

D.T2.4.2 Mobility data governance and management in the context of the development of a service hub - Strategic guidelines for cities and regions

SHAREPLACE pilot regions

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Executive Summary

More and more cities and regions worldwide are defining a decarbonised, intermodal and connected mobility system as the goal to aim for, tackling climate change, local air pollution and congestion. Digitalised architecture is the basis for new mobility services and technologies entering the public space. Therefore, data is the underlying force for any developments in such an environment.

This document aims to answer relevant questions on how to deal with mobility data on a local and regional governance level and on a technical/operative level. The use of open data can act as a useful approach for the public sector in the field of mobility data management and governance. Therefore, it is possible, by choosing this approach, to enhance and secure an intermodal, connected and inclusive mobility for the people. The advantages and barriers of this approach will be examined from four different perspectives, the public sector, the transport provider, the user and the developers and businesses. Together they are the most relevant stakeholder groups in the field of open mobility data governance and management.

The document concludes with guidelines to support the definition of rules and regulations for a holistic open mobility data governance and management through the public authority on two levels: on a governance and policy level on the one hand and a technical/operative level on the other hand.



1. Introduction

This deliverable is the first of three related deliverables - together they aim to draw a complete picture on implementing digitalised mobility services based on findings from the SHAREPLACE pilot regions. The three deliverables cover the following topics:

- Component 1 (Deliverable 2.4.2) Mobility data governance and management in the context of the development of a service hub - Strategic guidelines for cities and regions (AustriaTech)
- Component 2 (Deliverable 2.5) Open source code developed at pilot level for different pilot sites, and made available to third parties on a common repository (e.g. github.com) (Ulm)
- Component 3 (Deliverable 2.4.3) Guidelines (local strategic plans) for policymakers and planners on digitalization of mobility services in SHAREPLACE regions (Redmint)

For cities and regions it is essential to support, enhance and secure an intermodal, connected and inclusive mobility for the people. Many cities and regions are already developing plans and actions to reach their goals.

This document provides information in the field of mobility data management and governance for cities and regions to help them reach their goals. The information is prepared along following questions and on two levels of perspective, first on the policy level and second on the technical/operative level:

- How to deal with mobility data on a local and regional level (governance level)?
- How to deal with mobility data on a technical/operative level?
- What is the relevant legal framework for mobility data management and governance?
- Can an open data/open service approach be a useful approach for the public sector in terms of mobility data management and governance?
- What is important to know for cities and regions when using the open data approach in the field of mobility data governance and management? What are the advantages and disadvantages compared to proprietary solutions?
- How could be the first steps towards open data with reference to the other two deliverables with learnings from the pilot regions look like?
- What approach should a city/region choose?
- Why is it useful for cities and regions to deal with this issue - what are the advantages?
- Do cities and regions have decision-making sovereignty? If yes, where and how?

This document will also address some misunderstandings that may still exist, such as open data does not mean a complete do it yourself approach (e.g. clear rules for assigning service providers by contract).

In short, the document aims to give an overview on what has been done and what is possible in the field of open mobility data governance and management (open data to proprietary software) based on criteria such as resources, knowledge, availability, transparency, usability and costs. In the next chapter the mobility data governance and management is discussed, taking a closer look at the current rules and regulations. In chapter three, we look at what this means for cities and regions, transport providers and operators as well as users and developers. In chapter four, guidelines are provided for cities and regions as well as operators and providers for building and nurturing an ecosystem for mobility data in cities and regions.



2. Mobility data governance and management

Various organisations, institutions, companies and departments of cities and regions administrations have been collecting, managing and using data for years. Mobility data is also part of this data pool. This development gained more and more momentum as digitalisation made it easier, cheaper and more extensively, in one word - possible. In addition, the quick appearance of many and various new mobility services over the last couple of years was made possible through this megatrend named digitalisation. Because a digitalised architecture is the basis for all the new mobility services and technologies entering, the public space and markets worldwide - data is the underlying force, fuel and fundament for any developments in an environment that gets digitalised more and more. (Open Governance) Data in general, is defined as (non-personal) data that is collected, created or financed by public institutions and made accessible to the public without cost. Data in re-usable form for all interested groups and targeted to inform, analysis and visualisations or to create apps. This is considered as a basic infrastructure for digitalisation (Bertelsmann Stiftung 2020: 5).

Apart from public institutions also private companies rolling out new mobility services collect, manage and analyse huge amounts of mobility data automatically every day.

The quick appearance and roll out of many new mobility services by private companies based on a digitalised architecture revealed the fact that cities and regions face some important new challenges and also raised some important questions. The following questions can be seen as a general guidance for organisations, institutions, companies and especially for cities and regions interested in improving their effort in terms of mobility data governance and management.

- What aspects have to be considered implementing new mobility services into existing mobility systems?
- What aspects have to be considered integrating these new types of mobility data into existing systems and how could it be managed overall?
- How those learnings related to the management and governance of the mobility data from new mobility services can help to improve the general mobility data governance and management of a city or region?
- How cities and regions could use those data for their mobility management, planning and controlling to reach their defined goals for the mobility system?

Various approaches are an option here. Open data for example, can support cities and regions at the development of a decarbonised and connected mobility system focused on the interests and needs of the whole population. A holistic mobility data governance and management based on open data, even for cities and regions, can be the key to success. The following subchapters will highlight advantages and barriers of such a holistic, transparent, and usable mobility data governance and management system approach. A system based on open data.

To clarify the notion “open” in this respect, the “Open Definition” can be described as follows:

“Open data and content can be freely used, modified and shared by anyone for any purpose.” (Open Knowledge Foundation 2018, online)

The provision of open data means to provide data that can be used, reused and redistributed by everyone to plan, use and improve transport, ideally in a connected way (Kapl/Schwillinsky 2015).

Another definition of open data is stated as follows: Core attributes of open data include easily accessible (and findable) data in open standards that is free to use, originating from the primary source of administration, machine-readable and well documented (meta data) (BMDW 2019: 2-4).



Open Data - to live up to that notion - must fulfil following key elements:

- **Accessible and available:** Data should be available via Internet and at cost-price
- **Open formats and digitally and machine-readable:** Data provided need to be in a user-friendly, easily modifiable format as csv (as main format), json, rdf, xml) (Bertelsmann Stiftung 2020: 8). Regarding standards and formats it can be stated that the EU requires member states since December 2019 to “establish national access points for mobility data for open travel and traffic data” in prescribed formats in order to supply data to EU-wide multimodal travel information services (EU Regulation 2017/1926; ODIN 2019: 9). Here, awareness raising for EU standards in daily work in the transportation industry is essential.
- **Virtually free of restriction on use or redistribution** (Open Knowledge Foundation 2018, online): This should be clarified in the Terms of Use and licencing processes. For example, the licence CC-BY defines that: „where author's rights need to be protected under European copyright law, they should be secured with CC BY Creative Commons licenses.” (Deliverable 2.4.5: 7). In Austria, the currently preferred licence for open data is Creative Commons 3.0 (BY). Thus, users can edit, share and use the data freely for commercial purposes, when referring correctly to the source and author (Creative Commons 2020, online). A “Free licence” (decided from case to case but as open as possible (Bertelsmann Stiftung 2020: 6f) such as CC0 (CC0 - public domain, no copyright) can be considered less as a licence, but more as reference for the fact that no copyright protection is in place. “Through permissive and harmonised licences and terms, we will create sufficient room for innovation throughout the Nordics and minimise the legislative burden for innovators.” (ODIN 2019: 7). Furthermore, it would be very useful to have “established standards and practices for how to handle privacy concerns when opening up data.” (ibid.).
- **Universal participation:** Restrictions on certain use (e.g. only non-commercial) should not be applied.
- **Documented in metadata** to explain data column names and units, contact for questions and feedback (German standard: DCAT-AP.de). Other useful explanations within metadata are completeness (as complete as possible), original data from primary source and actuality (data in real-time published by programming interface API) (Bertelsmann Stiftung 2020: 9).

