify five key objectives (or "plays") that the city will target with respect to new mobility:

- ensure new mobility delivers a fair and just transport system for all
- enable safer, more active and people-first uses of the public right of way
- reorganise and retool SDOT to manage innovation and data
- build new information and data infrastructure so new services can "plug-and-play"
- anticipate, adapt to and leverage innovative and disruptive transport technologies.

While at the highest level the policy aims for transport authorities will be similar (efficiency, equity, safety, sustainability, accessibility), public authorities at various levels play different roles and are entrusted with different responsibilities. Accordingly, regulatory tasks and the data which enable them to be carried out and evaluated differ at the local/regional, national and even supra-national level. Likewise, data collection and measurement initiatives will also differ among these different levels of government and responsibilities.

Figure 5. Align data reporting mandates to targeted outcomes and tasks

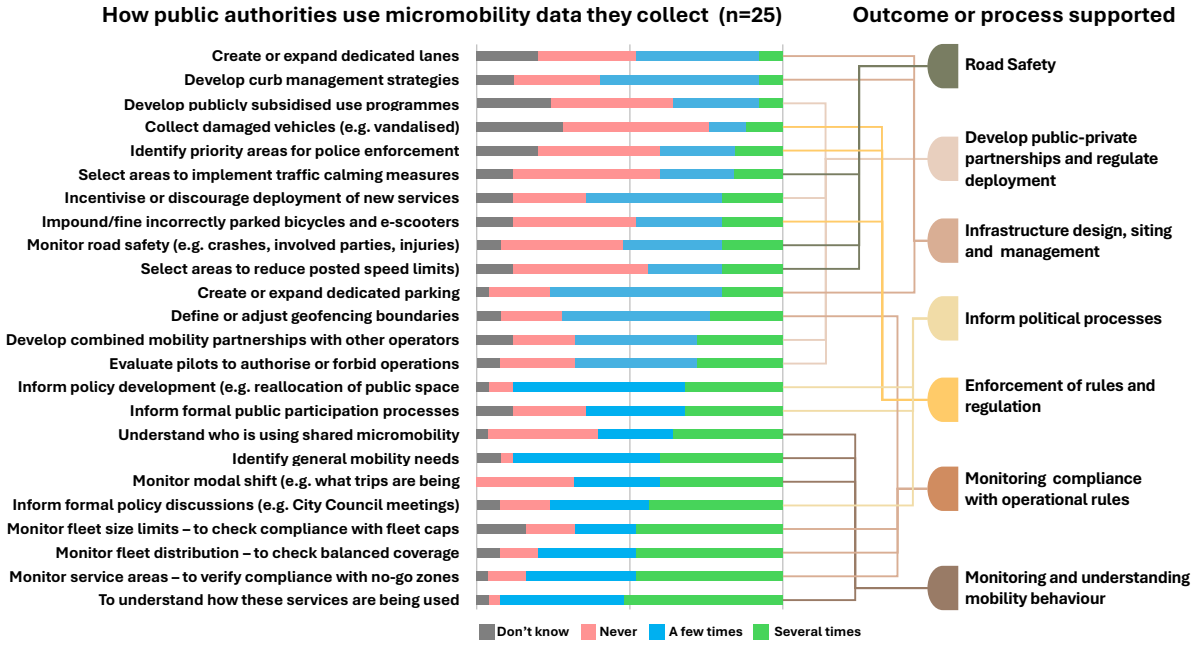


Local authorities

Local authorities, and in some cases regions, are concerned with how well people and businesses can access opportunities in their day-to-day activities. They are concerned with how well different transport services and networks function, addressing potential bottlenecks or dysfunctions and ensuring sufficient forward planning and investment to deliver benefits well into the future. At the local level, public authorities are responsible for orchestrating the use of public space, including mobility, curb and parking space, i.e. streets, roads, pavements and their environs (though in many cases, this responsibility is shared with regional and national authorities for strategic road and motorway networks). In this capacity, they are keenly interested in a set of spatial and network flow indicators at the local (urban region) or hyper-local (street) level. They are also concerned with local safety and health impacts as well as with the equitable distribution of transport-related benefits and impacts (ITF, 2021). Most of the indicators outlined in ITF (2023a) are directly relevant to local authorities.

A 2020 survey of how local and regional authorities in Europe use data collected from shared micromobility operators shows the range of uses to which these data are put (Figure 6). It also reveals the seven principal policy processes and outcomes the data supported. It also highlights that there may still be room to find new uses for data to support public policy mandates and actions (POLIS, 2021).

Figure 6. Use of micromobility data by public authorities



Source: Adapted from POLIS (2021).

Rules relating to market access and competition outcomes are shared across jurisdictions with many local authorities having control over market entry conditions at the urban level (e.g. public service obligations for public transport, licences or tenders for shared micromobility and carsharing services and operational permits for ridesourcing and taxi services). These rules may be conditional on higher level regulations (national and supra-national regulations concerning the organisation and subsidisation of public transport) or in some cases, may be completely out of the hands of local authorities (e.g. the regulation of ridesourcing in California is the responsibility of the State of California's Public Utilities Commission). Some indicators outlined in ITF (2023a) may be used to evaluate market entry requests or to enforce market participation conditions, but not necessarily at the same level of government.

Even at local and regional level, data collection regarding mobility services is not centralised and rarely co-ordinated across services due to historic divisions of responsibilities and administrative rigidities. For instance, public transport data are typically collected by the transport authority responsible for monitoring and oversight of public service obligation contracts. This may be in an independent agency or a specific department within the transport authority responsible for public transport. Data concerning taxi services and, in many cases, ridesourcing services, are collected by specific oversight bodies or separate departments, as are data regarding parking and freight pick up and drop off areas. Data regarding newer services may be collected by yet different departments, for different purposes (e.g. public space management vs. public service delivery) and with different formats, reporting conditions and frequency. Measuring new mobility services can best inform policy when the uptake and impact of these services are comparable to the impact of other incumbent services and data collection fosters relevant and actionable insight regarding overall mobility performance. This implies a level of co-ordination and coherence across mobility data measurement and collection initiatives that rarely exists.

National authorities

Most national authorities have direct responsibility over some aspects of new mobility services. These relate to the authorisation for certain vehicles to be operated on public roads, insurance coverage, market access rights, competition law and its enforcement, as well as labour and worker compensation laws, especially as pertains to new categories of "gig" or platform-mediated work.

Generally, national rules establish whether a new mobility service or vehicle is legal on the national territory, but it is often up to local authorities to manage the introduction of those in their jurisdiction. Also, while national authorities may set general rules, local authorities are often responsible for their enforcement. In almost all instances, local regulatory primacy is stronger for micromobility services than for ridesourcing services. National authorities rarely regulate aspects of new mobility services that are clearly within the remit of local oversight and control (e.g. delivering operating permits, setting fleet numbers, granting parking rights, managing traffic and curb access, managing airport or train station access), though some national governments are also involved in establishing and enforcing these rules (e.g. Singapore and the People's Republic of China). In some instances, regional authorities regulate certain mobility services (e.g. ridesourcing in the States of California and Massachusetts).

Hybrid regulatory responsibilities lead to equally hybrid data collection efforts, especially concerning data supporting regulatory compliance efforts. The type of data needed by national authorities is tied to their mandates and is not always the same as that needed by local authorities. Data are mainly used by local authorities to regulate operational aspects of new mobility services and enforce rules, whereas national authorities are generally more interested in assessing national transport system performance or establishing cross-regional performance measurement. These data need to cover at least the major cities or regions in the country. China, for example, gives some leeway to local administrations to set rules relating to ridesourcing operations but the overall regulatory framework is set at the national level (PRC Ministry of Transport, 2022) and includes data reporting requirements by operators to a national data portal ("Ride-hailing Regulatory Information Interaction Platform"). This data covers a mix of static (operator identifier, number of drivers, vehicles, vehicle type, etc.) and near real-time disaggregate dynamic trip-related data (trip time, route, pick-up and drop-off locations, etc.). Data reported to the platform is used to monitor and track ridesourcing activities and in some instances, to help enforce ridesourcing-related rules (e.g. with respect to driver training and licencing).

Ensuring safe transport is a concern at all levels of government but assessing overall transport system safety performance is a particular concern for central governments. The fact that new mobility services are rarely tracked separately in crash and injury statistics when they are first introduced is particularly challenging for safety performance assessment. In the absence of specific standards or rules relating to crash and traffic injury reporting for new mobility services, crashes involving commercially shared e-scooters or ridesourcing vehicles may be respectively categorised as "bicycle" or "taxi or car" crashes thus obscuring the real safety performance of those services. Many sub-national jurisdictions classify new mobility service crashes and injuries according to vehicle type (though rarely according to service type), but this practice is not typically harmonised at national level. A recent report from the US National Transportation Safety Board (NTSB, 2022) highlights the need for common crash reporting codes for e-scooters and e-bikes as well as the need to collate national statistics relating to crash risk for these vehicles and particularly to crash risk exposure (e.g. number of trips or kilometres travelled). However, as in many other countries, this advice does not call for further specifying whether the crash-involved micromobility vehicle is *individually* owned or offered as part of a *shared* micromobility service. This complicates both the local and national assessments of shared micromobility safety (ITF, 2024b). Depending on specific contexts, national governments can directly set disaggregated safety reporting

requirements for new mobility services, make these conditional (e.g. linked to national funding disbursements) or otherwise incentivise disaggregated reporting via standards, technical guidelines or voluntary agreements. Whatever the case, efforts should be made to cover all new mobility services and align safety reporting efforts across other modes to ensure broad comparability.

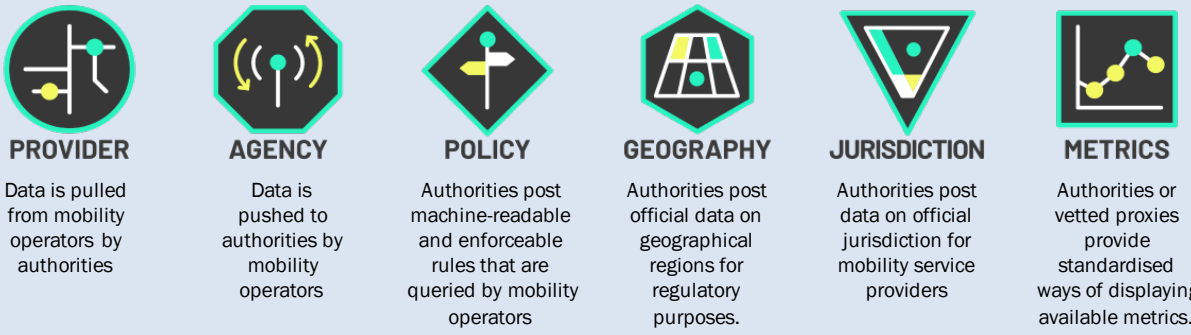
Synergies exist between local, regional and national data reporting initiatives in that all three benefit from enhanced data compatibility and interoperability. At a minimum, this means ensuring semantical alignment across all levels of government and the private sector (e.g. terms like “e-scooter”, “trip duration” or “ride start/stop” should always mean the same thing irrespective of whether data is collected by local, regional or national authorities). Enhanced interoperability efforts should aim to ensure that authorities and stakeholders seek to harmonise data collection syntaxes or otherwise ensure that the different syntaxes they use can be reliably mapped from one to another. National data collection initiatives and requirements should not add a new level of complication or introduce new data interoperability requirements, but should build on, or incentivise the use of existing data syntaxes and formats such as the Mobility Data Specification API (ITF, 2023b [see Box 3]). As noted earlier, purposive and documented meta-data can also help improve the quality and auditability of new mobility service data and thus may also be incentivised by national authorities.

Box 3. Mobility Data Specification 2.0

The Mobility Data Specification (MDS) is a set of application programming interfaces (APIs) that help public authorities better manage transport in the public right of way. It helps standardise communication and data reporting from mobility operators to authorities, allows authorities to share and validate policy digitally, and enables vehicle management and better outcomes for residents and increased predictability and lower interoperability costs for operators. It was first developed by the City of Los Angeles and has since been used by public authorities and new mobility around the world. It is managed by the Open Mobility Foundation (OMF), a public authority-led non-profit foundation.

The current version, MDS 2.0, covers four modes: shared micromobility (including e-scooters and shared bicycles), taxi and ridesourcing services, carsharing and sidewalk delivery bots. The six MDS APIs have specific data reporting, data sharing and related data-relevant functions, each with multiple endpoints (Figure 7).

Figure 7. The six MDS application programming interfaces



Source: OMF (2024).

Three of those APIs, Policy, Geography and Jurisdiction, allow public authorities to communicate machine-readable regulatory content to operators. Public authorities have used the Policy API in several different use cases that have leveraged new mobility service data to deliver on policy objectives. Examples include:

- city-wide and localised caps (e.g. "Minimum 500 and maximum 3000 scooters within city boundaries")
- exclusion zones (e.g. "No scooters are permitted in this district on weekends")
- cap allowances (e.g. "Up to 500 additional scooters are permitted near train stations")
- speed-limit restrictions (e.g. "15 mph outside of downtown, 10 mph downtown")
- idle-time and disabled-time limitations (e.g. "5 days idle while rentable, 12 hours idle while unrentable, per device")
- trip fees and subsidies (e.g. "A 25 cent fee applied when a trip ends downtown").

