Cities’ Use of MDS as Soft Digital Infrastructure for Micromobility – Key Findings and Challenges

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Abstract
In recent years, the e-scooter has gained exceptional worldwide adoption, and their hybrid vehicle design has placed them in a legislative void. To this end, many cities are developing local regulations to govern and follow-up e-scooter operations within their jurisdiction. As e-scooters are equipped with hardware like SIM cards, GPS sensors, and accelerometers, the vehicles can both collect and act on digital information. Increasingly, cities thus draw on these capabilities using the Mobility Data Specification (MDS) as a soft digital infrastructure to e.g., express local regulations and collect operator data for compliance purposes. This paper uses interview data from European and U.S. cities, e-scooter operators, and systems integrators to provide an overview of the history and components of MDS. The paper also presents cities’ current uses and emerging challenges regarding using MDS for regulation, compliance monitoring, as well as data analytics for physical infrastructure planning.

Keywords:
Soft Digital Infrastructure, Mobility Data Specification, Micromobility

Introduction
In the wakes of society’s increasing digitalization, transportation is becoming more interwoven with the digital realm. For instance, Google Inc. has grown into the primary conveyor of public transport information, cars can be called upon digitally to switch to electric driving mode in urban zones, and the proliferation of ride-hailing services is largely dependent on the two-sided markets that digital platforms enable. These examples show how existing modes of transportation are continuously being reshaped by digital technologies and where hard and soft digital infrastructure play a key role. Hard infrastructure refers to masts, cables, wires, and sensors for example, whereas soft infrastructure includes legal frameworks, standards, and shared constructs necessary to convey actionable data. This research is concerned with soft digital infrastructure.
In recent years, an all-new mode of transportation has emerged, the e-scooter. These vehicles have quickly gained exceptional adoption, and their hybrid vehicle design has placed them in a legislative void. To this end, many cities have developed local rules that e-scooter operators need to comply with to operate within cities’ jurisdictions. Since from their inception e-scooters have been equipped with hardware like SIM cards, GPS sensors, and accelerometers, they can both collect and act on digital information, and many cities have thus used hard and soft digital infrastructure to enforce and follow up policies related to e-scooters. In this space, the Mobility Data Specification (MDS) has been widely adopted by cities around the world as a standard for data exchange between e-scooter operators like Spin, Lime and Voi and the cities where these firms operate. While the interplay of data standards and regulations has been pointed to as crucial [1-3], empirical inquiries into how cities actually use soft digital infrastructure like MDS to exercise and follow-up such regulations remain scant. To this end, I thus have inquired into how and why cities use MDS as digital infrastructure for micromobility.

The rest of this paper is structured as follows: I continue this research article by accounting for the method and materials used in this research. Next, I provide an overview of the contents and history of MDS. The subsequent section includes how cities acquired the necessary capabilities to handle MDS, the type of concrete uses, and their corresponding challenges. These use areas are data sharing and processing capabilities; machine-readable rules; algorithmic rule compliance; and data analytics. I end this paper by offering some concluding thoughts.

Method
I used a qualitative research approach to understand how cities use MDS as digital infrastructure for micromobility. I chose to engage in a qualitative inquiry, as such an approach enables the research to provide a rich understanding of an emerging phenomenon [4].

The primary method used for the results in this report was semi-structured interviews. The interviews were conducted with three types of stakeholders. The largest group of interviewees were representatives of cities (and other related public sector organizations) currently dealing with implementing policies and determining their compliance through MDS as well as acquiring capabilities related to MDS. I also interviewed representatives of e-scooter operators that currently report to cities using MDS and, in some cases, interpret digital infrastructure rules governing how to have city-compliant operations using MDS. Finally, I inquired into representatives from commercial system integrators selling solutions that enable cities to ingest, understand and express MDS data streams.

I relied on a combination of maximum variation sampling and snowball sampling [5] as I selected cities, e-scooter operators, and systems operators with as different characteristics as possible with regard to geographical location, time using MDS, and how they used MDS. I ended each interview by inquiring about additional potential interviewees (also having these desirable characteristics). All interviews were conducted via video conferencing systems and recorded. I ended our data collection, as little new information was added. All recorded material was transcribed verbatim.