If provided along the above-mentioned criteria, no matter whether by public or private sector, such data can be considered as Open Transport Data (OTD) (Deliverable 2.2.1 2019).

In Deliverable 2.2.1 (2019) it was stated that The SHAREPLACE Service Hub should be usable in different system environments and not rely on any proprietary data formats or APIs. The use Open data will ensure that not only the hub will be usable in the different pilot regions but in other regions after the end of the project.

2.1. Important aspects for cities and regions

Based on the deliverable 2.2.1 “Analysis on open data existence, characteristics and potentials” this document focusses on the strategy on open data use. It especially focusses on the challenges the regions face when implementing it in a service platform. The pilot regions analysed the open data currently in use, especially concerning format, service level and digital availability. For each pilot region and each service that is available in the region a table was filled in with different data characteristics. The analysis shows that all regions have a lack of data, especially open data. Another problem is the lack of services in some



regions. The main strategy should be a good basic system of open data to implement the planned service hub. Agreements with public transport providers and other service providers can help to get open data. At least a better collaboration within the region between different service providers would be helpful.

Cities and regions are, sometimes even unknowingly and without being asked as in the case of the first massive roll out phase of E-Scooters and bike sharing services, the host for the implementation of various digitalized mobility services by various new mobility service providers. Those services have in common that they all need, to a certain amount, public space to operate. However, to operate orderly those new services need a digital architecture, a digital layer, which covers and enhances the physical space. Data, as the underlying basement of digitalized mobility services, driver of their further development and a crucial resource for digitalised mobility services in general offer a powerful leverage for cities and regions.

While the physical public space and its use is strongly and thoughtful regulated this is very often not the case for the new added digital layer and the produced data. Cities and regions, as public authorities, managing public space in the interest of the public have to enter this field more actively to ensure a development of future mobility services in the interest of the whole public within a city or region. So that those new mobility services can enhance, support and improve existing mobility systems in cities and regions.

This document wants to deliver helpful answers to the question: why dealing with the topic of mobility data governance and management and what could be the motivation behind it for cities and regions. What could be the motivation for cities and regions to start with a holistic mobility data governance and management, even based on open data?

The reasons can be various but are essential for cities and regions:

- Cities and regions have to lead (Polis Network 2019: 33) and choose a proactive approach. This holds also the chance for cities to know better what is going on in their streets and dealing with the issue of data sovereignty
- Reactive approaches can miss strategic opportunities (intense dialogue, active participation, strategic dialogue and cooperation (ibid: 3)
- Open data is an important prerequisite for the full potential of data from municipalities in the mobility sector (WIK 2020)
- Open (government) data does not in itself represent added value, but the added value arises through the re-use of the data inside and outside of municipal administrations (ibid.)
- It might be a good option for cities and regions to start with an open data approach from the scratch, if there are no mobility data available at all
- Establishment of a MaaS - in line with a citizen oriented approach to the management of public space and a potential future MaaS on city or regional level
- Mobility data governance and management as the basis for potential scenarios regarding multimodal mobility supply for public transport and sharing services in cities and regions based on the findings within the SHAREPLACE pilot regions

2.2. Regulations for mobility governance and management

This chapter will give an overview about the most relevant regulations, especially for cities and regions and is based on findings described in other deliverables related to the topic of (open) mobility data governance and management (Deliverable 2.2.1). It will also highlight regulations related to open data and will give some examples from the national level like Austrian and German regulations and from a municipal level.



In general, those following regulations and examples will give guidance and help to answer the questions on:

- Why collect, store, evaluate and distribute data?
- Which data must or can be provided?
- What is the role of data protection?

2.2.1. European level regulations and policies with high relevance

The regulatory framework for the provision of transport and mobility data, re-use and processing is still very fragmented in terms of governance levels as well as transport modes. On EU Level, the Transport White Paper, 2011, envisages with Goal No. 8 to “by 2020, establish the framework for a European multimodal transport information, management and payment system”. This generic goal is stepwise put into practice by several regulations and initiatives on both EU- and national levels (Deliverable 2.2.1).

The following regulations listed below have high relevance to the topic of (open) mobility data management and governance. Also for cities and regions and their current and future approach managing and dealing with mobility data. In addition, the question of what do those EU regulations and policies mean to the national level will be highlighted.

2.2.1.1. European Data Strategy

In 2019, the European Data Strategy was published. The goal is to create a single data market for the whole European Union. It aims to “*make the EU a leader in a data-driven society. Creating a single market for data will allow it to flow freely within the EU and across sectors for the benefit of businesses, researchers and public administrations. People, businesses and organisations should be empowered to make better decisions based on insights from non-personal data, which should be available to all.*” (European Commission 2020a, online).

The goal of this strategy is a) to build a framework where data can flow within the EU and across sectors, for the benefit of all; b) European rules, in particular privacy and data protection, as well as competition law, are fully respected; c) The rules for access and use of data are fair, practical and clear.

2.2.1.2. General Data Protection Regulation

The General Data Protection Regulation (GDPR) entered into force on 25th of May 2018 and replaced the Data Protection Directive 95/46/EC. It responds to the changes and related challenges that came up with increased digitalisation. Based on key principles of **personal data privacy** following changes will be implemented:

- **Increased Territorial Scope:** The GDPR addresses all companies that process personal data (e.g. monitoring of behaviour) of EU-residents, no matter if the respective company is located in -or outside the EU.
- **Penalties:** Breach of GDPR can be fined either with up to 20 Million Euro or 4% of annual global turnover (whichever is greater) and includes clouds.
- **Consent:** One key aspect of the GDPR is “privacy by design”, thereby the request for consent has to be in an easily accessible form and has to explain clearly the purpose for which requested data is processed. In addition, withdrawal of consent should be easily possible. This also comes with the “right to be forgotten; each data subject can request his/her personal data to be erased.



- **Data Protection Officer:** Companies processing personal data need to appoint a Data Protection Officer.

The GDPR and timely compliance to it is highly relevant for transport companies, processing personal data e.g. by collecting passenger's name and contact or personal user data in order to tailor travel propositions and improve the passenger experience as well as smart ticketing approaches. There, a pro-active approach to achieve user consent has to be taken and a positive framing of the use of personal data to improve transport and mobility needs to be addressed.

As *lex specialis* to the GDPR a "Proposal for a Regulation of the European Parliament and of the Council", concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC (Regulation on Privacy and Electronic Communications) has been elaborated and is currently under review (EUR-Lex 2017). This so-called e-privacy regulation addresses electronic communication regardless the technology used in terms of data and privacy protection and the right of confidentiality, following a privacy by design approach (Deliverable 2.2.1).

2.2.1.3. The PSI-Directive

The PSI-Directive (Directive on the re-use of public sector information) first entered into force in 2003 and was revised with the directive 2013/37/EU, in force since 17 July 2013 (EUR-Lex 2013). In 2017 a public consultation for a review was started.