Source: OMF (2024)

Biased data leads to biased policies

Public authorities collect data to increase their understanding of the real world. Yet all data provides only a partial representation of that reality. Certain biases may impact the relevance of collected data and their efficacy in contributing to an accurate basis for policy and decision making (ITF, 2019, 2021, 2023a; POLIS, 2023). Accounting for and addressing these biases helps authorities correctly gauge how well data on new mobility services reflect an understanding of those services and their contribution to overall policy objectives.

The first bias to account for is selection bias. New mobility services only partially represent the contributors to, or the causes of, the kind of phenomena public authorities have a mandate to address. For example, while measuring ridesourcing activity may help understand their marginal contribution to road traffic congestion, its contribution is small in comparison to the overwhelming bulk of travel undertaken by cars, vans and lorries. Likewise, measuring the public space impacts of micromobility parking may help identify pressure points, but it does little to address the major contributor to public space pressure which is the use of, and on-street storage of, private vehicles. Another factor to consider when looking at data collection initiatives is what is not collected – the bias of no data. For instance, when looking at equity impacts, considering only public space users and not those who do not venture into public space does not provide the full picture.

The disproportionate focus on new mobility services when it comes to policy discourse around urban mobility influences what data are collected and the conclusions these data inform. This focus can be linked to three other cognitive biases and effects: the salience bias, the status quo bias and the lamppost heuristic (POLIS, 2023; ITF, 2021; ITF, 2024a).

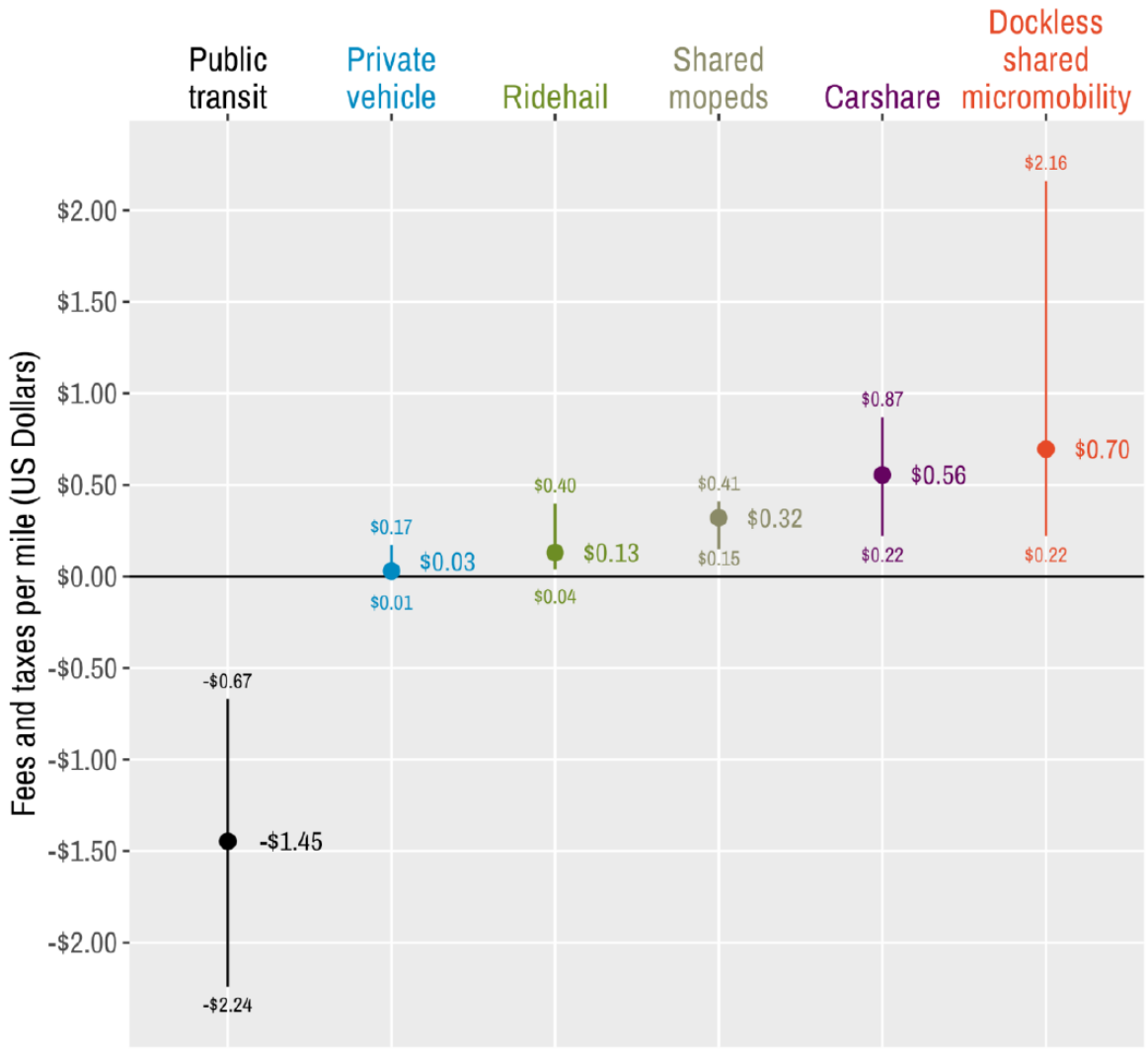
Salience bias explains why what is new or stands out from the ordinary tends to be noticed more and secure a disproportionate amount of attention. This is certainly the case with micromobility parking where discussions around the public space impacts of shared micromobility vehicles typically ignore the overall consumption of public space for private vehicle storage. Likewise, the status quo bias describes the tendency to prefer what exists (and be averse to its change or loss) over what may be. It helps understand why new things are often evaluated disproportionally with respect to their actual impact and potential benefits. This implies a need to ensure that data collection efforts adequately capture overall system performance across a range of outcomes and not just the performance of new mobility services.

The lamppost heuristic describes a form of observational bias wherein the phenomenon measured and data collected lead to false conclusions. It refers to the tendency to search for data where they are easy to discover, collect and manipulate. Many new mobility services are digital by design and produce digital data and logs that can be used to characterise their activities. Other mobility services may not produce digital data or, if they do, not in a format that is easy to use and compare across modes. Finally, much of what is important in terms of mobility and transport activity produces little to no digital data. Focusing principally on measuring and collecting data from digitally mediated services and systems because they are available and easy to collect may lead to erroneous conclusions and misguided policies.

Linked to the lamppost heuristic is a set of partial framing heuristics that may also bias data collection and policy conclusions. For instance, a key focus in delivering the Safe System approach to road safety (ITF, 2022) is to reduce the danger present in the road traffic system. Data collection efforts that gather and report data on injuries and deaths without recording or reporting traffic crash users focus attention on the vulnerability of the victims rather than on the sources of danger in the system (larger and faster vehicles). This may lead to policies that place responsibility for safety on the former and not the latter.

Finally, measuring and collecting data on new mobility services may involve costs and trade-offs both for the reporting parties (operators) and the collecting parties (public authorities). Data reporting requirements should be proportionate to the impact the targeted activity imposes on society and not be disproportionate compared to other impactful activities. A detailed comprehension of ride origin and destinations for new mobility services may be helpful in understanding traffic patterns and potential hotspots. However, it may not be worth imposing reporting costs on new mobility services if analogous data is not being collected by public authorities from the private use of vehicles.

Figure 8. Global summary of per-distance fees and taxes by mode



Source: MacArthur, Fang and Thigpen (2024).

These biases lead to a disproportionate focus on specific aspects of the overall urban mobility system, especially concerning new mobility services, which can lead to biased conclusions and policies. These same types of biases and the lack of a coherent system-wide assessment framework leads to certain mobility services being taxed at much higher rates than others irrespective of, and in some instances, despite their overall contribution to public policy outcomes (Figure 8).

Framework guidelines for mobility data collection by public authorities

The ITF report on mobility data reporting principles and framework (ITF, 2021) sets out a five-part framework for public authority data collection built on guidance provided by the Organisation for Economic Co-operation and Development (OECD, 2013, 2021), the European Union (EU, 2016), the European Commission (2018), the World Business Council for Sustainable Development (WBCSD, 2020), Sustainable Mobility for All (SuM4All, 2021), the New Urban Mobility Alliance (NUMO, 2021) and the Information Commissioner's Office (ICO, 2021). These guidelines target public authorities who require data reporting or make data reporting a condition of licensure or for the obtention of rights, including for the operation of commercial mobility services:

1. Establish and document the fundamental basis for data collection

   Public authorities should establish the legal and regulatory basis for their data collection initiatives and document these. Since public authorities may collect mobility data from a variety of stakeholders, for various purposes, across different government departments and at different levels of government, they should also co-ordinate data collection efforts and establish public authority data sharing channels in line with privacy protection and commercial sensitivity.

2. Ensure purposive data collection

   Public authority data-reporting mandates should be linked to explicit, identified and lawful purposes. Measurement initiatives and associated data collection efforts should explicitly be designed to minimise, account for and document potential biases which would erode the ability for data to contribute to those stated outcomes. Data measurement and collection initiatives should also incorporate data auditing mechanisms to ensure accuracy and be accompanied by sufficient metadata to understand the provenance of the data.

3. Engage in transparent and relevant data processing

   The results of data processing should be aligned with the purposes for which data were collected and the uses of the data that were consented by data subjects (for personal data) or data holders.

4. Limit sensitive data sharing

   Public authorities' sharing of personal and sensitive data should be limited to only the extent and to the parties necessary to achieve the purpose for its collection.

5. Appropriate data retention and destruction policies for sensitive data

   Clear data retention, transformation and destruction policies build confidence that sensitive data will only be retained as long as strictly necessary.

Classifying new mobility measurement initiatives

New mobility measurement initiatives are influenced by, or directly linked to, the context-specific regulation of these new services. As regulatory approaches in cities and countries are shaped by several factors, so too are different monitoring and measurement initiatives and the data reporting requirements that support them. New mobility services are rarely regulated within a consistent, whole-of-government approach. This is because these services may be assimilated into different existing services, with their own regulatory and monitoring frameworks, or because they are felt to fall far enough out of those existing

frameworks to warrant new regulatory and monitoring mechanisms. This section reviews the link between service-specific regulations and the measurement and monitoring initiatives that underpin public authority understanding and governance of mobility.

Regulatory frameworks shape data reporting and new mobility service monitoring

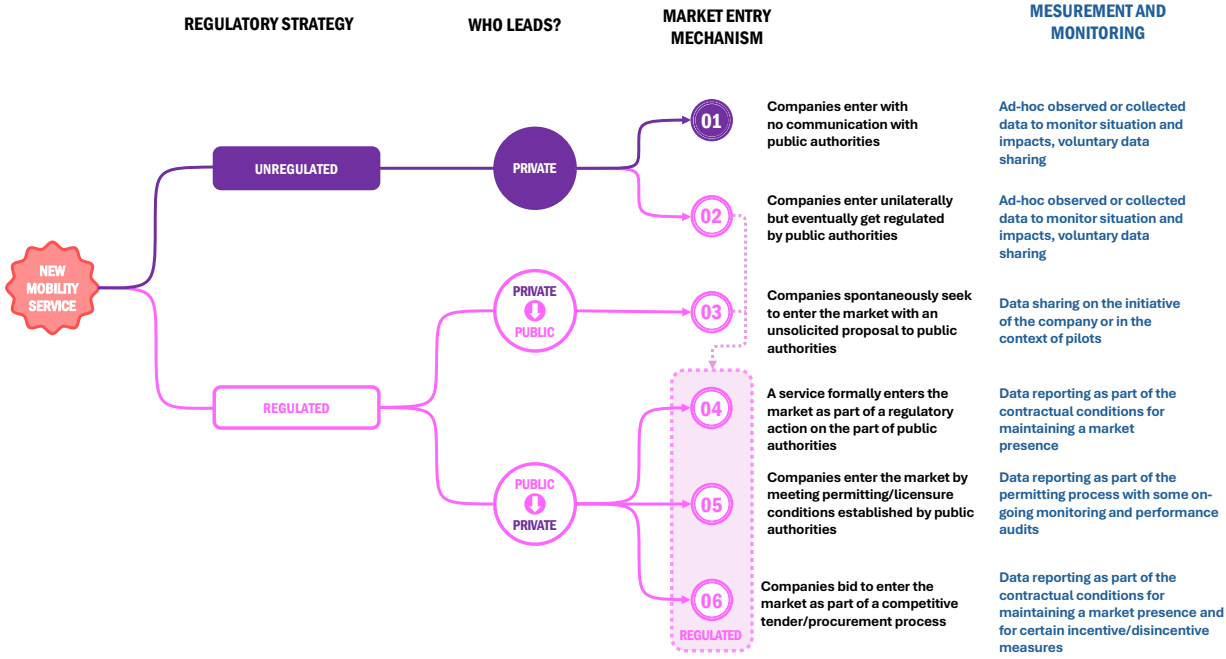
The rapid uptake of new mobility services is testimony to the benefits they confer on people. At the same time, these services often generate unwanted and sometimes unanticipated outcomes with respect to public space use, safety and impacts on society. They are, by their nature, disruptive, not just to people's behaviours, to incumbents, to cities and to society, but also to the governance models and regulatory frameworks that have developed to ensure public welfare outcomes. Public authorities are faced with a number of market entry cases and have at their disposal a number of hard or soft regulatory approaches to ensure that the benefits of these services are maximised and their negative impacts are minimised.