Data analysis followed a data reduction – data display – conclusion-drawing process [6] using a qualitative data analysis software package: atlas.ti. Data reduction included winnowing out empirical material pertaining to the objective of this study (e.g., policy implementation through MDS) while excluding other observations (e.g., experiences of the local political landscape). Data display included deriving the
analytical categories and their manifestations (i.e., the axes and table cells, respectively, in Table 2) using qualitative coding. Finally, conclusion-drawing included validation by getting the interviewees’ feedback on the findings of this research and revising the findings accordingly.

<table>
<thead>
<tr>
<th>Type of interviewee</th>
<th>Number</th>
<th>Total minutes</th>
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<tbody>
<tr>
<td>City and other government agency representatives</td>
<td>19</td>
<td>900 minutes</td>
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<td>Of whom</td>
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<tr>
<td>- 6 U.S. (2*)</td>
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<td>360 mins</td>
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<tr>
<td>- 2 EU (2*)</td>
<td></td>
<td>120 mins</td>
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<tr>
<td>- 11 Sweden</td>
<td></td>
<td>420 mins</td>
</tr>
<tr>
<td>Representatives of commercial system integrators</td>
<td>3</td>
<td>180 minutes</td>
</tr>
<tr>
<td>Representatives of mobility companies</td>
<td>4 (1*)</td>
<td>240 minutes</td>
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<tr>
<td>Total</td>
<td>26</td>
<td>1320 minutes</td>
</tr>
</tbody>
</table>

* Number of people who no longer worked for the organization in question at the time of the interview.

Table 1 - Interviewees

**Mobility Data Specification – origins, governance, and uptake**

The MDS [7] (Mobility Data Specification) standard was initially developed by the Department of Transportation in Los Angeles in 2018 to regulate and exchange data on new types of vehicles in the city. While cities’ de facto usage of MDS at present is primarily focused on electric scooters, it can also be used for other modes of transport such as rental bicycles and mopeds. Also, several cities have stated an ambition to handle emerging modes of transportation through MDS. For example, some cities are experimenting with using MDS to set up rules governing how autonomous robot deliveries can use pedestrian pathways and sidewalks.

MDS contains six API specifications:

1. **Policy** - used by cities and other government agencies to express policies, e.g., permitted/prohibited parking, speed limits, maximum fleet size cap.
2. **Provider** - used to retrieve post-trip data from mobility companies and status changes for vehicles (for example, whether a vehicle has been in motion or not). This API specification is currently the most widely used part of MDS.
3. **Agency** - in principle, Agency overlaps with Provider in terms of content. However, the transfer mechanism is based on mobility companies transmitting information to cities at a specified regularity (for example, every five minutes).
4. **Geography** - used to define geospatial boundaries for the areas where policies apply.
5. **Jurisdiction** - used to define who has decision-making power for example in a particular geographical area if several authorities are active in the same area.
6. **Metrics** - used to communicate aggregate information about policy compliance procedures.
In addition to MDS, the open standard GBFS [8] (General Bikeshare Feed Specification) is often used in conjunction with MDS. Here, GBFS is used to describe data on electric scooters that can be made available openly, for example, the number of electric scooters available in real-time. GBFS provides the opportunity for some anonymization, for example, of vehicle identities.

Ownership and governance
In 2019, the ownership of MDS was transferred from Los Angeles to the non-profit Open Mobility Foundation (OMF), which currently has some 50 members. OMF’s work takes place openly and mainly on the GitHub platform. Changes and additions to MDS are worked out in working groups. The working groups’ proposals are reviewed and monitored by committees for privacy protection and strategy (Privacy Committee and Strategy Committee) and a technology council. Both public and private actors can become members of the OMF. However, the fee for membership of the OMF is voluntary for public actors and mandatory for private actors.

According to the OMF’s bylaws, its board ultimately approves new versions of MDS, and the board only has public actor members. In the survey before this report, however, several interviewees stated that, through the working groups, in practice private actors significantly influence the ongoing development of the standard.

Reasons for MDS adoption
Cities were surprisingly quick to regulate e-scooters digitally using MDS. Several of the interviewees believe that this happened because of three interacting factors:

Firstly, as ride-sharing services quickly became popular in the early 2010s, this had a significant impact on the cityscape in several American cities. For example, fewer journeys were made using public transport, while the load on the road network increased inside the cities, which typically went against cities’ mobility strategies. As a result of this development, many cities became more vigilant about emerging transportation modes and realized that they needed to invent new ways to regulate new mobility companies and their services, as explained by a city representative:

[T]he cities and governments like completely missed the boat in terms of Uber and Lyft and understanding that what was going on there and how it impacted cities. […] A lot of where MDS was coming from was a reaction to this.