The focus is on the re-use of public sector information (PSI) and encourages all member states to provide as much information for re-use as possible, both on national and regional/local levels. Contrary to a full-fledged open data approach, the re-use of data provided can be charged for, but only at self-cost of data provision. In addition, data provided needs to be machine-readable, easy to search and be provided along standards. Transport data is not necessarily PSI, as the operation of public transport is not only carried out by Public Sector Bodies (PSBs), but also by private or semi-public bodies. This differs strongly between countries, regions and transport modes and depends on the respective legal frameworks and contracts between public bodies and transport operators (Deliverable 2.2.1).

The PSI-Directive needs to be transposed into the respective national legislation; thus, each country has a different status that can be found under the following link:

<https://ec.europa.eu/digital-single-market/implementation-public-sector-information-directive-member-states>

2.2.1.4. INSPIRE Directive and Implementing Rules

The INSPIRE Directive (2002/2/EC) aims at the creation of a European Union spatial data infrastructure in one or more of the 34 spatial data themes, among which are transport networks (EUR-Lex 2007). It aims at the provision and unrestricted use across borders of harmonised, high-quality government geo data in electronic format. It came into force on 15 May 2007 and was implemented in several stages, with a full-fledged implementation planned for 2021. The Directive is complemented with binding common Implementing Rules¹. The INSPIRE Directive has to be transposed to the Member States, the status of which is available under following link (Deliverable 2.2.1):

<http://eur-lex.europa.eu/legal-content/EN/NIM/?uri=CELEX:32007L0002&qid=1473844236873>

¹ <https://inspire.ec.europa.eu/Legislation/Data-Specifications/2892>



2.2.1.5. ITS-Directive and its priority areas

The “Directive 2010/40/EU on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport” came into force in 2010.

Its objectives are:

- Establish a framework for coordinated and effective deployment and use of ITS
- Develop specifications necessary to ensure the compatibility, interoperability and continuity for the deployment and operational use of ITS for priority actions (EUR-Lex 2010)

Article 3 sets out priority actions for the development and use of specifications and standards, which are further specified in so called delegated acts.

- a) the provision of EU-wide multimodal travel information services
- b) the provision of EU-wide real-time traffic information services;
- c) data and procedures for the provision, where possible, of road safety related minimum universal traffic information free of charge to users;
- d) the harmonised provision for an interoperable EU-wide eCall
- e) the provision of information services for safe and secure parking places for trucks and commercial vehicles;
- f) the provision of reservation services for safe and secure parking places for trucks and commercial vehicles.

Notably **Priority Action a) on the provision of EU-wide multimodal travel information** is key to promote connected mobility with open data across Europe (see² Commission Delegated Regulation (EU) 2017/1926 of 31 May 2017 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide multimodal travel information services).

It targets at access and exchange of at least static public and private travel and traffic data for travel planning across all modes. The phased implementation is made via National Access Points (NAPs), single points of access for users to at least the static travel and traffic data and historic traffic data of all transport modes.

The exchange and re-use of data provided including its quality shall be on a non-discriminatory basis and fully transparent and be arranged with licence agreements, a harmonised set of terms and conditions and quality criteria.

The ITS Directive also addresses the use of interoperable data exchange formats and protocols based on existing technical solutions and standards for all different transport modes (Deliverable 2.2.1 2019). Please see chapter 2.3 for further elaboration on data exchange formats.

2.2.2. National level regulations - Austria, Germany and Finland as examples

The regulatory framework for the provision of (open) transport and mobility data, re-use and processing is still very fragmented in terms of governance levels, transport modes and therefore when even existing, vary, in terms of depth and scope, from country to country, region to region and city to city.

² <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32017R1926&from=EN>



In the European Union, the legal framework regarding open data and the re-use of public sector information is based on Directive (EU) 2019/1024 of the European Parliament and of the Council on open data and the re-use of public sector information (Open Data and PSI Directive). The new version of the guideline came into force on July 16, 2019 and the implementation period of two years ends on July 17, 2021.

In Austria, the previous Directive 2003/98/EC in the version of the amendment from 2013 (Directive 2013/37/EU) is replaced by the Federal Law on the Further Use of Information from Public Bodies (Information Further Use Act, IWG), Federal Law Gazette I No. 135/2005, implemented in the version of Federal Law Gazette I No. 76/2015. In addition, the federal states have their own information reuse laws (BMDW 2019).

In Germany, on May, the 18, 2017, the German Bundestag approved the draft of a first law to amend the e-government law (EGovG) passed. Through the amendment of the Federal E-Government Act with the addition of § 12a EGovG (Open Data Act), the authorities of the direct federal administration have to publish unprocessed data based on the open by default rule. The law specifies central criteria for Open Data. These include in particular free provision, free access to the data and machine readability. Data protection and other reasons that could prevent publication must be respected (WIK 2020).

Aim of the Finish government is “to make all significant public data available to citizens, enterprises and society in machine-readable format, free of charge and under clear terms-of-use. (if there are no restrictions in the legislation).” (Karvonen 2017, online: 6).

2.2.3. Regulations and policies on a local level with examples

Through the massive appearance and roll out of various new mobility service providers over the last couple of years, cities and regions had to react with new regulatory governance and management approaches. Those approaches are based on their federal regulations and therefore vary often. Cities worldwide started to use, additionally to fragment and partly unclear legal frameworks, new types for dealing with the new situation and defining rules with private law agreements, tenders and Requests for Proposals (RFPs). Vienna, Paris, and many more cities have been using this mix, due to a lack of clear regulatory frameworks to manage new mobility services and their data and implement them into existing (mobility) data systems in the cities. With this approach, cities and regions aim to define certain criteria for data quality, availability, re-use and exchange.

Some international municipal or regional examples highlighted in the following paragraphs will show current developments in the field of (open) mobility data governance and management approaches.

The Manifesto for technological sovereignty of the city of Barcelona states:

- “Free Software, Open Data and Open Standards, Document and Data formats and communication protocols are the bases for technological sovereignty for cities and best support the digital rights of our citizens.”
- “Provide cities and citizens with tools enabling non-discriminatory access to and provision of digital services. This is not just a technology paradigm, but a culture that helps individuals and communities to protect their digital rights as well as to achieve innovation and reach goals that are beneficial for society in a collaborative manner.”
- “We believe that Free Software provides a solid foundation to achieve better levels of efficiency, stability and interoperability [...] through source code ownership, collaborative development and sharing.” (Bria/Bain 2020, online)

The application of the above-mentioned regulations and strategies at a municipal or regional level is also often reflected in practical implementation, e.g. by setting up Open Data Portals or ITS projects (Intelligent



Transport Systems) (WIK 2020). Setting up such Open Data Portals includes a process in advance to clarify up to what quality level cities have to provide or request data, what is decided on which level or which department and a definition of a data exchange framework for stakeholders in the mobility data ecosystem. An example here is the “Open Data Plattform Mobilität Schweiz” (SBB AG 2020, online). It is the customer information platform for Swiss public transport and private transport. Mobility data free of charge can be viewed and access to various services is provided. The data published on this platform is prepared for developers, for example, a readable version of the public transport timetables are available.

Furthermore two guidelines, one in Germany and one in Austria, were published in the year 2019 for the management and governance of new mobility services and their data. The demand for such information was high, so compact guides can be seen as a useful tool for supporting public administration and authorities handling new mobility services. In both publications the topic of mobility data governance and management were highlighted and discussed. Important questions were answered in how to deal with mobility data from new mobility services and integrate them into existing systems.