The European Union-funded GECKO project[1] involving a consortium of nine partners, led by the International Association of Public Transport (UITP), addressed these governance challenges across a range of new and disruptive mobility services. The GECKO consortium stresses that: "The governance of the multitude of disruptive mobility innovations is challenging because it is not immediately apparent what are their actual benefits for the society and whether there will be negative externalities that need to be accounted for" (GECKO, 2021). This challenge reinforces the need to measure and monitor these innovations to build the knowledge that will shape the longer-term regulatory framework for these services. GECKO also notes that the regulatory framework may change over time given that experience must be gained regarding not only the real benefits and impacts of new mobility services, but also with consideration to short-term versus long-term regulatory concerns (GECKO, 2021).

When new mobility services are indeed "new" – that is, there is little experience with their benefits and impacts – "soft law" approaches may be best suited to give space for all stakeholders to gain that experience. The OECD describes "soft law" as "co-operation based on instruments that are not legally binding, or whose binding force is somewhat 'weaker' than that of traditional law, such as codes of conduct, guidelines, roadmaps, peer reviews" (OECD, 2020). This contrasts and often precedes the development of "hard law", i.e. regulatory approaches in which public authorities establish rules and regulations that impose requirements on people, businesses and institutions that have legal force (OECD, 2024). Gauging the sufficiency of "soft law" and determining if and when to shift to a "hard law" regulatory framework requires data on the impact of the new services. At the same time, the type of governance approach also determines how and what data is collected regarding those services.

The New Urban Mobility Alliance (NUMO) evaluated how new mobility services entered communities around the world and mapped out typical new mobility market entry mechanisms (Figure 9).

Figure 9. New mobility service market entry pathways and monitoring



Source: Adapted from NUMO (2021).

Looking across a range of representative examples from around the world, the following categories of regulatory approaches emerge:

1. Unregulated, unenforced, or unclear

New mobility services can enter unregulated markets, as many ridesourcing and micromobility companies have done. In these instances, there are no specific regulations about who can and cannot operate this new mobility service, or the existing rules are either unclear or unenforced, resulting in an unregulated market in practice. In some cases, there may be no formal regulation of the market, but several "soft law" approaches may be present, including codes of conduct, guidelines, standards or voluntary self-governance initiatives. Some of these soft law approaches may use fines or vehicle impoundment if they do not meet specific pre-defined standards or general legal requirements to disincentivise unwanted behaviours or outcomes.

In the above instances, public authorities may monitor new services on an ad-hoc basis using data provided by the services themselves, through observation, data already collected by public authorities (crash statistics, enforcement data) and indirect data collection (counts, flows, etc.).

2. Shift from unregulated to regulated

In many instances, an unregulated market may shift to a more formal regulatory pathway – this is explored below in the case of micromobility in Brussels and Stockholm. This shift may involve simultaneously monitoring unregulated services while regulations are being developed. A global survey in 2020-21 of over 40 local public authorities gathering data on shared micromobility services showed that most of them were simultaneously monitoring developments as they were seeking to develop regulations (POLIS, 2021).

3. Governance of trials or pilot projects

Another market entry mechanism for new mobility services is to solicit public authorities to allow a trial application of their service in their jurisdiction. In these cases, a formal regulatory framework may not yet exist but as the public authority holds responsibility granting the request or not, they may set conditions on the new mobility service operator to provide data allowing the trial to be evaluated. This approach is still a "soft law" approach, and any data reporting is conditional to the trial or project itself and not a formal rule imposed for all market participants. In this sense, the data collection is still ad hoc, though more tightly framed by the public authority. This pathway may also convert into a more formal regulatory pathway with specific data reporting requirements imposed by default.

4. Established by regulatory action

In some cases, a new mobility service may be established by the public authority itself in the context of a direct rulemaking. This has been the case with some forms of demand-responsive transport or certain bikeshare systems (and historically, with many forms of public transport). In these cases, the new mobility service is a public asset operated directly by government staff. Performance measurement is carried out by the service operator itself or by another agency of government.

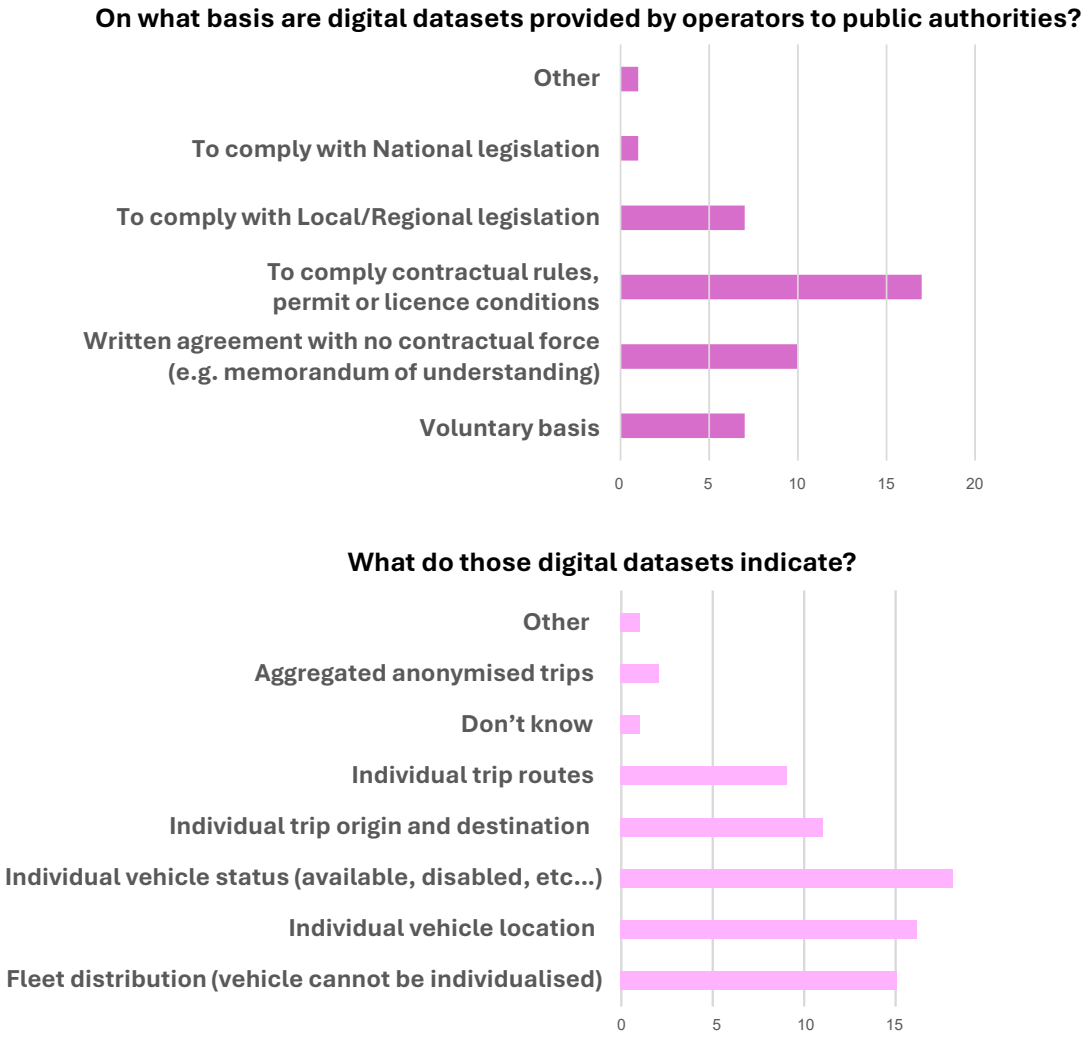
5. Licensure and permitting-based approaches

After the first waves of adoption and as authorities gain more experience with new mobility services, more formal, public authority-led regulatory frameworks tend to emerge – these comprise "hard law" approaches. These can take the form of licence or permit-based market entry regimes. This involves public authorities establishing criteria for gaining the right (in the form of a permit or licence) to offer and operate their services in the market. These criteria may only cover market entry criteria (e.g. registering the operator, meeting liability or other insurance requirements) or may include criteria regarding vehicles, fleets and key performance indicators. The latter may be used to reward operators for meeting or exceeding targets or be used to enforce penalties. For example, Mexico City provides licences to ride-hailing operators in exchange for operating fees if they meet specific vehicle and driver standards. This qualifies as a licensing approach that does not include performance measures. On the other hand, Stockholm offers licences to e-scooter sharing operators with requirements on vehicle condition. However, they also use performance measures related to vehicle activity (e.g. occurrences of illegal parking) to ensure operators are meeting the city's goals for pedestrian safety and accessibility.

6. Competition for the market via procurement and competitive tenders

New mobility services enter the market via a periodic competitive procurement process in which operators apply for a finite number of licences or the right to sign an operating contract. In some instances, procurement processes may be used to select a single service provider to develop and operate a public asset such as a station-based bikesharing system. The licences or contracts are awarded based on criteria set out by the public authority. As with the previous category, the conditions of market entry may only stipulate the provision of basic information regarding the entity competing for the market including its identity and ownership, business plan, financial standing and insurance coverage. Tender-based processes may also specify performance indicators related to day-to-day operating conditions that are used to enforce penalties or offer rewards linked to service quality. Past performance with respect to these indicators may also be used as criteria for the procurement process.

Figure 10. Digital micromobility data collected by public authorities: Basis and attributes



Source: Adapted from POLIS (2021).

A survey undertaken in 2020 by the POLIS network of predominantly European micromobility operators indicated that the most cited basis for providing public authorities with data was to comply with contractual rules, permit or licence conditions (POLIS, 2021). If considered alongside compliance with local, regional and even national regulations, this data reporting pathway largely dominates the sample (Figure 10). "Soft law" data sharing (written agreements, memorandums of understanding, codes of conduct or voluntary reporting) was the second most cited basis for data reporting to authorities – though this may have evolved as many European cities and regions have migrated to more formal "hard law" or contractual data reporting models. These data reporting pathways concern several different shared micromobility-specific attributes (Figure 9) at varying degrees of granularity. As noted previously however, the POLIS report notes that the level of detail these attributes reveal regarding shared micromobility are rarely, if ever, matched by an analogous focus and data collection effort for other, significantly more impactful, modes of travel.

Regulatory frameworks differ by mobility service

A final factor to consider when looking at the link between new mobility service regulation and data measurement, monitoring and reporting initiatives is that the regulation for these services differs according to the type of vehicles used, business models and areas of operation.

When faced with new and oftentimes disruptive services, public authorities may first seek to apply existing regulatory frameworks they have "on hand" or, alternatively, ban the new service. Both reactions were common with the arrival of ridesourcing, with public authorities seeking to either fit these under existing taxi or commercial for hire vehicle services or by banning them outright. Neither approach is optimal in the long term, but the legacy of these approaches is that different public authority departments may inherit responsibility for these modes as well as the impetus to regulate them according to their historical remit.

Likewise, the sudden arrival of shared micromobility led some cities to apply existing regulations designed to manage the use of public rights of way by restaurants and cafés to manage (and charge fees for) micromobility parking. In other cases, new mobility services – micromobility services in particular – were sufficiently new to lead to wholly new governance mechanisms, most often housed in the departments responsible for cycling policy or oversight of municipal station-based bikesharing systems. This inherited legacy, again, shapes what data is collected, for which purpose and by which means.

Five separate categories of new mobility services can be identified based on adoption rates and regulatory interventions:

1. car-based ride-hailing (e.g. Uber, DiDi)
2. mototaxis (e.g. Grab, Gojek)
3. car and moped sharing (e.g. Zipcar, Cityscoot)
4. free-floating micromobility such as e-bikes and e-scooters (e.g. Bolt, Kakao T), including where parking for these is concentrated in hubs or corrals
5. station-based micromobility such as bikes and e-bikes (e.g. Citibike, Ecobici, Velib) that have docking points.

The five services above remain differentiated because they either: a) fall under different regulatory regimes, such as ridesourcing and micromobility; or b) benefit from different performance indicators due to their vehicular or operating characteristics. Other new mobility services, such as ridepooling and microtransit, were not included due to limited adoption or a lack of formal performance measurement programmes.

1. Governance principles and mEthods enabling deCisions maKers to manage and regulate the changing mObility systems

New mobility service measurement in practice

Many cities and regions around the world have sought to respond to and accommodate the deployment and uptake of new mobility services in a way that benefits their inhabitants. The case studies below review how public authorities have done so, highlighting key challenges as well as good practice where relevant.