Consequently, when electric scooters were launched, a readiness and political will to use digital infrastructure to regulate these new vehicles had already emerged.

Secondly, since electric scooters were equipped with GPS and an Internet connection, this made it possible to collect and share data about travel with the cities. Thirdly, the cities could require land use permission from the mobility companies. This approach allowed the cities to require e-scooter operators to comply with city rules on micromobility, including an obligation to share data, as stressed by a city representative:
One of the things that we really enjoy about it, having it as a permit program is because we realized early on through the pilot program that this industry is evolving constantly. The companies are very nimble, a lot of times we didn't find out about things until after the fact. So, by having a permit versus a contract we can update our regulations as needed to keep up with the vendors. It's much more challenging and you need to amend contracts and you know that involves typically lawyers on both for both parties.

Also, several interviewees noted a willingness from mobility companies to collaborate with cities on the introduction of electric scooters in cities, for example, by sharing data.

**Data sharing and processing capabilities**

Most of the cities interviewed had purchased systems from commercial system integrators to implement policies, receive and visualize historical travel data, and monitor compliance – by using MDS. The primary reason for using commercial system integrators was that buying systems was considered more cost-effective than developing systems in-house. The interviewees mentioned costs in the order of USD 100,000-200,000 for developing a system plus additional costs for maintenance. By comparison, they estimated the cost of a procured solution to be in the range of USD 20,000-30,000 thousand per year. Finally, interview data revealed that cities that developed in-house systems were typically early adopters, and that these cities may have decided otherwise with hindsight, as explained by a city representative that had developed systems in-house:

*So, like, I’ve got plenty of resources, and even that is not as good as the dashboards that I can get right from [systems vendor].*

Several interviewees stated that the biggest challenge for systems developed in-house is that it is difficult for an individual city’s IT department to maintain a system after it has been delivered. This challenge applies to implementing support for new versions of MDS for example, continuous work with the visualization of incoming data, and developing new functions that the business requires. Another cost-driving challenge is the knowledge required about MDS. For example, different mobility companies export MDS in various “dialects,” meaning that each city needs to understand and handle these subtle differences. Another example given by interviewees concerned the development of algorithms for monitoring compliance with rules, which informants described as a continuous process, as described by a former city representative:

*[A]nalyzing the data, preparing it in order to be analyzed, the algorithms to come up with those policy metrics that was very challenging, very challenging, and it wasn’t like a one-time thing that we worked through and then we figured it out and then we kept like that issue of how we calculated that metric. It never went away: we just always were talking about that, and we were looking at new ways of calculating it.*

Most city representatives hence recommended using external system integrators, but they also voiced concerns about procuring solutions. A risk of relying solely on external suppliers is that commercial suppliers will be the only actors who fully understand the machine-readable rules, follow-up, and visualization using MDS. Consequently, cities (and indirectly also mobility companies) may end up being too dependent on external system integrators. Another risk is that the algorithms that are the basis for the
follow-up of compliance with the rules, and thus at the core of exercising authority, will be opaque and therefore not under sufficient scrutiny.

**MDS and Privacy**

Several privacy concerns have arisen regarding MDS. The background of this debate is the data model used by MDS to transfer data from e-scooter operators to cities. This data model is based on individual journeys and vehicle status changes within an e-scooter fleet. Based on these data, cities can carry out a variety of activities, such as planning physical infrastructure and monitoring compliance. However, the issue with the design is that personal privacy can be violated. No direct personal data about travelers is transferred (this data is available from the mobility companies but is not transferred via MDS). Nonetheless, it has been argued that the travel patterns that MDS conveys can be used in combination with other data sources to track individuals and their travels [9, 10].

This debate has been particularly prevalent in the European Union where the General Data Protection Regulation (GDPR) regulates how EU Member States must handle personal data. A cornerstone of the GDPR is that any legal entity must have support in the legislation for storing and processing personal data. Such support can be a public remit or obtained consent from personal data providers (i.e., the e-scooter users). Since individual journeys are considered personal data, MDS is typically seen as requiring processing in accordance with the GDPR within the EU. To this end, OMF has developed a set of guidelines to help cities deal with MDS subject to the GDPR [11].