In Austria, AustriaTech together with the Austrian Association of Cities and Towns published a guideline for cities and regions on how to deal with new mobility services (AustriaTech 2019, online). In Germany, Agora Verkehrswende (2019) published a similar guide for German cities and regions.

2.3. (Open) Data standards and formats

As mentioned in the chapters above, many efforts have been undertaken over the last couple of years to set up data standards and formats on different governmental and regulatory levels from the EU level down to regional or local levels. They all based on the demand for a clear, transparent und manageable process of data gathering, managing and sharing among all the stakeholders in the field of mobility. In reality, many different approaches can be observed which makes it difficult to reach this goal for the stakeholders in the public sector but also in the private sector.

As highlighted in the chapters above, open data can be the fundament for a successful development to reach the goal of a clear, transparent und manageable process of data gathering, managing and sharing. On the one hand, there have been many efforts put into the standardisation of data formats on the European level (therefore see the following paragraphs on the ITS directive). These efforts can be seen more as a top-down approach. On the other hand, this development in standardisation, which is often a long and difficult approach, does not always keep pace with new and unforeseen demands and developments in the field of mobility, such as the appearance of new mobility services (therefore see the paragraphs below on MDS - Mobility Data specification). This approach developed in the cities has reacted more quickly on the specific demands and problems of cities and regions and it is based on open data. In addition, it can be seen as a more bottom-up approach.

The goal for all the affected stakeholders has to be combining those two approaches, the top-down and the bottom-up approach to develop a common approach in the field of mobility data governance and management.

As always in the process of standardisation the development is ongoing, existing standards will be further developed, and new ones will arise. Therefore, it can be stated, that we are currently in the middle of a process with various interests, goals and aims. This can be examined in the case of LADOT (Los Angeles Department of Transportation with their developed MDS format and standard against Uber as a private mobility company, which do not want to use this standard. Their argument is that they want to protect their user’s data sovereignty. Thus, sovereignty over data generated in public space is one of the fundamental questions now and very likely for at least the next couple of years.



Based on the work within deliverable 2.2.1, following can be stated. In the EU the **ITS Directive** and notably the **Commission Delegated Regulation (EU) 2017/1926 of 31 May 2017 (“Prio a”)** calls for a “harmonised set of interoperable data exchange formats and protocols based on existing technical solutions and standards across different transport modes” to be used by the respective National Access Points.

Along the ITS Directive/Prio a following pre-existing standards and technical specifications are relevant:

- Road traffic information: DATEX II; e.g. travel time information, traffic messages, etc.
- Rail: TAP-TSI technical documents B1, B2, B3, B4, B8, B9
- Air: IATA SSIM
- Underlying spatial data: INSPIRE

If transport modes choose other standards, they are strongly recommended to avoid duplication of travel and traffic data in more than one format (e.g. urban rail data to be provided either in TAP-TSI or NeTEx). DATEX II in this respect is expected to expand its scope to cover further urban elements.

For the exchange of data, the NAP (National Access Point) - to ensure EU-wide interoperability and continuity of services - is asked to use:

- For static scheduled data (e.g. public transport, long distance bus, etc.) the “CEN data exchange standard 16614 based on the underlying conceptual data reference model Transmodel EN 12896: 2006 and subsequent upgraded versions or any machine-readable format fully compatible by the agreed timeline”.
- For dynamic public transport data, (if included in the NAP) “the relevant parts of the CEN public transport data exchange standard SIRI CEN/TS 15531 and subsequent upgraded versions or any machine-readable format fully compatible should be used”.

Prio a lays down data categories for static and dynamic travel and traffic data to be provided incrementally in an annex.

For **national data operations**, member states can still use national public transport data standards but need to ensure the provision of data in the specified EU standards on the national access point level.

In practice a **wide variety of data file/syntax formats and standards is being used** by public, semi-public and private actors in terms of data provision and related information services. Except from those mentioned above, machine-readable data formats include: TCIP (Transit Communication Interface Profiles), XLS, XML, JSON, CSV (comma-separated values) or XSD. GTFS (General Transit Feed Specification, the “google format”) is a common format for public transportation schedules together with geo-information.

In addition, geo-data provided for free and often used is based on Open Street Map that builds on data voluntarily collect by individuals using xml-data.

A so-called web service comprises different open protocols and standards for exchanging data between apps or systems. For IP (Internet Protocol) based mobility services following standards can be identified.

Most data standards (DATEX II/NETEX) rely on XML (eXtensible Mark-up Language)-based technology, therefore XML schemas are often used for pre-defining the exchange behavior between different service applications. Examples are

- W3C-XML - specified by the World Wide Web Consortium (W3C), the main international standards organization for the internet.
- SOAP web services: The Simple Object Access Protocol (SOAP) is an XML based lightweight protocol for the exchange of information in a decentralized, distributed environment.



- REST services: The Representational State Transfer (REST) is based on web standards and uses HTTP protocols for data communication.

For an integrated approach to retrieving up-to-date data in a direct-access manner for re-use e.g. in travel information applications, interfaces are needed that link existing information systems to exchange routing result. These so-called **APIs (Application Programming Interfaces)** are a respective set of requirements for the interaction and communication among different web-based services resp. distinct systems. The opening of APIs, i.e. the simplified linking of data via direct access for other transport and travel information providers, is currently a main discussion issue when it comes to multi-modal transport information and services.

The Prio a (19) recommends that “travel information services should use the European Technical Specification entitled ‘Intelligent Transport Systems – Public Transport – Open API for distributed journey planning 00278420’ currently under finalization (CEN/TC 278 (2017)) when performing distributed journey planning”. “Technical solutions for APIs comprise e.g. CKAN and DKAN.” (Deliverable 2.2.1).

As mentioned above, due to urgent practical needs on city and regional levels, some bottom-up approaches of open data and interfaces were developed within the last years, outpacing international standardisation processes. One of these is the currently very influential Mobility Data Specification (MDS), which was first created by the Los Angeles Department of Transportation (LADOT) and is now furthered by the international non-profit Open Mobility Foundation. Worldwide 75 cities are using or referencing the LADOT MDS project, including European cities like Zürich, Helsinki, Lyon, Hamburg, Brussels or Lisbon (LADOT 2020: 16; Mobilservice 2020, online). MDS will be discussed in more detail in section 3.2.

MDS is an open source interface that created a nowadays widely used standard for data exchange between private (micro-) transport providers and the public sector. This can work both ways: As vehicle and aggregated trip data provided to the public in order to coordinate and improve own services and infrastructure, as well as vehicle caps and restricted service areas sent to the private service providers. Transition to the practical field seems easy as compliance to MDS can be made a prerequisite for receiving a local permit. The expectations are high that MDS can be a driver to efficiently implement services of multimodality and to create a wider data evidence for public sector transport planning, as the development of the interfaces and adaptation for more use cases are constantly advancing.

In Germany, for example to highlight the current situation, very similar to many countries worldwide, in finding a solution to solve the issues and various drawbacks from the two approaches mentioned above, the VDV (Verband Deutscher Verkehrsunternehmen -Association of German Transport Companies) offers via the VDV Journey timetable interfaces: static data and the open journey planner. They also presented publications on technical specifications of how data transmission in local public transport should look like.³ However, the disadvantage of these documents is that they were always intended for internal communication between public transport operators, but not for communication to the end customer in an app or similar. To overcome this shortage, the VDV started to offer the Cooperation platform DELFI as foundation for the app “Mobility inside”. The aim of this cooperation platform of federal states in Germany to connect their mobility services for customers to offer transport information across administrative borders. Since the beginning, the main functions of the database was enriched with further improvements for useability, ticketing and real time data (WIK 2020: 24f).