A scan of relevant literature was conducted to collect information and learn from experiences. One of the main sources was the last survey conducted by POLIS on the regulation of shared micromobility. Additionally, interviews with city officials and outside experts involved in the oversight of new mobility services in medium and large cities in North America, Europe, Latin America and Asia provided first-hand knowledge. Finally, discussions with staff at several new mobility operators and leading third-party data aggregators contributed to understanding the perspectives of these key stakeholders on effective new mobility performance measurement. Collectively, these efforts provide a well-rounded, qualitative overview of practical insights towards measuring and managing new mobility services. The case studies that follow reference the population size of the Functional Urban Area (FUA - a measure of the commuting basin for any given city) to give an indication of the size of the urban area under consideration. FUAs extend beyond administrative boundaries and many of the regulations discussed below only apply to the core administrative area of the FUA.

Antwerp, Belgium

Focus on micromobility, MaaS
FUA population: 1.1 million

The first commercially shared free-floating micromobility services arrived in Antwerp in 2018 and proved to be very popular with inhabitants, including the relatively large student population. The arrival of these services complemented the shared mobility offers already present in the city, namely a public, station-based bikeshare system and carsharing services. The city quickly recognised the challenges that the uptake of free-floating fleets would pose, especially in the historic city centre, and introduced regulations to channel their use. These rules included a requirement to obtain a licence to operate from the city and an obligation for operators to deploy no more than 30% of their fleet in the city centre to limit nuisances and to favour use of e-scooters in outer districts. By 2021, Antwerp had twice iterated its micromobility regulations. The city has identified several “no-go” and “no-park” zones in the centre and has established physical and virtual hubs for use by shared e-scooters, e-cargo bikes, e-bikes and e-mopeds.

Antwerp initially levied a system of financial penalties based on a penalty point system. This was hoped to be a flexible mechanism to disincentivise poor parking and use. The ability to levy financial penalties ran into legal challenges and, in the end, the city reverted to two principal, non-financial, penalties linked to their power of licensure. The first was simply to revoke operator licences in response to documented poor behaviour or performance as outlined in the terms of the licence. The second was to impose fleet size reductions in response to documented poor behaviour or performance on the part of operators. The threshold for triggering these actions is based on the penalty point system with clear and transparent criteria and weighting of sanctionable behaviours and performance. Operator performance is evaluated every three months. The introduction of penalty point enforcement was graduated with warnings issued before the first enforcement actions were undertaken.

High quality data is the cornerstone for the city's monitoring and enforcement efforts. The data are collected directly from operators as part of their terms of licensure and are provided in digital format (e.g. mobility data specification (MDS) for micromobility data) to be compatible with the city's data dashboard. Some of the data is provided in near-real time allowing the city to monitor key performance indicators (e.g. location of vehicles with respect to no-park zones, fleet availability, etc.) and quickly alert operators to the need to take corrective action. The reliance of Global Navigation Satellite System (GNSS)-dependent positioning to detect and trigger enforcement actions has proven sometimes problematic due to the low accuracy of some operators' GNSS and the different ways in which geofenced zones are defined by public authorities (polygons) and implemented by some operators (points and buffer zones). This has led to situations where operators have contested some of the penalty points attributed to their services.

Antwerp has implemented a mobility as a service (MaaS) application ("Slim naar Antwerpen", Smart Ways to Antwerp) that combines all available shared mobility services, including public transport. Further, the issuance of licences for free-floating services (e.g. shared bikes, shared mopeds and shared e-scooters) and carsharing operators is conditional to the integration of the transport services with at least three local MaaS providers. Additional provisions require free-floating and carsharing operators to "make their data available to MaaS providers and to open their booking and payment features to at least three active MaaS providers in Antwerp". These regulations entered into forced in April 2021 and March 2022 respectively.

Sources: Interview, ITF (2024a); POLIS (2023).

Berlin, Germany

Focus on micromobility, MaaS
FUA population: 4.9 million

Soon after e-scooters were made legal in Germany via the Small Electric Vehicle Regulation (eKFV) in June 2019, free-floating shared e-scooter operators started deploying their vehicles in Berlin, complementing an existing offer of shared bicycles. From the outset, the deployment of commercial free-floating micromobility fleets entered a legislatively ambiguous environment. The eKFV set out technical guidance regarding road-legal e-scooters and imposed a requirement for e-scooter licence plates but did not stipulate the obligations that shared e-scooter operators would face to have a legal right to operate on public roads. At the federal level, the two main pieces of legislation covering all forms of road transport and establishing traffic laws applicable to all regions and cities (the Federal Law on Road Transport [*Straßenverkehrsgese*tz or StVG] and the Federal Regulation on Road Traffic [*Straßenverkehrsordnung* or StVO]) contain some grounds for requiring operational permits for events or vehicles that exceed normal road usage. The city-state of Berlin tried to invoke a federal responsibility for licensing free-floating vehicles under the StVO but failed.

The different German states (*Länder*) also have significant regulatory authority over public rights-of-way via their respective road laws (*Straßengesetze der Länder*). These laws stipulate the classification of public roads and the uses to which those roads may be put (*Gemeingebrauch*). The tension between federal and state levels emerges from the former establishing norms for traffic rules and behaviours and the latter establishing authorised road uses, including in cities. Under prevailing *Gemeingebrauch*, states may determine that a simple memorandum of understanding is sufficient to start providing free-floating e-scooter services. Alternatively, state authorities may intervene and require special use permits (*Sondernutzungserlaubnis*) when they believe the use of a road exceeds the publicly defined purpose for that road. Such permits are required for on-street or pavement outdoor dining, street signs, street vendors and micromobility services – if the state so chooses. The role of states in setting conditions for the special

use of roads has led to fragmentation in micromobility regulation across Germany. This fragmentation is exacerbated by the fact that some states establish their free-floating e-scooter permitting frameworks on the basis of prior court rulings which concerned bike rental systems instead of the very different free-floating e-scooter services.

Determining the criteria for special permits is the prerogative of each state and is subordinate to the Federal StVG and StVO. In particular, the latter forbid cities or states from including any criteria not relating to traffic fluidity or safety in their licensing or public use statutes, unless they undergo a more complicated and time-consuming strategic framing process. This means that cities or states cannot make permits conditional to environmental or social outcomes. The strategic framing process involves establishing a holistic concept for the insertion of free-floating micromobility services into the overall mobility ecosystem and setting up specific non-traffic fluidity or safety criteria for attributing permits. These additional bureaucratic hurdles have meant that many cities (or states) choose not to include such criteria in their permitting processes.

The Berlin Road Act categorises free-floating e-scooter, bike-sharing and carsharing services as special use of road land for which a *Sondernutzungserlaubnis* permit is required. This act, initially amended in 2021, addressed the rapid growth of free-floating e-scooters and increasing public space use conflicts. The amended Act also addressed the unbalanced distribution of vehicles between the densely served central areas and the sparsely served periphery. The Act establishes the legal basis for the collection of fees from operators, assigning specific parking areas and limiting fleet size. E-scooter parking was found to be particularly problematic with a study by the German Pedestrian Lobby Association finding that two-thirds of e-scooters were incorrectly parked (or fallen over) in sampled areas (Carey, 2023b). A further amendment to the Road Act in November 2023 outlined more stringent data reporting obligations for operators and established the legal basis for the use of this digital data to ensure compliance with the terms of operator licences. Operators have had to re-apply for permits under the new terms.

Figure 11. A multi-modal “Jelbi Station” in Berlin

Source: Gesobau (n.d).

Using data collected and other sources of information, the city has established further "no parking" zones while at the same time creating more e-scooter and bicycle parking corrals and dedicated drop-off zones. As of March 2024, the city has also reduced the number of e-scooters allowed to operate in the city centre from 24 000 to 19 000. Data collected from operators feeds into a city micromobility dashboard (operated by a data integrator), similar to Antwerp's, which enables the city to proactively manage micromobility.

In parallel, the Berlin Public Transport Authority (BVG) has developed a city-wide MaaS application, "Jelbi", which brings together real-time traffic information, service offerings, availability, and integrated booking and payment. As of 2024, Jelbi is the largest MaaS service in Europe (with 25 service providers) and one of the largest in the world. All new mobility service providers are present in Jelbi and the uniform data sharing environment within the app has fostered greater interoperability amongst the services. BVG has rolled out a series of hubs ("Jelbi Stations") represented virtually within the Jelbi app, as well as in dedicated parking areas that are linked to public transport and other popular destinations (see Figure 11).

Sources: Interview; POLIS (2023); Carey (2023b); Deutscher Städtetag (2023); DB and Dekra Digital (2021); Musa (2023).

Brussels, Belgium

Focus on micromobility
FUA population: 3.3 million

Free-floating bicycle services arrived in Brussels in 2017, soon followed by free-floating e-scooter fleets in October 2018. Acting rapidly, the Region issued its first "Cycle Sharing Ordinance" ("*Ordonnance relative à l'utilisation de modes de transport partagés en flotte libre alternatifs à l'automobile*" Brussels Capital Region, 2018), covering shared bicycles, e-scooters and moped-sharing, but not the public station-based shared bike fleet which was operated under a separate multi-year concession from November 2018. This was followed by the application decree in January 2019, entering into effect in February 2019 – a short five months after the arrival of the first free-floating e-scooter fleets.

Brussels Mobility, the transport authority for the Brussels Capital Region initially adopted a light-touch approach to see what these services could bring to the city and to the delivery of its sustainable urban mobility plan "Good Move". The initial Cycle Sharing Ordinance and Decree established a licence-based approach without restrictions on the number of operators who could enter the market so long as they abided by the licence conditions.

These conditions were split into two principal areas: those necessary to obtain the licence and those relating to operating conditions. The former included the following:

- technical characteristics of the vehicles
- technical requirements for vehicles (no combustion engines)
- data reporting obligations including
    - real-time reporting of the number of available vehicles
    - quarterly reporting of aggregate trip data (number of users, number of trips, number of vehicles)
    - a commitment to share data with regional MaaS applications and open data streams when these do not involve exposing personal data
- sufficient insurance coverage
- no advertising (except for sponsors)
- renewable electricity sourcing for vehicle charging

- full respect of the personal privacy provisions of the EU General Data Protection Directive (GDPR)
- a commitment to participate in customer satisfaction surveys.

The Ordinance and Decree also stipulated several operational conditions:

- application interfaces and customer-facing communication should be in Dutch, French and English
- operator fleets must respect geofenced no-parking zones and are incentivised to use designated drop zones where these are present
- vehicles should not be unavailable for more than five days
- operators must respect a 24-hour maximum delay to address issues reported to them or face rapidly increasing penalties, licence suspension or outright withdrawal of the licence.

The Ordinance and its application decree also gave Brussels Mobility, in consultation with local councils, the right to cap individual operator fleets or overall fleet numbers in determined areas as well as impose minimum operator performance obligations (i.e. vehicle turnover rates).