During the interviews, different views emerged on how the GDPR should be interpreted in agreements between cities, mobility companies and system integrators. These different views primarily concerned who can and should take on the roles that GDPR talks about (e.g., personal data controller and personal data assistant) and the content of the agreements that exist between the parties (cities, e-scooter operators, and systems integrators).

**Machine-readable rules**

The MDS standard has a dedicated API designed to handle machine-readable rules: the policy API. A policy can, in turn, contain many rules. For example, a municipality’s speed limits (policy) may include several geographically marked zones with different speed limits (rules).

During the interviews, respondents were asked to explain what policies the city required e-scooter operators to follow and to what extent MDS was used to express these policies. A somewhat surprising result from the interviews was that several interviewed cities currently do not use MDS to communicate their rules digitally. Instead, these cities published rules in written ordinances or used alternative digital formats. The reason given by the interviewees was either that the city was using older versions of MDS (where the policy API was not sufficiently well developed to fit the cities’ needs) or that the city had developed a system in-house to handle MDS, where the policy part remained to be implemented. All interviewees who implemented digital rules through MDS did so with the help of third-party software.
### Table 2 – Cities’ use of MDS as digital infrastructure for micromobility - key findings and challenges

<table>
<thead>
<tr>
<th>Area</th>
<th>Key findings</th>
<th>Challenges</th>
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<tbody>
<tr>
<td>Data sharing and processing capabilities</td>
<td>- Most interviewees procured commercial systems (“buy over make”)</td>
<td>- In-house system</td>
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<td></td>
<td>- Dissuaded from developing systems in-house</td>
<td>o Keeping up with MDS</td>
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<td>- Mature market with several competing third-party options</td>
<td>o Visualization</td>
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<td>o Understanding MDS dialects</td>
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<td>o Cost of maintaining compliance algorithms</td>
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<td></td>
<td></td>
<td>- Procured system</td>
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<td></td>
<td></td>
<td>o Outsourcing important knowledge</td>
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<td></td>
<td></td>
<td>o Lack of control and insight into control algorithms</td>
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<tr>
<td></td>
<td></td>
<td>- Privacy concerns requires EU cities to find ways of being GDPR compliant for example</td>
</tr>
<tr>
<td>Machine-readable rules</td>
<td>- Not all cities express machine-readable rules through MDS</td>
<td>- Selecting what rules to make machine-readable</td>
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<td></td>
<td>- All cities using machine-readable rules used procured systems</td>
<td>- Determining how to represent a rule in machine-readable way</td>
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<td>- Changes in machine-readable rules in practice require an implementation period by operators</td>
<td>- Developing skills in the intersection of law, data modelling, and mobility policies</td>
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<td>- Only a subset of the city regulations was appropriate for machine readability</td>
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<tr>
<td>Algorithmic rule compliance</td>
<td>- Cities apply algorithms to data generated by e-scooter operators to measure compliance</td>
<td>- Proving whether violations occurred (or not)</td>
</tr>
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<td></td>
<td>- Cities experience fewer violations over time using algorithmic compliance</td>
<td>- Methods to cross-check reported data</td>
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<tr>
<td></td>
<td>- Additional algorithmic transparency key to instill trust</td>
<td>- Adjusting for erroneous data points during compliance checks (e.g., inaccurate GPS coordinates)</td>
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<td>- Doubts whether data really reflects the ground truth</td>
</tr>
<tr>
<td>Data Analytics</td>
<td>- Besides rules compliance, MDS data is used to plan physical infrastructure</td>
<td>- Privacy concerns and regulations (like GDPR) can affect the usability of MDS for analytics purposes</td>
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<td></td>
<td>- This includes e-scooter infrastructure (e.g., parking infrastructure), bicycle lanes, and obstacles</td>
<td>- Being able to MDS data analytics outside dedicated MDS tools</td>
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<td></td>
<td>- Data is analyzed in MDS tools and in general analytics tools</td>
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A further observation was that when a rule is expressed digitally, it implies a manual implementation process for each mobility company. Consequently, a new or changed digital policy requires a certain implementation period by the mobility companies before the rule is implemented in vehicle fleets.

The most common policies expressed in a machine-readable way were:

- Maximum number of vehicles per mobility company
- Zones with prohibited traffic
- Zones with prohibited parking
- Zones with desired parking
- Maximum time for inactive vehicle
- Requirements for the distribution of vehicles in different districts (for increased equity).