On the other hand, there is some critical review on this development. Based on the deliverable 2.4.5, following shortcomings can be described with the current approach of the VDV.

“In Germany, the umbrella organisation of the German public transport operators (VDV - Verband Deutscher Verkehrsunternehmen -Association of German Transport Companies) represents the outdated opinion to not

³ <https://www.vdv.de/oepnv-datenmodell.aspx>



implement international data standards but set up "own" standards for Germany (VDV Schriften). Those are then of course not interoperable with international standards like GTFS and GBFS, which are commonly used by most of the new mobility service operators and data standards outside Germany." This makes it difficult to share data as open data according to the open definition (Open Knowledge Foundation 2018, online).

In one of the workshops the deliverable 2.4.5 is based on, important steps were discussed to improving that situation once new contracts are made in order for everyone to slowly move in the direction of more open data and international standards. The focus has to be laid on small steps, which can be reached in the near future like starting to ask detailed questions to digital service providers on integration possibilities of international data standards and opening data in small steps (Deliverable 2.4.5).



3. Mobility data governance and management from the perspective of four key stakeholder groups

Globally, the dimension of creation and collection of data is expanding continuously: Between 2013 and 2020, we will have accumulated an amount of digital data that is 10 times more than the whole data stock before 2013 (Ziomek 2019, online). In addition, the pace is still accelerating. Nevertheless, the important question is not how to collect and store this oceans of data - in Europe it is estimated that 85% of all collected data won't be used a single time (profil 2020: 63) -, but how to cluster and bring them to a practical application for existing or upcoming problems. Data are often called the fuel for our information-based society and at the core of economic and innovative activities. However, differently to crude oil data will most definitely lose value when (only) being stored. As an informational good data only develops value when it is compiled, analysed, visualised and contextualised - and the more often this is done, the more benefit data brings to society and economy. Therefore, if you want to maximise the reach and impact of data, you need to open up the faults that contain them. This concludes the main line of thought of an open data approach.

SHAREPLACE is supporting this and is dedicated to the development of tools supporting the design and implementation of innovative sustainable mobility services, in order to provide better connectivity within local and regional passenger transport systems. As such, it depends on an eco-system connecting a variety of stakeholders, technology, data and associated mobility services - creating added values for each player involved. In this chapter, we therefore want to focus on the actors and stakeholders that take part in the governance and management of mobility data, concentrating especially on potentials and challenges that come with offering and applying open data, open interfaces und open source software. These are clustered into four groups:

- **Cities and regions** with their main role as initiators and promoters for open data in the public sector, providers of general data as well as operators of the therefore needed platforms
- **Mobility and transport providers and operators** collecting many mobility data that can be offered as open data and thus hoping for internally improved digital services as well as positive inputs from external actors. They can be privately or public-owned and include from small platform-based on-demand (micro) mobility companies to the dominant city transport network agencies
- **Users of mobility services** who are mainly interested in an efficient and comfortable provision of public transport
- **Developers and businesses** working on new business models and practical applications of provided data

All these actors largely depend on the quality, availability and exchange of mobility data for setting-up innovative and connected mobility services in the upcoming years. Often, availability of mobility data is not clear in the first place, or various stakeholders manage mobility data in separated data silos of public and private institutions. Therefore, in order to open up, combine and contextualise open mobility data, a certain level of cooperation and co-creation between different administrative departments and transport companies that are collecting and providing data as well as an active debate and interaction with the needs and capacities of service users and developers (plus the open data community) is needed. This can be done best, when effective and long-term oriented platforms are established and maintained in an involving process.



3.1. Relevance of an open data approach for cities and regions

Public institutions collect huge amounts of data sets and information within their daily administrative and operative activities - take e.g. geo-information, budget or infrastructure data. Data can enable a city administration to understand the flows and dynamics of mobility and transport better and deliver the base to tackle today's problems in transport, like traffic jams and focus areas of accidents and air pollution (WIK 2020: 28). Within the last ten years, the idea to make these (non-personal) data accessible to a broad audience in civil society and business took off and was declared an important policy towards improving transparency and innovation (Bertelsmann Stiftung 2020: 19f). Today, many institutions at all levels of government (and even international entities, like the United Nations and the World Bank) have made a substantial share of their data stocks publicly available. Accordingly, the EU has published a data strategy that plans to position the EU as "role model and leader for a society empowered by data" and plans "setting up a true European data space, a single market for data, to unlock unused data, allowing it to flow freely within the European Union and across sectors for the benefit of businesses, researchers and public administrations" (European Commission 2020b, online). One key aspect of this approach is to make high-value public sector data accessible to all - "whether public or private, start-up or giant" (ibid.).

More and more cities, some regions⁴ and also institutions on national level consider open data and accessible open programming interfaces (open APIs) a basic (public) infrastructure for digitalisation and embed it in a paradigm of technological sovereignty on the one hand, and digital citizen rights on the other (Bertelsmann Stiftung 2020: 5; Bria/Bain 2020, online). While the former sets goals and activities for public institutions to enter or stay on full control of their service infrastructures, websites, applications and data, the latter is concerned with putting a key public policy focus on citizen rights in the digital world - ranging from privacy and security, to digital identity and possibilities for participation (Bria/Bain 2020, online). For this agenda the public sector should take on the role of a multiplier and raise awareness for advantages and benefits of open data (WIK 2020: 33f). Following this understanding, a city or region should put down the foundation of digital rules on basis of which private operators can provide mobility services in public squares and streets. Control and data sovereignty are critical and need a decisive mobility data governance and management.

At the centre of these efforts stand open data, which - at the core and as discussed above - are essentially non-personal data that are collected, created and/or financed by public institutions (but also semi-public and private) and made accessible to the general public without cost. The sense of openness mainly builds up on three pillars: An open licence to be used and re-used, open formats and transparent documentation in the metadata (Bertelsmann Stiftung 2020: 9). As such, a wide array of users can access, use and integrate public data into their personal or research interests, community activities and entrepreneurial purposes in order to develop analysis or applications and encourage improvements of services or business models.

Following the principle of knowledge and information to be "open" and available to the highest numbers of users possible, the optimal approach for mobility data governance would be "open by default" and the notion of "open data as a service" - while only deviating from this rule when explicit reasons stand against it, like personal data or other legally limiting factors. "Open by default" responds to the observed fact that too little data is published too slowly and therefore not up-to-date. The German Open Data law explicitly states the commitment to "open-by-default", but the implementation process currently seems to be less ambitious (Bitkom 2020a: 6).

Such an approach to open data requires, promotes and drives at the same time a broader cultural change within data providing institutions towards openness, transparency und participation (ibid.: 4). Consequently,

⁴ E.g. the Ústí Region in Northern Czechia with the platform "Portabo" as unified open data intermediary, shared between 59 municipalities within the concept of a smart region (Stich 2020, online).



this helps public administration and transport operators changing their point of view towards perceiving themselves as enablers of digital transformation and do their stint to take part in establishing a constructive digital culture internally and externally. Thus, organisations need to be open to change and evolve, be collaborative, invest in experimentation and in people's digital skills (LADOT 2020: 25).

3.1.1. Advantages and potentials of an open data approach

The local and regional administrative levels are exposed to two massive momenta of transformation of the urban mobility sector in the upcoming years. On the one hand, climate change and its effects on cities and regions drive the growing need and increasingly stricter regulatory provisions to decarbonise transport and interconnect mobility modes. On the other hand, automation and connected mobility create huge amounts of detailed, real-time data that call for a use, analysis and contextualisation. In this moment of transition neither municipal administrations, nor transport operators can lean back, but should intensify their efforts of promoting digital instruments internally and externally.