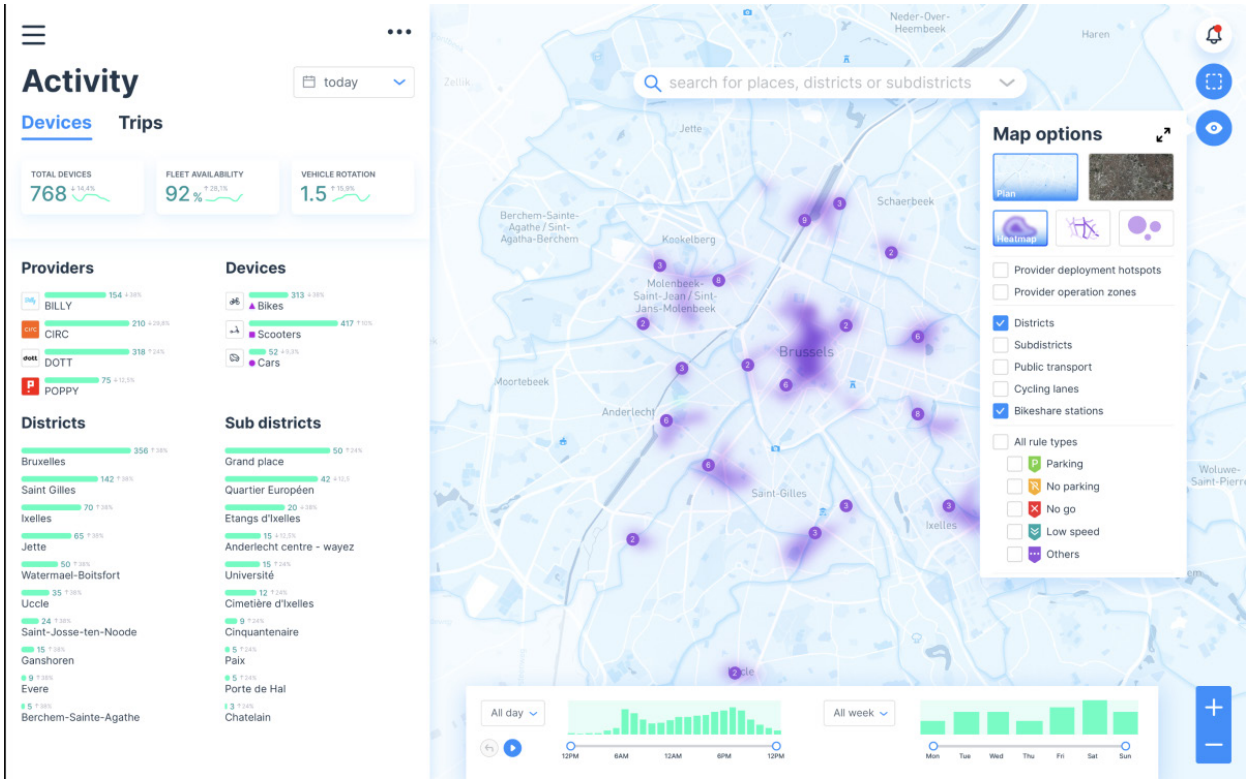
Several operators entered Brussels under these conditions and fleet numbers quickly rose up to over 23 000 e-scooters (not including free-floating e-bikes). Under pressure from inhabitants to address scooter parking and to limit impacts on public space, Brussels Mobility announced in 2022 that the current open licence system would be revisited and, in its place, a limited number of concessioned slots would be open for tender in a revision to the application decree of the 2018 Ordinance. The revised decree was issued in July 2023 and a call for tender was issued for all free-floating micromobility services. The call fixed two slots for free-floating e-scooter fleets for up to 4 000 vehicles for each operator, three slots for shared bikes for up to 2 500 bikes for each operator, two slots for e-moped sharing for up to 300 mopeds for each operator and two slots for shared cargo bikes for up to 150 vehicles for each operator. Brussels Mobility set out expanded data reporting requirements in the tender and specified that all operators must report this data digitally using either the Mobility Data Specification, version 2.0 (MDS 2.0) or the General Bike Feed Specification, version 2.3 (GBFS 2.3). The procurement process was also accompanied by an accelerated roll-out of dropzones by the city and as selected operators would face a firm obligation to park free-floating scooters, e-bikes, e-mopeds and cargo bikes within those zones. As in Antwerp, differences in the way in which dropzones were specified by Brussels Mobility and implemented by operators, coupled with differences in GNSS sensor accuracy across micromobility operator fleets has complicated efforts to maximise the benefits of more proactive parking policies.

Operators holding existing licences brought a legal challenge to the procurement decision following the selection of the winning bids in December 2023 on the grounds that their licences could not be revoked and should be allowed to run their course until their expiry. A ruling allowed those operators to remain in the market though they reduced their fleet. As of mid-2024, about 12 000 e-scooters were still in operation in Brussels with incumbents and concessioned services operating under slightly different rules and data-reporting obligations.

Brussel Mobility uses a third-party data aggregator to centralise data collection and management and to provide a real-time dashboard enabling Brussels Mobility to monitor activity, identify issues, ensure compliance and, if needed, initiate enforcement actions (see Figure 12).

Source: ITF (2024a); Interview; Beroud et al.,(2024); Chini (2024); Lefrancq (2019a, 2019b); Keane (2023); POLIS (2023).

Figure 12. Brussels micromobility dashboard operated by Vianova



Source: Vianova (2024).

Los Angeles, United States

Focus on micromobility, carsharing and equity
FUA population: 17.7 million

In 2016, the Los Angeles Department of Transportation (LADOT) issued "Urban Mobility in a Digital Age", a report and strategic plan that set out the key challenges digitalisation posed for transport in Los Angeles and charted out a comprehensive strategy to address those challenges. The report highlighted the importance of data collection by public authorities to achieve LADOT's objectives and deliver better transport outcomes for inhabitants. Equity, alongside safety and efficiency, was one of the key outcomes LADOT sought to improve with the strategic plan and related actions.

In November 2017, the first commercially deployed e-scooter services arrived on Los Angeles's streets before an appropriate regulatory framework governing their deployment was in place. These services proved to very popular with residents but posed important challenges including cluttering public spaces and distribution patterns that disfavoured underprivileged neighbourhoods.

After initially banning these services in March 2018, LADOT established a one-year "Dockless Vehicle Pilot Program" in April 2019 that set out governing rules for shared micromobility. This programme was updated and made permanent in March 2021 and renamed the "On-Demand Mobility Permit Program". A key element of both programmes was the inclusion of a set of initiatives to ensure equitable access to and coverage of shared micromobility services. Monitoring these equity outcomes required a comprehensive data reporting structure put in place by LADOT.

Establishing an equity-focused micromobility framework required categorising different Los Angeles neighbourhoods into mobility-equity relevant categories. After initially using State of California boundaries for disadvantaged communities, LADOT created its own set of categories that more closely mapped to local neighbourhoods and included specific mobility-related characteristics (see Table 2).

Table 2. Los Angeles's on-demand mobility programme geographies and per-vehicle fee structure

Geography	Description	Fee applicability	Per trip fee
Mobility Development Districts (MDD)	Neighbourhoods where people, on average, travel for short periods, have access to comfortable bicycle infrastructure and high-frequency transit, and have a lower rate of crashes.	Trips that end in a Mobility Development District	USD 0.25
Equity-Focus Mobility Development Districts (EFMDD)	Neighbourhoods that meet the same criteria as Mobility Development Districts but where many households also experience economic hardship due to living in poverty, overcrowded housing, high rates of unemployment and low educational attainment.	Trips that end in the Equity Focus Mobility Development District	USD 0.00
Standard Permitted Zones (SPZ)	Neighbourhoods where people take longer trips on average, have less access to physically separated bicycle infrastructure, are not served by high-frequency transit, and where more crashes occur.	Trips that end in the Standard Permitted District	USD 0.50
Special Operation Zones (SOZ)	Neighbourhoods where specific rules are necessary due to high on-demand mobility demands within finite boundaries, an oversaturation of deployed devices, or specific geographic characteristics that prohibit dockless devices.	Trips that end in the Special Operations Zone	USD 0.75

Sources: LADOT (2024c, 2021); Cheung et al. (2023).

These geographies were then used to set different per-vehicle fees for operators to incentivise greater ridership in underprivileged zones and disincentivise trips stopping in saturated districts or ridership in areas less adapted to e-scooter use. In addition to these fees, LADOT set a fine and penalty point system for operator non-compliance with programme rules. These requirements helped counter the tendency for operators to focus only on high-demand zones and led to a better distribution vehicles and improved equity outcomes. The latter, however, have plateaued below where LADOT would have liked and additional policies to improve equity outcomes have been deployed or are under consideration. These include an updated fee schedule (reflected in Table 2) and a multi-action comprehensive Universal Basic Mobility (UBM) initiative seeking to eliminate "functional and/or structural immobility people experience due to systemic marginalization, cost burdens, and other forms of exclusion" (LADOT, 2024c). The UBM initiative includes equity-based outcomes for BlueLA, the city's carsharing programme, to ensure service availability in disadvantaged neighbourhoods and accessible pricing. UBM also includes a provision for a Mobility Wallet transport subsidy pilot available to qualifying low-income households. The Mobility Wallet pilot provides a monthly, pre-paid, balance that participants can use to pay for their mobility needs including public transport, ridesourcing, taxis, shared micromobility and certain purchases in bicycle shops.

Underpinning all of LADOT's initiatives to improve equitable outcomes in the use of new mobility services is the comprehensive data reporting framework pioneered by the city and that has since evolved into the Mobility Data Specification – a global open-source standard for sharing data between mobility service operators and public authorities (OMF, 2024) (see Box 3).

Sources: Interview; LADOT (2024a, 2024b, 2024c, 2022, 2021, 2020, 2016); OMF (2024); Cheung et al. (2023).

Manila, Philippines

Focus on ridesourcing
FUA population: 24.1 million

The Philippines was one of the first countries to adopt national legislation for ride-sourcing services using passenger cars in 2015. Several operators, including Uber and Grab, competed for riders. Ultimately, these platforms became so popular that the government decided to stop accepting new driver applications, effectively putting a cap on the number of active vehicles.

Several years later, in 2019, app-based moto-taxi platforms were formally introduced in Manila as part of a six-month government-sponsored pilot programme. Like many cities, Manila cut public transport services during the Covid-19 pandemic, leaving moto-taxis as one of the few available modes for many essential trips. Their popularity boomed as a result and moto-taxi platforms have now become an everyday part of the transport system in Manila, with over 50 000 active riders across three platforms. These services are seen as a convenient mode for accessing transit stations and an important source of employment in the city. There are also concerns about safety, but data are not yet available because crash reports do not differentiate between moto-taxis and private motorcycles.

The pilot programme has been extended several times and remains active in 2024. Outside of the pilot programme, however, there is no law recognising moto-taxis as a form of commercial transport. New operators wishing to enter the market must therefore wait until the pilot is complete. Moreover, the current regulatory limbo makes it quite difficult to adapt existing data collection, performance measurement and policy development efforts to reflect the prominent role of moto-taxis in Manila today.

Source: Interview.

Mexico City, Mexico

Focus on micromobility, ridesourcing
FUA population: 20.5 million

One of the largest urban areas in the world, Mexico City, suffers from extreme roadway congestion in the city centre. In 2011, the city introduced the popular EcoBici bikeshare system to combat congestion and the environmental externalities of driving. The system began as a public venture operated by the city, then, in 2019, the city partnered with a private company to finance and manage the renewal and expansion of the system. The private operator provides anonymised trip data to the city as part of their licensing conditions. The city uses these data to monitor service quality, identify rebalancing needs and inform long-term transport planning. A team of four people manages the overall programme.

Several e-scooter platforms were available in Mexico City, but operations were suspended in the wake of the Covid-19 pandemic and have yet to return. Initially, the operators were each granted licences by the city in 2019 based on new regulations that were introduced following an e-scooter and dockless bike pilot

project. The licences require operators to adhere to technical vehicle standards and to provide monthly aggregate data related to utilisation and safety. Operators have recently expressed interest in reintroducing e-scooters to Mexico City. Still, the city has yet to grant any new licences, citing concerns about road safety. One dockless bikesharing operator (Dezba) continues to operate in the city centre, subject to the same regulatory programmes as e-scooter sharing platforms.

Regulations for ride-hailing platforms were updated in 2023 to ensure that vehicles meet standards related to road safety, passenger safety, accessible features and tailpipe emissions. However, platforms remain reluctant to provide data to the city, limiting efforts to introduce performance measurement based on day-to-day activities.

Source: Interview.

New York City, United States

Focus on ridesourcing
FUA population: 20.1 million

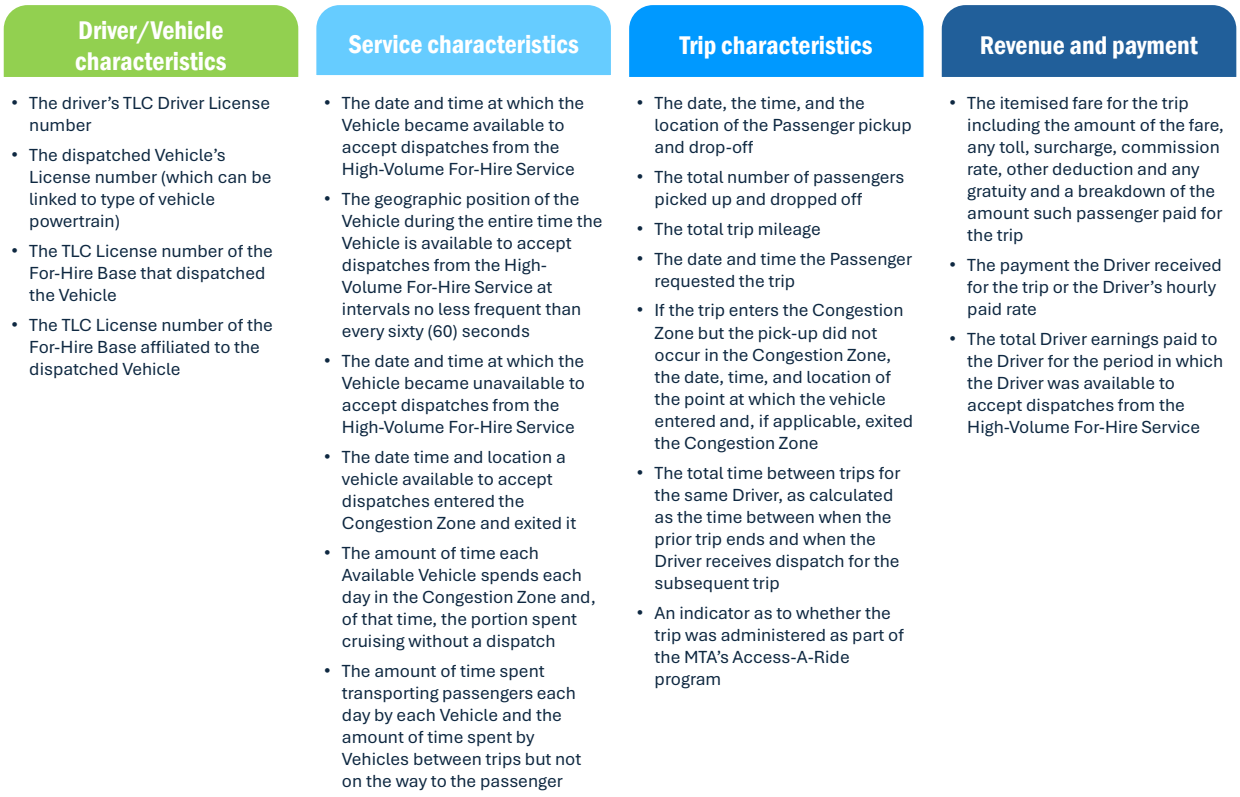
New York City is a major market for app-based shared mobility with ridesourcing and shared bicycle services complementing an extensive public transport network along with taxi and other for-hire vehicle services (FHV). The city has sought to leverage data from these services to better manage public space, improve safety, reduce congestion and environmental impacts, and ensure fair working conditions for drivers.