At the same time, the interviewees expressed that several rules which were seen as being best expressed digitally were not implemented via MDS:

- Overturning a vehicle
- Careless driving of a vehicle
- Driving a vehicle outside the permitted road (for example, on the pavement)

The reasons given for not expressing these rules digitally was their inability to be enforced. This shortcoming, in turn, is primarily because the equipment used by e-scooter operators is not accurate enough to collect this data (at least across all companies). In addition, it is algorithmically challenging to determine whether these rules indeed have been broken. A further objection from the mobility companies was ambiguity about what a specific rule means in practice. E-scooter operators, therefore, requested a set of standard rules to minimize tailoring for each city.

*I do think that there's a bit of work still to be done by the industry and the OMF and it's actually something where we had a discussion with them for them to standardize the policies that can be shared through the API. [...] It would be really valuable if OMF as data governance organization to bring cities and operators together to agree on this kind of use case framework and on very clear policies to make it very smooth and very easy for both the city and the operator to digest this information into our system.*

The interviewees stated that the advantage of machine-readable rules primarily lies with the precision with which digital rules can be communicated. This increased precision applies particularly to geographically delimiting rules, such as zones where traffic is prohibited. The cities that instead used images and text to communicate geographical boundaries experienced minor misinterpretations by the mobility companies (often to the city’s disadvantage).

Several interviewees also pointed to an unexpected consequence of expressing a rule digitally. Being digital, there was a tendency to formulate a rule with regard to how compliance with the rule can be followed up algorithmically. A recurring example of this potential bias concerned the maximum number of vehicles that a mobility company was allowed to operate in a city. This seemingly simple rule can be interpreted in a variety of ways, such as:
A maximum number that may never be exceeded (“never more than 500 active vehicles, at any given time”)
An average during the day that must not be exceeded
An average during the busiest time.

Several interviewees also stated that the work required special skills in the cities, somewhere between data modeling and local traffic regulations. These skills were typically available from external experts, and often only from external system integrators.

**Algorithmic rule compliance**

All interviewed cities said that MDS played an essential role in monitoring how e-scooter operators complied with local regulations.

The most common form of follow-up was that the city, typically monthly, compiled a report containing the extent to which mobility companies complied with the various rules (see above). The algorithmic follow-up was based on the MDS data that the mobility companies transferred to the city. Next, a city officer reviewed the status of each company, either in a group meeting with all active mobility companies, or individually. They also compared compliance with the previous month. There was a general experience among the cities interviewed that the lists of violations became smaller for each such meeting.

Most interviewees, therefore, experienced that using MDS for expressing machine-readable rules and digital rule follow-up, considerably facilitated the work of establishing compliance with cities’ permit programs. However, some interviewees brought up incidents where cities and mobility companies had conflicting views on whether MDS data really indicate that violations have been committed. Here, the algorithms for detecting violations are critical, as well as the factors causing the parties to have different views on what happened. Therefore, greater transparency about the algorithms was seen as desirable, especially by the mobility companies.

Some cities exercised stricter follow-up of rules and used data from MDS daily, or even several times a day, to monitor that no more vehicles than permitted were available on the city streets. If the cities discovered violations, they contacted the companies directly, prompting them to take action. Finally, some interviewed cities had imposed or were in the process of imposing additional fees based entirely on the digital rule follow-up that MDS permits. In one such case, an e-scooter operator contested the fee and appealed the city’s fee in court.

The interviewees had somewhat different views regarding the extent to which the data shared from e-scooter operators to the cities reflected reality. This issue was discussed because the mobility companies themselves generate the quantities of data that are used to assess whether the company has complied with the city’s rules. Hence, this approach could create incentives for mobility companies to trim the data they transfer to cities for assessment in a way that makes the data compliant with the rules. In addition, vehicles from different operators are equipped differently in terms of their positioning equipment and Internet connection capabilities, which may yield different results for different manufacturers, as explained by a city official:
I wouldn't say the technology is different but it's more the way the technology is set up per vendor. So, for example, the ping rates that the devices have per vendor is set up at a different rate. So, for example, [Mobility Operator A] has a ping rate between a device and the network every 60 seconds versus [Mobility Operator B], that is setup to ping every 20 to 25 seconds. In this case, [Mobility Operator Bs] vehicles are going to have much better accuracy when it comes to entering and exiting areas for which we have prescribed geofence rules, like for no parking and no riding.