The critical foundation of these processes is open (mobility) data. Advocates of open data initiatives emphasise vast perceived benefits of providing open data for all sectors of society. While some of these can be measured, some will become more visible in the future and some may stay rather anecdotal or simplified myths that nevertheless can inspire collective action and decision-making (Melin 2016: 113). Such advantages and potentials of open data will be presented in the following section, grouped in three dimensions: Political and social, economic, and operational and technical benefits.

Political and social benefits

Increasing public sector transparency and accountability, establishing a culture of openness: Open data helps reinforcing trust of civil society as well as the external and internal legitimacy in government agencies and municipal departments because underlying data for many decisions is made transparent (Melin 2018: 116). Extending the concept into other areas of policy means widening the possibilities of checks and balances by civil society further. Non-personal or aggregated data created or enriched within public institutions has already been paid by the public and therefore should not be hidden behind a paywall, but be accessible for the biggest number of interested stakeholders as possible (Krabina 2016, online).

Open data as resource for education and research: High Schools and Universities worldwide use public data to teach, experiment and investigate and thus pass on and deepen technical and statistical capacities (Karvonen 2017, online: 11). The more specialised, detailed and contextualised open data sets become, the more elaborate the conceived solutions and practical digital skills in the new generation of citizens will become.

Breaking out of data silos: Open data combines information from many institutions, agencies and departments as well as many different topics and disciplines and incentivises them strongly to coordinate the shared effort and cooperate. Likewise, the better contextualised and linked this data becomes, the bigger is the value for the users. Similarly, civil society does not know or care much about the distribution of administrative responsibilities between departments and will ask for data that is cross-referenced in more than one area. All of this helps lowering the boundaries of data silos and making them more permeable and thus more likely prone to innovation.

Boosting democracy and participation: One major hope that is set in the application of free software and open standards, as well as in the provision of open data, will help equipping citizens and developers with more material to build evidence-based arguments and helpful digital instruments (Karvonen 2017, online: 11). Civil society is empowered by these means of digital production and the democratisation of data and can bring in their interests and purposes towards public data providers via the exchange in data communities



or directly on the platforms (Bria/Bain 2020, online). In addition, open data improves the surrounding conditions of available information for many fields of society, like social commitment, (data) journalism and research. It can be seen as taking a step towards the growing interest of society for participation and developing a dialog between administrative city bodies and civil society by publishing open data. A clear trigger are strong alliances between politicians, civil servants, IT professionals, and decision makers that are willing to establish and promote “a first mover advantage” (Melin 2018: 116).

Economic benefits

Boosting innovation and business opportunities: Open mobility data contributes to new innovative services and market opportunities for local and regional entrepreneurs and innovation as well as to job creation in software companies that base their activities in open data (ibid.: 119). Between 2016 and 2020 it is estimated that 40.000 new jobs were created through provision of open data in Germany - which goes hand in hand with a significant increase of tax income (WIK 2020: 3; Karvonen 2017, online: 11). In a survey from 2017, the benefits of open data for London are estimated to reach 105 to 150 million Euro this year. However, it should be considered that this is the case a big front-runner city, of which data and activities in this sector are reproduced all over the world. For smaller cities or less well-funded agencies it is much more difficult to quantify specific results (Bailey 2020a, online).

New services and applications: Additionally, indirect economic effects can be observed as in the improvement of mobility services through new apps using open data. These benefits unfold (from a holistic point of view) over time because the starting phase of new open data platforms is connected to significant costs and slight losses of income from selling data for the public domain⁵. From today’s perspective, these potentials are only partially realized with much room for improvement, especially in accessibility of publicly owned data (WIK 2020: 31). A good example can be observed in Finland: In 2012, the National Land Survey opened up its digital geo-data inventory for the public. Within three months downloads multiplied 50 times (compared to purchases before) and the first application using the data was published after only one month⁶ (Karvonen 2017, online: 9).

Operational and technical benefits

Efficiency and synergies in public administration: Open data creates economic value when used, combined and enriched with other data inside and outside the scope of public administration. Direct effects are estimated to sum up to approx. 300 Mio. Euro in Germany for the year 2020, mainly resulting from increasing efficiency of technical procedures and lowering costs through sharing technical infrastructure, creating synergies and economics of scales (WIK 2020: 3). In addition, special manual requests for data, coming with the need to clean and prepare them for individual use cases will be much fewer, because users and developers will head directly to the open data portal, where they can find all the data provided. This reduces the load and administrative burden on other communication channels (Melin 2016: 118).

Building up technical expertise and digital competences within the administrative bodies: Open data and open source solutions are considered more flexible and give the data provider higher control over the outputs, but also come with more work for the staff and are especially demanding in terms of necessary IT-competencies, all of which is costly (Stich 2020, online). However, confronted with the massive transformations ahead driven by the continuous process of digitalisation in the next decade, now could be the best moment to prepare for these challenges. Sharing and pooling resources in city departments can also be put in practice for internal trainings and workshops of public employees. At the same time, a deeper

⁵ A summary of studies investigating the benefit of open data to the GDP can be found here: WIK 2020: 6-8

⁶ Other examples for the impact of open data can f.e. be found in Verhulst and Young 2016.



confrontation of public bodies with digital technologies on the one hand brings more awareness towards and use of (mobility) data in the administration and raises the attractiveness for technical professionals on the other. These combined efforts can lead the way towards realising technological independence and data sovereignty (Bria/Bain 2020, online).

Clear (data) structure and active exchange with other institutions: Publishing data regularly and interacting with other institutions for that, makes having a clear structure in both the technical operative departments as well as in data management an indispensable necessity. Furthermore, specific responsibilities can be much intuitive and clearer to the public when installing specific contact people (e.g. a “data steward”) for topics like traffic data.

Higher data quality through feedback loops: Offering data to the public comes with an intensive co-creation process together with developers and the wider open data community. These will point out needs for the introduction of appropriate formats and standards and give feedback on provided data sets. This creates new feedback loops between municipal departments and the public: Firstly, the institution gets value back, when a third parties refine the data and add value, which can then be used again by the public institution. An example for that can be data on air pollution that is crowd-sourced⁷, which can result in a much finer network of sensors, being of use for the administration (Melin 2016: 118f). Secondly, more eyes see more and thus errors in the data can be detected and corrected more easily (Karvonen 2017, online: 11).

3.1.2. Challenges of an open data approach

As mentioned above, some of the expected benefits of open mobility data are rather abstract and their impact is not easily measurable, besides from the number of applications developed and estimations on efficiency gains and job creation (Melin 2016: 113). Obviously, making data public also comes with challenges and trade-offs, which will be discussed in three groups: technical barriers, institutional challenges as well as competition and legal objections.

Technical barriers

Abundant data, but not in open formats: Municipalities collect massive amounts of non-personal data as part of fulfilling their daily duties and activities. More and more of those are available to be read and downloaded on municipal web presences, but still do not fulfil two major technical criteria: The accessibility in machine-readable formats and a lack of clarity about the possible uses of data, like a specific generalised licence. Therefore, municipalities should strive to climb the ladder of the 5-star open data quality scheme, where level three (data in structured, non-proprietary formats) can be reached rather easily and improves the quality of data provision drastically. With open mobility data specifically, it can be observed that certain data required for dynamic multi-modal travel information is not available from all transport and mobility providers. Here, incentivising measures need to be set to get these providers to collect and share such data (e.g. real-time transport information) (Deliverable 2.2.1: 17).