The arrival of ridesourcing services proved to be a major disruption to existing taxi services. From 2014 to 2017, the number of trips performed by FHVs increased by 46% (Atkinson-Palombo, Varone and Garrick, 2019) and now app-based FHVs outnumber taxis eight to one (TLC, 2024). The arrival of app-based ridesourcing services has displaced taxis in Manhattan and in the surrounding boroughs and has had an impact on semi-formal jitney van services ("dollar" vans). All the latter services fall under the regulatory authority of the New York City Taxi and Limousine Commission (TLC) that licenses FHV services, sets and enforces fares, ensures driver working conditions, regulates taxi lease rates and oversees the sale of taxi medallions. App-based ridesourcing services were rapidly assimilated into the existing regulatory framework governing FHVs and thus quickly came under the jurisdiction of the TLC.

In 2014, the TLC imposed extensive data reporting rules on FHV services to better understand and balance the benefits these services bring to travellers with the negative impacts they sometimes impose on citizens. New York was a pioneer in establishing robust data reporting requirements for FHV services, including app-based ridesourcing, and is still one of the few jurisdictions requiring extensive data reporting from the sector (other jurisdictions include Chicago, the State of Massachusetts and China).

The New York TLC makes a regulatory distinction between different taxi services (Yellow Taxis in Manhattan and Green Cabs in the surrounding boroughs), high-volume app-based FHV services and other FHV services. High volume app-based FHV services are those that generate more than 10 000 trips per day under a single brand. There are currently four licensed high-volume FHV services in New York City – Juno, Via, Uber and Lyft – with the last two dominating the market. High-volume app-based ridesourcing companies must report multiple specific data points for every trip they carry out providing a rich base on which to measure and monitor FHV performance with respect to identified policy outcomes (see Figure 13). These data must be reported to the TLC on either a monthly or bi-weekly basis according to the type of data and must be provided in a format, layout and procedure prescribed by the TLC.

Figure 13. New York TLC data reporting requirements for high-volume for-hire vehicle services



Source: Based on TLC (2021).

These data have helped the city address concerns regarding the contribution of FHVs to congestion (via the calculation and imposition of a congestion surcharge currently set at USD 2.75 per trip within the designated Congestion Zone) and driver working conditions (through the imposition of a minimum driver take-home wage).

Sources: NYC (2024); TLC (2021, 2022a, 2022b, 2024); Wang, Du and Lee (2024).

Providence (Rhode Island), United States

Focus on micromobility, carsharing
FUA population: 1.0 million

The primary objective of Providence's micromobility regulations is to ensure that the system is operated safely and equitably. To accomplish these objectives the city created a set of regulations and performance criteria for a competitive procurement process. Operators were then invited to submit applications and the winners were given the right to negotiate a one-year contract, with the city dictating the terms of operation, including data-sharing requirements. The city also retains the option to extend the contract by one additional year if satisfied with the operator. The city uses a third-party mobility data service to calculate day-to-day performance indicators. These indicators include the share of trip starts in each district of the city to ensure equitable geographic distribution and the number of improper parking occurrences to measure safety and accessibility outcomes. Operators who demonstrate excellent

performance are offered discounts on fees, while those who do not comply with minimum standards are subject to fines.

While the competitive procurement process took several months from start to finish, it provided the regulators with an effective tool for performance measurement. The city also set up an internal working group with staff from the sustainability, public works, legal and accessibility teams to discuss cross-departmental micromobility-related concerns. Regular meetings between the operators and city staff directly responsible for oversight allowed both sides the opportunity to identify and address potential issues early on.

Providence also has one carsharing platform, Zipcar, which has been operating in the city for over a decade. The terms of the contract for carsharing are quite different than those signed by micromobility operators. For example, no data sharing is required. Under the carsharing contract, the operator provides signage for parking spaces and the city installs them to create a network of designated parking spaces for carsharing vehicles.

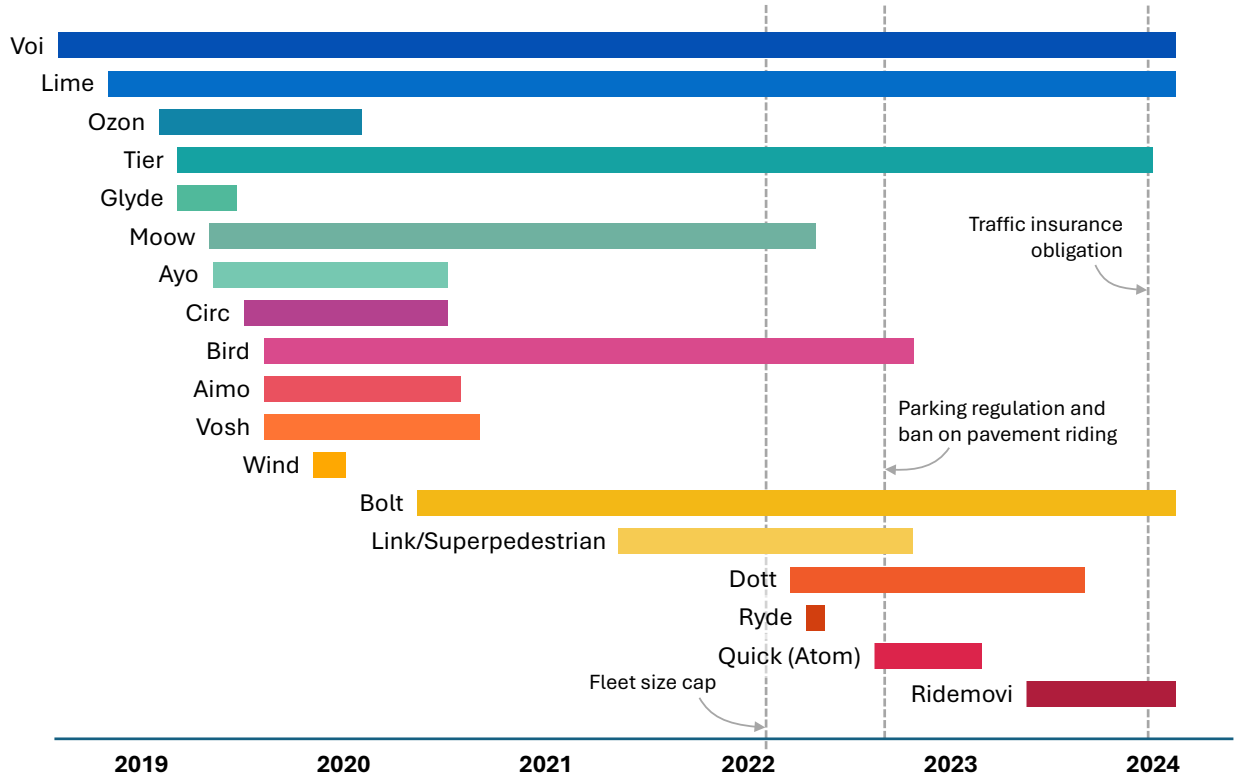
Source: Interview

Stockholm, Sweden

Focus on micromobility
FUA population: 2.4 million

Stockholm first established a public station-based bikeshare programme in 2006 that remained until a court challenge revoked the procurement process put in place to renew the bikeshare service in 2018. A first free-floating bikeshare operator arrived in 2017, followed a year later by another as well as the first free-floating e-scooter fleet. With no market entry rules or restrictions, e-scooter operators rushed to establish their services in the city and within a year, eleven operators were present, leading to an increase in fleet numbers that peaked in 2021 at over 24 000 vehicles. Over time, eighteen different free-floating e-scooter operators have offered services in Stockholm (Figure 14).

Figure 14. Shared free-floating e-scooter operators present in Stockholm from 2018-2024



Source: Based on Wincent (2024).

Part of the difficulty the city faced in establishing early regulations for e-scooters was that according to the Swedish National Transport Administration, e-scooters must be treated the same as bicycles under Swedish law. This meant that actions targeting the use of e-scooters would also apply to bicycles (e.g. parking requirements) and that actions targeting e-scooter services would also apply to bikesharing services. For these reasons, and to give all stakeholders time to familiarise themselves with these services, the city of Stockholm and e-scooter operators jointly negotiated a voluntary agreement to help frame the use of free-floating e-scooters in the city. This code of conduct proved to be insufficient to address certain recurring issues, in particular the use and parking of e-scooters on pavements.

Following the COVID-19 pandemic, several e-scooter operators left the market and the remaining operators introduced new e-scooter models with swappable batteries. This led to a change in the operations profile of the services with e-scooters no longer being picked up nightly and redistributed after warehouse charging. This meant that e-scooters remained in public spaces longer – including when they were badly parked – and operators no longer intervened as frequently to ensure their compliance with the voluntary code.

In September 2020, the city started collecting vehicle and trip data from operators via a third-party data aggregator. In February 2022, the city implemented a permitting system associated with an overall fleet cap of 12 000 e-scooters. These permits were based on an existing police permit system which establishes rights for entities to operate in public spaces, as well as a land use permit (*markupplåtelse*) from the municipality granting operators the right to use public space under certain municipality-defined conditions. Eight operators were granted operating permits allowing each to deploy up to 1 500 vehicles.

The permitting system also allowed the city to charge an annual fee for each e-scooter. Following the creation of the permitting system and the fleet cap, Stockholm introduced a ban on pavement riding as well as an obligation to use designated dropzones ("hotspots"). This was soon followed by analogous national legislation forbidding riding and parking on pavements and requiring e-scooters to be parked in stands or designated areas. As of 2024, the city has created over 700 dedicated e-scooter parking corrals and shared e-scooters can also be parked at bike stands. In central Stockholm, there are an additional 100 parking places at operator-deployed e-scooter stands.

As part of the permit conditions, operators are required to submit trip data and vehicle data to a third-party mobility data service using the Mobility Data Specification (MDS). The data service provider calculates several performance indicators that are used to detect noncompliance and other issues in near real-time and to evaluate the performance of each operator during the licence renewal period. Utilisation indicators may also be used in the future to determine the appropriate fleet size for each operator. This exchange of information goes in both directions; the city uses the MDS Policy API to designate to operators the boundaries of low-speed zones. A core team of three people, collaborating with staff in other departments, manages the micromobility programme.

Improper parking has two major concerns for the city. While location data are available through MDS, enforcement is carried out by parking officers. The officers have the authority to relocate vehicles parked outside designated parking areas and issue fines for each occurrence. Vehicles that are parked well beyond the designated parking areas are impounded and subject to an even larger fee for retrieval. These incentives have proven to be quite effective in improving compliance with parking regulations and reducing complaints from residents.

Sources: Interview, POLIS (2023); Kythreotis (2024); Gummeson (2023); Faxér and Olsson (2020); Anderson (2022); Stockholms stad (2022, 2024); Wincent, Jenelius and Burghout (2023); Wincent (2024).

Tel Aviv-Yafo, Israel

Focus on micromobility, carsharing
FUA: 3.0 million

Management of new mobility in Tel Aviv-Yafo has evolved to meet the needs of residents. After an initial oversupply of e-scooters, the city introduced an annual tendering process for operating licences. Operators must share real-time and historical data with public authorities as a condition of the licence. Data from operators is first processed by a third-party mobility data service provider retained by the city. The processed data are the basis for a robust performance measurement programme now used to enforce safety regulations and inform policy making. The public authority is also exploring opportunities to make anonymised new mobility data available to the public.

Historical new mobility data play an essential role in planning active mobility infrastructure across the city. By reviewing the trip volumes on each block, planners can identify corridors where bicycle and micromobility lanes would improve safety. Trip destinations are regularly examined to determine the appropriate capacity and location of designated e-scooter parking zones. In a rather innovative application, planners also use e-scooter trip counts to complement private vehicle traffic counts. Because the e-scooter data have full spatial and temporal coverage, they can be used to infer trip rates for passenger cars and private micromobility vehicles in nearby areas where traditional traffic counts have not been conducted or during periods when traffic counts are not available.