Some interviewees maintained that there was still good reason to rely on the data transferred to the cities to monitor regulatory compliance. Since large quantities of data are transmitted in near real-time, it is difficult for mobility companies to trim data to their advantage systematically.

Other interviewees were more skeptical that the mobility companies created the data they were assessed on. They argued that the mobility companies in this model needed to understand and control what data they transferred to the cities. Therefore, out of pure self-preservation, they had to process and possibly trim the data, such as removing incorrect data from scooters that did not report their status correctly. They therefore stressed that the mobility companies always pre-processed their data before transferring it, which would allow them to modify the data on which their compliance with the rules is based.

Given some of the challenges of self-reporting, several cities conducted physical checks to validate reported figures. For example, employees from the city could rent a vehicle themselves and try to drive in the prohibited areas under current regulations, as explained by one city representative:

>You know we have slow zone along like our [popular city district] because there's so much foot traffic, it's a shared path with both cyclist scooters people walking, so that's a slow zone. We're testing the policy that we put out through MDS [by riding the scooters]. We publish it and the operators ingest it. So we do test that in our vehicle inspections anytime that we add a new zone.

They could also count vehicles in a given area in a day and compare this number with the figures reported by mobility companies via MDS. In addition, most cities seemed to have some form of safety margin. For example, given the uncertainties connected to self-reporting of data, interviewees explained that a rule was considered broken only when the number of vehicles exceeded the maximum number allowed by more than 10.

A more general risk with digital rule follow-up arose in the case of MDS and was expressed by some of the interviewees. This risk was that the way the rules are designed can be biased towards what can be followed up automatically. One such example concerns policies related to social equality. Since MDS does not allow a city to monitor who uses a vehicle, many cities instead have rules that mean vehicles must be located according to a specific distribution, for example, 70 percent in central areas and 30 percent in more vulnerable areas. The critical interviewees believed that this did not guarantee equality and justice in practice but merely gave the impression of it.
Data Analytics

Since the MDS data model is based on journeys made at a mobility company, MDS data is well suited to analyzing travel patterns to understand and improve the physical infrastructure.

In particular, MDS data is used to improve the physical infrastructure for electric scooters. Such improvements include, for example, planning for dedicated e-scooter parking zones and identifying areas where electric scooters tend to disappear. Once these issues have been identified, the city can adapt the infrastructure accordingly. Another interviewee’s example was identifying obscure detours, which may indicate obstacles (on the shortest journey) that need to be removed.

In addition to this, several cities use data from MDS to plan cycle paths, which can be used by both bicycles and electric scooters. The cities analyze which places most journeys take place between, thereby obtaining a reasonable basis for planning cycle paths along these routes.

The most common way to analyze and plan was to use tools purchased from external system integrators that cities used to manage MDS data. These tools contained various visualizations that the interviewees described as very useful. The disadvantage was that the interviewees felt that the MDS applications had limitations in how easy it was to combine MDS data with other data types, such as population data or public transport data. Two of the interviewed cities had built their in-house analysis systems where MDS was used as one of several data sources.

Some interviewees raised the issue of how the GDPR can affect the possibilities of using MDS for planning. How a municipality has handled the GDPR affects what data they receive and thus what they can plan. An important choice is whether data is based on individual journeys (the basic model in MDS) or aggregated data (additions in MDS according to the demand from European cities). Aggregated data is less detailed, reducing the scope of analyses that can be performed.

Conclusion

This study has shown that soft digital infrastructure can play a critical role in mobility modes with regard to regulation, compliance monitoring, and physical infrastructure planning. However, to leverage machine-readable rules, cities need to recognize what policies to express digitally (and what policies benefit from being formulated as written ordinances) and acquire new skills in defining policies in the digital realm. Moreover, data-driven follow-up of policies requires increased transparency concerning the compliance algorithms that determine whether violations of local regulations have occurred. Data-driven follow-up of city regulations also needs to recognize that reported datasets may not entirely reflect reality and thus need to be supplemented by physical checks. Finally, for cities to effectively draw on soft digital infrastructure like MDS for analytics purposes, there is a need to handle the privacy aspects of mobility data sharing, especially in jurisdictions subject to data protection laws like the GDPR. Nonetheless, the interview data on cities’ uses of MDS also demonstrate that soft digital infrastructure can emerge quickly and generate substantial value for cities, their citizens, and local businesses.
References