Cost for providing and maintaining high-quality open data: Data need to be updated regularly to ensure exactitude and improve their quality, as certain requirements are needed to be met for processing and analysis. Even if open data is mandated from private operators, data workflows and evidence-based city and mobility planning can be hobbled by technical debt and out-of-date processes within the public sector. This calls for a strategic approach to build up competences in-house. In addition, resources needed for technical staff and hardware can conflict with the needs of other departments or projects. The return of

⁷ Especially in Germany under the domain luftdaten.info



investment on these costs is mostly not immediately traceable respectively benefits might fall to others (e.g. time saved by transport users) and therefore such investment is internally often hard to argue. Faulty information from not well-maintained data rather compromises a transport company's reputation than getting benefits from data meeting the required level of quality. (ibid.: 16) All of these issues should be considered under a strategy of investing in digitalisation of public authorities processes (Bitkom 2020b: 10).

High technical requirements: The provision of open mobility data brings up many questions on data formats and standards, necessary technical equipment and structure of the process of offering data. Nevertheless, in all of these fields a vast range of experience has already been collected by different actors, which can be screened and applied. Some technical obstacles, like missing APIs and standards, that first seem especially demanding are considered to be the easiest to solve. (Deliverable 2.2.1: 17) Furthermore, there can be concerns about security when opening systems for external access, which however should be considered as an ongoing challenge that has to be tackled anyways in any digital public appearances.

Size matters: Still, the requirements of data quality and (semi-)automated handling und updating of data can bring smaller municipalities to the limits of their technical capacities. At the same time, such municipalities can be too small for having an active data community that can use the data for innovation and new business models. Both of the arguments then call for stronger cooperation on a regional level and for making use of synergies (Bertelsmann Stiftung 2020: 21f).

Institutional challenges

Low awareness of municipal decision makers for the use of open data: In the study of WIK for the German context, it got apparent that decision makers at data owning administrative bodies often still know little about or are not yet convinced of the benefits of open data (WIK 2020: 32). Still such initiatives need clear enthusiasts and local supporters, together with positive examples from the external context (Melin 2016: 116). However, it has to be recognised that government institutions are heterogeneous and unite both supporters and opponents for open data, "depending on position, type of department, norms and values and line of business." (ibid.: 120) When developing a local or regional open data approach, this has to be considered and addresses appropriately.

Principle of risk avoidance in the public sector: Making data accessible for external users also challenges traditions and norms within the institution, as the organisation needs to open up to some extent. This can come with a fear to make mistakes, as errors will be more visible to the public, thus enforcing risk avoidance and little interest for experiments and failure in the public sector, as it is connected with the waste of tax money in public perception. Similarly, on a data level this can lead to a type of convenience sampling, implying the smallest effort, where data is chosen for publishing that is already prepared, cleaned and legally safe. This approach will give little room for real improvements and innovation (ibid.: 114; 117).

Interaction with the open data community: When using a participatory and empowering technological approach like open data, publishing data sets alone cannot bring the whole potential for society. It is meaningful exchange, taking in advice, feedback and hints from the local and regional community that makes it special and valuable. Such a community usually consists of people that range from a merely interested person in the respective topic, up to experienced specialists and developers. Focussing on their needs and perceptions on data provision helps the public sector extending their perspective of a predominantly publishing to include user views and will directly affect the success and impact of the initiative (Bertelsmann Stiftung 2020: 21f). On the other hand, citizens interest, resources and competences in open data should not be taken for granted, but need to be attracted and nurtured actively (Melin 2016: 113f).



Competition and legal objections

Fear of starving out own income sources: Against the development of local and regional open mobility data platforms can stand commercial interests, especially when high-value data, like real-time traffic or geo information data that previously were sold, are planned to be published without cost. Here, the benefits mentioned above should give an indication of the higher impact of open data to administrative efficiency, as well as to the wider society and economy, than the loss of the often work-intensive, user specific and low quantity data sales realised in the public sector.

Perception of losing control when providing open data: Companies like Google, but also community-led-developments like Open Street Map have started to collect and share data, because public institutions reacted too slowly to the general need for data. Public data adds to existing commercial, co-created civil data pools, and lay the foundation for better information and services. Limiting accessibility of data comes with far more negative consequences than offering open data, especially for citizens and small firms that usually cannot afford to build up or buy data on a bigger scale (Bertelsmann Stiftung 2020: 21f). By providing open data, cities and regions can actively participate in this arena and influence the development of new applications and incorporation of specific topics in the public debate, when offering more data.

Question marks about the legal basis for open data: Municipalities deal with questions of legal foundations, licences and privacy in their daily work. Therefore, providing open data does not represent an incalculable challenge. According to the EU-wide “Open Data and PSI-Directive (EU) 2019/1024” and its national implementation, it is within the own decision marking responsibility of a city or region, which data they want to publish⁸. Privacy concerns should not be a big issue as the subject of open data is strictly non-personal, non-sensitive and aggregated or abstracted information; anonymity must be ensured and most of the time data is aggregated. If a municipality does not own the (exclusive) rights for data, these legal questions need to be actively clarified from the beginning (Bertelsmann Stiftung 2020: 21f).

3.2. The perspective of mobility and transport providers

After discussing possibilities, advantages and challenges of an open mobility data governance and management approach for cities and regions, we will now focus on the second set of institutions, the providers and operators of mobility and transport. They are the ones that add up on the general pool of data offered by the public hand, with their specific expertise and information concerning mobility. Transport providers can be publicly or privately owned, or take mixed forms, such as profit-oriented companies operating under considerable public influence or financing. Many of the needs, expectations and topics concerned with processing and handing out data that come up for public institutions apply here. Differences can be seen in the specific role of the transportation sector as a generator and provider of specialised data, feeding into public data portals and less as operator of such platforms.

Current developments in open data and data-driven services are new regulations on the one hand, that are especially set up with companies offering shared micro mobility services in mind, and demand travel data of offered vehicles to be shared with municipal planning institutions. On the other hand, more and more data is interlinked between different mobility providers - independent from if they are public or private - across administrative borders and means of transport. As such, former fragments are combined into new integrated digital services, like MaaS, and consequently create and activate more information and knowledge on traffic flows in municipal and regional institutions.

One of the most important prerequisites for open data is harmonisation of data standards that make data exchange possible between institutions of different sectors and diverse in practise established formats: E.g. for the Scandinavian mobility providers it is clear that “public transport actors are currently invested in

⁸ For more details see section 2.2



different standards” (ODIN 2019: 8). Often fragmented approaches, thus resulting in diverging standards, were used to quickly react to newly upcoming problems that created a strong momentary need for action, leaving coordination at the end of the list of priorities. Some of the results of such bottom-up solutions can be considered as virtual best practice, but unfortunately does not always go along with contemporary top-down national or transnational efforts for coordination - in particular with today’s activities on EU-level to develop standards in areas where other approaches are already used.

One example of such a bottom-up international standard is the open interface (open API) Mobility Data Specification (MDS). MDS constitute a set of open source tools developed by the transport planning department of Los Angeles (LADOT), that are now widely used for real-time data exchange between (private) mobility providers and city administrations. Another showcase is digitransit, a service platform for an intermodal public transport journey planner developed by the Finish transport agencies. Digitransit is used in the project SHAREPLACE as the open source software to design a transnational, technology based mobility service hub. Both examples work to reshape the transport system towards becoming more efficient, sustainable and inclusive and represent a multi-modal, pan-urban approach to mobility management (Bailey 2020a, online). They will be presented and discussed in detail below.