Authorities also use real-time data to ensure that the platform operators have implemented fleet size, speed and parking restrictions. The data submitted by operators are validated by field surveys and reviewed on a regular basis. While specific thresholds for performance measures have not been introduced, infractions are discussed with operators and reviewed as part of the annual tendering process. One of the main challenges with leveraging real-time data for safety applications is limited positional accuracy. Regulators had initially hoped that vehicles could be automatically prohibited from operating on sidewalks. However, they found that the positional accuracy of on-board sensors was not sufficient to distinguish between sidewalks and adjacent travel lanes. Pilot projects to introduce more accurate onboard sensors are under consideration.

Other new mobility services are active in Tel Aviv-Yafo. A city-owned docked bikeshare platform with pedal and electric bicycles has seen intense competition from e-scooters but remains a part of the transport system. AutoTel is a joint private-municipal free-floating carsharing platform that can be booked by the minute for trips that end within the city limits. GoTo Global and Shlomo Sixt also offer temporary access to passenger cars and delivery vans. These new mobility services contribute to a sustainable transport system but are subject to different regulations and performance management than shared e-scooter services.

Source: Interview.

Outcomes and benefits

New mobility data collection initiatives and performance management programmes have proven to be useful in maximising the positive social and environmental effects of new mobility. Spatial distribution requirements or incentives like those in place in Antwerp, Baltimore, Berlin, Brussels, Chicago, Los Angeles, Providence and Vienna (OMF, 2021) are an example of how performance management can promote equitable mobility access across an urban area. Authorities can also encourage co-modality by incentivising or requiring operators to deploy micromobility near public transport stations to increase first-last mile access as they do in Alexandria (Virginia, United States), Berlin, Bologna, Vienna and the Flanders Region in Belgium. Innovative applications of new mobility data are emerging providing yet more social benefits. For example, the use of real-time vehicle speed data from Kakao Mobility, the leading taxi-hailing platform in the Republic of Korea, enables dynamic travel time estimates on roadside signs and provides helpful information to drivers.

Data sharing and performance indicators evaluated on a regular basis can inform infrastructure planning decisions. Mexico City has used new mobility performance indicators to prioritise new bikeshare station locations during the recent significant expansion of the city's EcoBici docked bikesharing system. The City of Sacramento reviews precise trip data alongside complaints of illegal parking to determine where to expand new mobility parking zones (City of Sacramento, 2020). Similarly, new mobility trip data are an essential component of bicycle track and parking planning in many cities including Baltimore, Berlin, Brussels, Lyon, Portland, Stockholm and Tel Aviv-Yafo. Planners even use trip data to optimise the direction and design of the new lanes to match demand. In Sligo, Ireland, data from new mobility operator Bolt were used to demonstrate the demand for new bike lanes in a successful application for infrastructure funding from the national government.

Performance management programmes can also be operationalised to limit the negative impacts of new mobility. For example, Stockholm, Tel Aviv-Yafo, and many other cities have used data to enforce and adjust fleet sizes to match demand and avoid overcrowded public spaces. Chicago and Los Angeles have both used new mobility data to enforce restrictions on e-scooter use in busy pedestrian areas (City of

Chicago, 2021; LADOT, 2020). Los Angeles enacted a prohibition on bike and e-scooter use on Venice Boardwalk, then used their performance management data to ensure that operators were compliant. As a result, daily trips in the prohibited area dropped from 270 to 15 and public complaints decreased by 30% (LADOT, 2020). New York City uses real-time data provided by ride-hailing operators to check that drivers do not become fatigued by exceeding limits on total working hours within a given period (Hawkins, 2016).

These examples illustrate the benefits of performance management programmes in managing ongoing concerns about new mobility operations. However, new urban mobility challenges are constantly emerging. When productive data-sharing relationships exist between new mobility services and public authorities, new mobility data can be applied in creative ways to understand these challenges and design evidence-based policy reforms. Box 4 presents the experience of how Kakao Mobility has been used to this end in the Republic of Korea.

Box 4. How Kakao Mobility has informed innovative policy making

Kakao Mobility, the leading taxi-hailing platform in the Republic of Korea, has collaborated with public authorities on three innovative projects to address the needs of residents.

1. The resumption of economic activity and mobility after the Covid-19 pandemic led to a surge in the demand for travel, especially during peak periods and late in the evening. The supply of taxis did not increase as quickly as demand and customers became frustrated by long waiting times and unfulfilled trips. The Ministry of Land, Infrastructure and Transport (MOLIT) collaborated with Kakao Mobility to analyse taxi market dynamics, particularly focusing on the supply and demand balance during specific periods. This comprehensive analysis, which included various metrics and data points, was used to inform policy decisions. Based on this performance data, MOLIT introduced new flexible pricing policies to encourage more taxis in the evening, which led to improved outcomes for customers.
2. One unique feature of the mobility system in Korea is the popularity of “designated driver” services, where users can pay for another person to drive their car. Used in various situations where the driver needs another driver to operate their vehicle (e.g. after medical visits or due to alcohol consumption), thousands of designated drivers serve hundreds of thousands of requests every day across the country. Replacement drivers are typically gig workers contracting with platforms to service requests. The government, concerned about the welfare of replacement drivers, took the initiative to build shelters for drivers to rest between trips and provide nighttime shuttle bus routes so that they could return to areas of high demand after completing a request. Kakao Mobility, which offers a platform for replacement driver services, helped the government identify promising locations for driver shelters and corridors for shuttle bus routes using their trip destination data.
3. Finally, the Korean Transportation Safety Authority (KOTSA) also collaborated with Kakao Mobility to evaluate the performance of a new government policy to reduce speed limits on urban roads and residential streets. Kakao Mobility reviewed the travel speeds of the taxi drivers operating on their platforms before and after the policy to determine where the policy was successful in reducing speeds and where further interventions were needed.

Lessons learned from common challenges

While every city is unique, there is a range of typical challenges faced by public authorities seeking to introduce new mobility management initiatives. This section identifies common issues and how they have been addressed. These lessons, which relate to regulations, performance indicators, data sharing, and operator relations, should be incorporated into the design of future programmes.

Procurement and licensing

Many of the public authorities interviewed for this report identified careful design of either procurement or licensing processes as the cornerstone of an effective performance management programme for shared micromobility services. A lack of flexibility in the legal framework governing relationships between the authority and the operator was cited as a particular challenge. The new mobility market can be volatile; new entrants, mergers and market exits are commonplace. Public authorities need the flexibility to adapt to these events to minimise service disruptions and ensure that their constituents continue to reap the benefits of new mobility. This flexibility should extend to how authorities specify data formats used for data sharing and data reporting. The Brussels mobility and transport authority (Brussels Mobility) requires micromobility operators to report data in a legal ordinance which references, but does not contain, a list of allowed data formats. This allows Brussels Mobility to adapt to new data syntaxes without having to revisit the relevant implementing ordinance (ITF, 2024a).

In Mexico City, the publicly operated Ecobici docked bikeshare network was so successful that an expansion to the network was needed to accommodate demand. Operating an expanded network was beyond the capacity of the city. Still, flexibility in regulations allowed the public authority to seek a private partner to take over operations and finance the network expansion. Other cities recommended that legislation provide the local government with the legal authority to create contracts with new mobility operators, without specifying the terms of those contracts in the legislation. This gave Brussels, Providence and Copenhagen the ability to adjust their data sharing and performance management programmes over time without the need to amend any legislation.

The City of Zaragoza was one of the first local governments to regulate both the number of vehicles and the number of operators under a licensing scheme (EIT Urban Mobility, 2020). While having a variety of operators encourages competition on the basis of service quality and price, there is a point where managing the licences, data and performance of many operators becomes a burden for the public authority. It also fragments the market and makes it quite difficult for operators to achieve financial stability. Madrid initially granted licences to 18 different e-scooter operators in 2019 but decided to switch to a procurement model in 2023 with a maximum of three operators (Carey, 2023a).

When procurement is used, the length of the period must be considered carefully. Approaches can vary depending on the city. For example, Oslo's e-scooter tendering process occurs every 12 months, with frequent replacement of incumbents (Randall, 2022). While the short timeframe provides the city with considerable control and flexibility, it can also make operators reluctant to invest in the market and substantial staff time is required to manage the process on an annual basis. On the other hand, multi-year tender awards can make it challenging to replace operators due to poor performance or leave cities without any service if operators decide to exit the market. This occurred in Nottingham in late 2023 when Superpedestrian shut down operations, leaving the city without any e-scooter operators until the launch of a new tender (Stanley and Watson, 2023).

Performance indicators

There are several practical constraints when considering which performance indicators to include in the performance measurement programme. One such constraint is the public authority's legal capacity to request specific data. Officials have found that collecting data from passenger vehicle-based new mobility services, even driver logs, can be complex. Unlike micromobility services, licences for ridesourcing or procurement for carsharing rarely include comprehensive data-sharing provisions. In Mexico City, where such data-sharing requirements exist, operators do not comply with them due to the lack of an effective enforcement mechanism (Joshi et al., 2019). Public authorities seeking to introduce performance indicators for vehicle-based modes should ensure that they have both the legal authority to request the data they need and a solid mechanism to enforce compliance by operators. China, the State of Massachusetts, New York City, Seoul and Chicago all offer good examples of public authorities with detailed data reporting requirements for ridesourcing.

Another common issue is the legal authority to connect performance indicators to enforcement actions and fines, specifically concerning improper parking. Many cities have laws stating that parking fines cannot be issued unless a parking enforcement officer observes the violation; a record in the data provided by the operator is not sufficient. Stockholm has introduced a dedicated parking enforcement team for e-bikes and e-scooters that is notified when a new mobility vehicle has been parked improperly for a certain period.

The details of the selected performance indicators can contribute to different outcomes. For example, cities such as Providence and Los Angeles have encouraged equitable access to shared micromobility services by reducing fees paid by the operator for trips starting or ending in disadvantaged neighbourhoods. In those examples, public authorities generally opted to measure trip starts, as this was directly connected to their goals of enabling better access to opportunities across the city. Some operators have indicated a preference for switching to a related indicator, i.e. vehicle availability in disadvantaged neighbourhoods, as vehicle availability is entirely within the control of the operator.

The setting of performance thresholds is crucial to achieving public objectives. Many cities place a maximum threshold on fleet size for shared micromobility services, which is important for avoiding cluttered public spaces. Minimum fleet size thresholds are less common, however, and this has led to a degradation of service in some instances where the operator has declined to replace damaged vehicles. Another key lesson is to vary performance thresholds for different seasons in locations with variable weather. Utilisation rates for micromobility are likely to be much lower during colder months, therefore utilisation targets should be adjusted accordingly.

Data quality, processing and management

One major issue confronted by several cities is data quality and accuracy. Poor GNSS spatial accuracy and communication systems lag produce occasional errors or inaccurate information. Low accuracy in vehicle position data makes it very difficult to apply precise geo-located speed, pick-up/drop-off or parking restrictions, especially in tightly defined zones such as pavements or parking corrals. Public authorities have also encountered problems with vehicle status data, such as micromobility vehicles with "available" status despite being in the operator's maintenance facility. Many cities have engaged third-party mobility data intermediaries to process and clean the raw operator data. Resources should also be dedicated to conducting routine field surveys to verify the accuracy of any reported data.

The second issue is related to data management. Public authorities with the resources to set up an automated process to import micromobility data directly into their data management system have found the practice to be time-consuming but ultimately worth the investment. Local authority staff have shared

concerns about the technical capacity needed to process MDS data or extremely large files of spatially referenced ridesourcing data (as in New York City and Chicago). Nonetheless, authorities interviewed for this project also noted their appreciation for the opportunity to learn new skills and understand global data standards. Authorities also need to be aware of the regulations governing public data; evolving privacy regulations in Europe, California, Brazil, India and other jurisdictions must be accounted for in the collection, use, transmission and retention of personal data. The ITF report "Reporting Mobility Data: Good Governance Principles and Practices" (ITF, 2021) explores these issues in greater detail.

Building strong relationships

The last set of lessons learned relates to managing the relationship between public authorities and operators. Consulting operators at an early stage of the public licensing or procurement process can be very helpful. This will help cities avoid launching a procurement process that receives little interest from the operators due to the inclusion of infeasible or disadvantageous terms.

Public authorities and operators were encouraged to treat their relationship as a partnership towards achieving public mobility and sustainability goals. For example, the town of Bray in Ireland and Bolt submitted the launch of their e-bike system to a national awards programme for energy-smart community initiatives.

An approach that proved successful for one public authority was to share anonymised operator performance data with all operators in the city each month. This communication initiative allowed operators to benchmark their performance against their competitors and identify areas where their performance was deficient, without revealing the performance of any operator to its competitors.

Recommendations for future implementation

Many cities around the world have some new mobility services active in their jurisdiction. However, not all of them have a performance measurement programme in place. Even in cases where authorities collect data on, and monitor the performance of, some services (e.g. shared micromobility), they rarely do so for all new mobility services or co-ordinate this data collection within broader data collection efforts. The previous two chapters examined a few examples of what cities can do to measure the performance of new mobility services. This chapter will provide some recommendations on how to implement an effective measurement programme.

Process design

There are many indicators that can be used to assess the performance of new mobility services. Mobility service operators have access to data available on all aspects of their services. This might lead authorities to transmit overly broad data requests to operators or design unnecessarily complex performance measurement programmes. Authorities should avoid collecting data just because it is available and focus on collecting only the data necessary to carry out their well-defined mandates. Overly broad data collection efforts also challenge many authorities, especially in smaller jurisdictions, who may not have the in-house capacity to analyse these data. Addressing the skills gap by training, hiring expertise or outsourcing data collection and management all come with resource implications which may be especially acute for under-funded authorities.

As noted earlier, authorities should instil a straightforward and purposive data collection process. This process should focus on a set of new mobility services performance indicators that are directly linked to public authority mandates and local contexts.

Set objectives for new mobility services

New mobility services respond to their users' needs and are also helpful in fulfilling public authority objectives. However, public authorities often treat new mobility services in different ways. For instance, in Europe and North America, the role of shared micromobility and carsharing in achieving public policy outcomes is much more prominent in public authority mobility strategies and plans than ridesourcing. These services address the first-last-kilometre problem for public transport passengers, for example, allowing people who arrive by train to reach their workplaces easily. In San Francisco, bikesharing stations are installed adjacent to Caltrain and BART stations. Similarly, in Mexico City, Ecobici was originally configured to complement the city's mass transit network (ITDP, 2018). In other cities, new mobility services are a way to increase the sustainability of transport and reduce greenhouse gas emissions. In cities where public transport does not cover all jurisdictions, new mobility services can improve the availability of sustainable transport modes in peripheral areas and reduce car dependency.

Local authorities should clearly define the objectives they would like to achieve with the help of new mobility services. This will assist local authorities in prioritising which data to collect. If a city would like to reduce car dependence by incentivising the use of bikes and e-scooters, it could calculate the vehicle-kilometres or passenger-kilometres travelled by these modes (see Table 3). When compared over time and to other transport modes, local authorities can evaluate whether the introduction of new mobility services has helped in shifting the modal share towards more sustainable transport modes. In this case,

looking at safety indicators, such as the number of seriously injured, would not be very helpful in assessing the effect on transport equity of new mobility services.

Table 3. Example of calculation methodology for utilisation-related performance metrics

Data needs	1. Passenger related vehicle-kilometres (pvkm) for vehicles travelling with passengers, whether the vehicles are deployed in a fleet or operated by contractors. For ridesourcing vehicles, this measurement should commence when a trip is booked, not when the passenger has boarded, to account for passenger-related vehicle travel. 2. Operational vehicle-kilometres (ovkm) covering indirect vkm related to support vehicles involved in maintenance, rebalancing, charging and other routine operational tasks. 3. Total number of passengers or riders. 4. Total number of vehicles (split by passenger and operational vehicles.
Calculation method	Total vehicle-kilometres (vkm): sum 1 and 2 above by vehicle class. Report overall vkm separately for pvkm and ovkm. Average vehicle occupancy rate: divide 3 by 4 (passenger-carrying vehicles) above. Passenger-kilometres travelled (pkm): multiply pvkm by the average vehicle occupancy rate. Average pvkm per pkm: divide the total pvkm by the number of pkm travelled. Average overall vkm per pkm: sum 1 and 2 above and divide by pkm.

Source: ITF (2023a).

Identify public concerns around new mobility

In the last decade, the number of new mobility services has increased exponentially in many jurisdictions. This has not been without impact. The perceived safety of new mobility vehicles, especially e-scooters, is quite often at the centre of public debate. Vulnerable road users, in particular pedestrians, perceive the behaviour of e-scooter riders as hazardous for themselves and others. Another common concern is the way these vehicles are parked. In many cities, the main critique towards shared e-scooters and dockless share bikes is that they block walkways and pavements when parked illegally.

Local authorities should consult the population to understand their main concerns about new mobility services. Their performance measurement initiatives should include some indicators that will help to respond to these issues. For example, if the main concern is safety, the most important indicator would be the injury rate (Table 4). In this way, local authorities can compare the injury rate of e-scooter riders with that of passenger car occupants. This indicator can be used as a justification to incentivise the use of shared bikes and e-scooters instead of passenger cars.

Table 4. Example of calculation methodology for safety-related performance metrics

Data needs	1. Total number of injuries (fatal and serious, as measured on a standardised scale, e.g. the Maximum Abbreviated Injury Scale [MAIS] in Europe) resulting from the use of a new mobility vehicle, and the location at which the injury occurred. 2. Number of people involved in a crash with a new mobility vehicle, by road user category. 3. Total passenger-kilometres (pkm) per new mobility service model.
Calculation method	Injuries per pkm: total number of injuries reported (fatal and serious) divided by the total pkm. Distribution of injuries by the road user category of the crash opponent: number of injuries reported (fatal and serious) by road user category and crash opponent, including self-crashes, divided by the total number.

Source: ITF (2023a).

Implement a pilot project

In the absence of a regulatory framework for new mobility services, the unregulated introduction of new vehicles could pose several issues, from illegal parking to a decrease in road safety. For example, as described for Brussels and Stockholm, the initial roll-out of e-scooters rapidly led to very large fleets with their associated parking problems. This motivated both cities to change their regulatory approach towards micromobility, organise parking and reduce fleets. In similar instances, performance measurement initiatives help local authorities to identify the needs of the city and define the fleet size needed to fulfil them. Piloting data collection initiatives help authorities gain experience and skills that will assist in designing and deploying a formal performance initiative. This in turn will help refine the list of indicators to avoid wasting time and resources collecting data that are not meaningful and rather focus on those that are useful to reach the desired outcomes.

Pilot projects may be helpful in cases where new mobility services are not yet available. In this case, together with the launch of new mobility services, cities can introduce a performance measurement programme to evaluate its effects on local mobility and prepare a regulatory framework to ensure an efficient and sustainable system. Box 5 examines the pilot project introduced in England in 2020.

Box 5. E-scooter trials in England

In the United Kingdom, the use of e-scooters is illegal as there are no specific regulations related to this kind of vehicle. Between July 2020 and December 2021, the UK Department for Transport (DfT) introduced 32 trials of rental e-scooters across 55 areas. The main aim of this pilot project was to provide information for the future governance and regulation of e-scooters and other micromobility vehicles.

DfT commissioned Arup and NatCen Social Research to evaluate the trials and assess the feasibility of introducing these vehicles across the nation. They defined a list of indicators to analyse and identified data sources:

- operator data on trips and their characteristics
- user and resident survey
- qualitative research with users, residents and local stakeholders.

Based on these data, the evaluation analysis helped in understanding the profile of e-scooter riders, the purpose of their trips, and the impact on travel behaviours. It also looked at the effects on safety and the environment. This will help prepare the regulation on e-scooters and introduce an effective and sustainable e-scooter-sharing service.

Source: DfT (2022).

Define relevant indicators

Effective indicators should be calculable on a repeated basis, relevant to policy goals and regulatory actions, easily understood and communicated, and consistent across other modes (ITF, 2023a).

To help local authorities identify the most policy-relevant performance indicators, the first publication in the ITF's series on Measuring New Mobility presents 17 indicators. For each one, it provides data needs, standard calculation methodologies and actions that can be taken based on the results (ITF, 2023a).

While it is suggested to consider the local context as much as possible, local authorities should work in co-operation with other local authorities in the same country to have a consistent set of indicators. In this case, new mobility services can be compared across the country and best practices in one city can be easily reproduced in another.

Launch the procurement process

Once the list of indicators is defined, local authorities need to collect the necessary data. The main data source is the service providers. For this reason, local authorities should set data reporting regulations in co-operation with operators to ensure they receive the necessary information.

Many cities have opted for public procurement processes to govern shared micromobility and carsharing. Among the criteria used to select the winning bidders, local authorities should introduce data sharing requirements. During the procurement process, clauses should be included about which data to report, in which format and how frequently.

It is important that local authorities explain clearly the reason why they need to collect specific data. Private companies need to be assured that data provided to public authorities will not compromise their competitive position. Service operators need to be involved in the process to provide reliable and timely data. It is recommended that data reporting be linked to some incentives. For example, suppose a city would like to promote the use of shared vehicles in areas with limited public transport availability. In that case, it can offer discounts on the per-trip fees paid by operators that reach an established threshold for number of trips starting or ending in the targeted service areas (Table 5). In the same way, providers that perform poorly according to certain performance indicators can be subject to fines or other penalties.

Table 5. Example of calculation methodology for equity-related performance metrics

Data needs	1. Location where trip starts (aggregated to pre-defined geographic zones). 2. Location where trip ends (aggregated to pre-defined geographic zones). 3. Geographic boundaries representing targeted service areas.
Calculation method	Number of trips starting or ending in targeted service areas: sum of the number of trips beginning and ending in each zone that is within a community of concern. Number of trips starting or ending in targeted service areas relative to broader service area: compare the results above against results for the full service areas.

Source: ITF (2023a).

Data management

Once local authorities define the list of indicators and find the right data sources, they should collect and analyse the data.

Develop in-house capacity to process data

In many cities, especially smaller ones, public authority staff may have insufficient technical skills to process the data received by service providers. In addition, their IT infrastructure should be able to store the large amount of data needed to produce meaningful indicators.

Local authorities should seek to upskill their staff either through training or new hires. They should also invest in adequate IT infrastructure and instil appropriate IT protocols. However, given the financial constraints that many municipalities are encountering, the public sector faces difficulty in competing with the private sector when it comes to hiring data analysts.

Use third-party aggregators

While large cities may have the financial resources and the interest in hiring staff dedicated to analysing new mobility data, this is not usually the case for smaller municipalities. In all instances, but especially for the latter, the use of third-party aggregators may be an attractive and cost-efficient option. In most cases, the services of these companies are affordable, even for small cities. In addition, more and more cities are working with third-party aggregators. This helps create a standard list of indicators and benchmark against other cities. The most popular third-party aggregators have already developed dashboards and data visualisation tools to present performance indicators in a user-friendly way. If a new city asks for their services, it is easy for them to adapt what they have already done to a new local context.

Using third-party aggregators is also an advantage for service providers. The data they need to provide to third-party aggregators are typically standardised across different cities. In this way, they are protected against the need to meet separate data standards for each city.

Organisational considerations

Communication and transparency both within public authority departments and with service providers is vital for the smooth operation of new mobility services and to be able to fully benefit from indicators and data collected.

Create advisory working groups

Local authorities should create an advisory working group across departments that may be affected by or responsible for different aspects new mobility services. This is important to discuss cross-departmental issues. The mobility department is not enough to assess the overall impact of new mobility services. The sustainability department can be consulted to evaluate the environmental impact, the legal department can help in the procurement process, and the public works department can evaluate if new infrastructure is needed. It is essential that decisions consider all the aspects touched by the introduction of new mobility services.

The advisory working group can also consult with the public from time to time. This is crucial to respond to concerns and to understand if the direction taken is the right one.

Meet regularly with service providers

Local authorities should organise regular meetings with service providers. The basis of these meetings should be the analysis of the indicators included in the performance measurement programme. Local authorities should inform service providers about the actions they intend to carry out to further develop existing new mobility services and which direction the wish to take. Service providers should be able to express their concerns and solve potential issues before they become too complex to resolve. It is important that these meetings are open and that service providers are not concerned about being excluded from the market.

From measurement to action

The steps recommended above are meaningless if no action is taken based on the performance measurement programme in place. It is, therefore, crucial that local authorities have clarity about which actions they wish to take based on the results of data analysis.

Monitoring actions

For each indicator, local authorities should set a threshold and decide what to do when the threshold is exceeded. For example, they can introduce a points system for service providers. Every time the offered service does not respect the standards set in advance the provider loses points. When the operator exceeds the threshold too many times, it can risk losing the operating licence. Another option is to impose fines in cases where the minimum level of provided services is not respected.

This system can also work constructively. In cases where a service provider complies with the requirements set by the public authority, it can receive a discount on the operating fees. For example, suppose new mobility services are required to complement public transport in certain areas. Once the indicators show that an operator fulfils this requirement, local authorities can subsidise part of the service.

Planning actions

Performance measurement programmes should be the basis for making planning decisions. For example, utilisation indicators, as proposed in ITF (2023a), can be useful in evaluating the need to increase the offer of new mobility services. Local authorities could decide to let the existing service providers raise the vehicle fleet or grant operating licences to new service providers. Local authorities could also decide to build new cycling infrastructure based on the extent that new mobility services are used.

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International Transport Forum

Measuring New Mobility

Case Studies and Best Practices

In many cities, new mobility services have become a small yet important component of urban passenger transport systems. Local authorities must be able to measure these services to understand their benefits, monitor negative impacts and guide policy interventions.

This report helps policy makers implement new mobility measurement and monitoring frameworks. It draws on lessons from ten case studies around the world to offer practical recommendations for effective data reporting and monitoring frameworks.

This report builds on the first publication in the ITF's series on Measuring New Mobility, which outlines a classification framework for new mobility services and proposes a series of detailed performance indicators to help cities monitor and understand their impact.

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