The connection between these two practical examples is the use and propagation of open APIs for new mobility services. Since the omnipresence and availability of data is no end in itself, we need technical interfaces that connect different strains and origins of data with an end users service surface and thus push interoperability. Open APIs make formerly closed and invisible backend systems accessible to third party developers, who then can engage and work on new connections and services with the provided data (this is an approach that some digital platforms, e.g. Twitter, provide for many years already) (Bitkom 2019: 7).

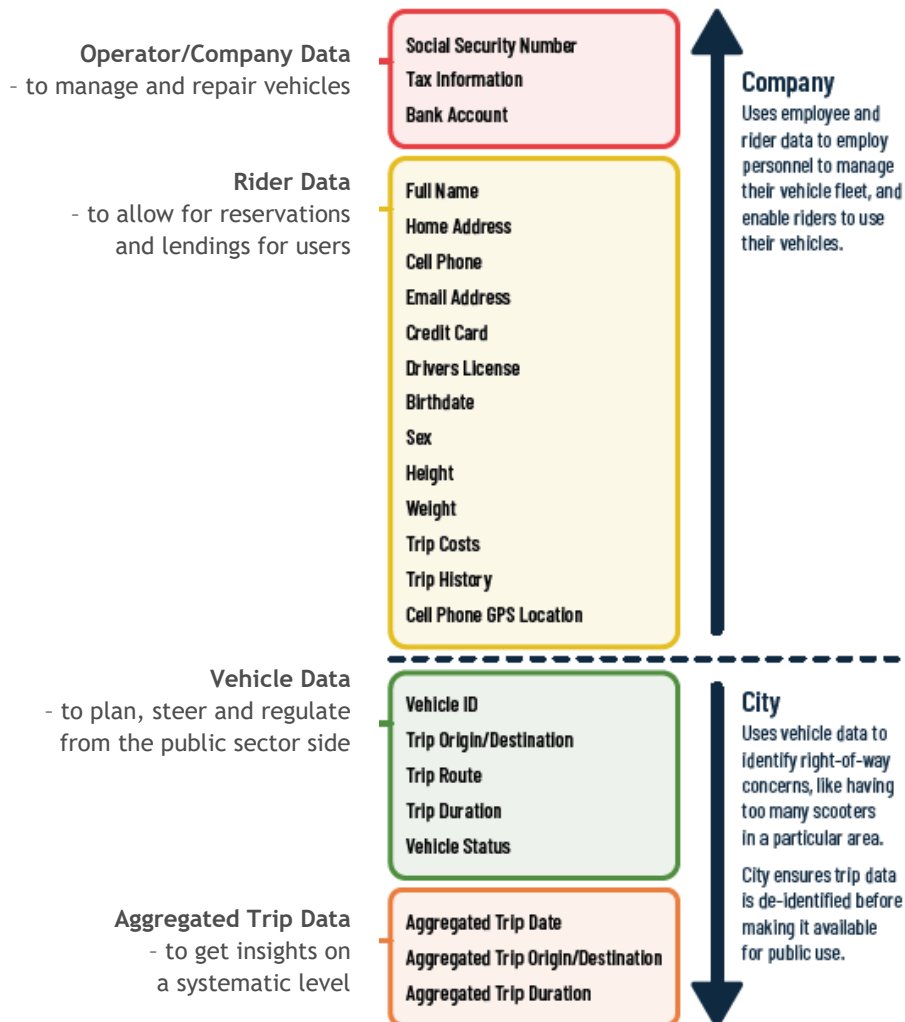
Mobility Data Specification (MDS) - connecting public and private mobility data

In the last years, many cities have been caught by surprise by the sudden influx of numerous private free-floating shared bike and e-scooter operators, powered by digital platforms and a constant flow of data. In reaction, city administrations and transport planning departments started working on establishing a legal basis for these new service providers, limiting negative effects of their use (such as occupation of wide areas of public space and lack of disposal of broken devices) and on incorporating these services as a purposeful piece within the whole local transport system.

For the latter, the Los Angeles Department of Transportation has developed the open source standard and interface MDS, which opens up ways of data exchange between private (micro-)transport providers and citywide transport operators or public institutions. Its aim is to bring the data of operators together and provide the best mobility service, regardless of it being offered by the public or private sector (LADOT 2020: 15). This can work both ways: As the bikes and scooters are tracked by GPS, these vehicle data can be applied by city transport planning to regulate the on-demand mobility offers, add up to existing statistics on traffic flows and sensor data, and consequently plan infrastructure improvements. Implementation for the city seems easy: Adherence to MDS can be made a prerequisite for receiving a local permit. Micro mobility operators thus can be obliged to share real-time information, including trip data, costs, vehicle locations and usage (Mobilservice 2020, online). [Figure 1](#) depicts and explains the practice of LADOT for exchange of mobility data in the context of micro mobility providers. Aggregated trip data and vehicle data is going to be shared with cities. Operator/Company data and rider data stay within the companies.



Figure 1: Overview on shared and processed data by entity within the framework of MDS



Source: LADOT 2020: 19

On the other hand, local transport planning agencies can also send information via MDS to the private transport providers, e.g. on vehicle caps and service areas of the city, where micro mobility offers are temporarily or permanently not allowed. Furthermore, real-time management information can be interchanged, like street closures, parking restrictions or designated zones where micro mobility services are strongly encouraged (LADOT 2020: 15).

While the attractiveness of MDS for the public sector is clear, also (micro) mobility companies profit from the emergence of this governance for data exchange: They do not have to provide different data formats depending on the country or even city of operation and it facilitates to implement regulation effectively - such as temporary ban zones. In addition, MDS strengthens communication and coordination with the city authorities, reducing the risk of conflicts - as it happened in the beginning of the micro mobility boom (Baily 2020b, online).

MDS is considered the necessary digital infrastructure in the time of intensifying digitalisation that adds up to the existing analogue means of transport. As LADOT (2020: 16) puts it: “Both digital and analogue infrastructure matter. We will need both to succeed.” LADOT first coded MDS with local needs in mind, but



then decided to share it on Github, an open source software repository, to be copied and co-created by all interested actors. One year later, 75 cities were using or referencing the LADOT MDS project in their permits for free-floating micro mobility. European cities, like Zürich, Helsinki, Lyon, Hamburg, Brussels or Lisbon, are currently applying the technology in pilot projects (Mobilservice 2020, online).

As a next step of upscaling, the code base of MDS was transferred to the non-profit Open Mobility Foundation, bringing together municipal stakeholders and public transport providers with micro mobility and software businesses and research. This organisation represents an international discussion platform, where exchange on new issues in mobility data governance take place and the necessary interfaces are developed further and adapted for more use cases - such as micro transit, autonomous vehicles, last-mile delivery and the operation of drones (LADOT 2020: 20f).

Digitransit - an alternative way to go for MaaS

Multimodality is one big hope to incite changes of individual mobility - leaving behind the private car more often and opting for a variety of (shared) means - and thus reducing the carbon footprint of society as a whole. “Mobility as a service” (MaaS) concludes this concept and is inseparably coupled with new digital services to make switching back and forth between train, shared car, bike and scooter as easily and comfortably as possible. Still, there are not many software solutions available that allow local transport providers to implement MaaS efficiently, adjusted to their and the municipality’s needs, and that are manageable in terms of costs for a small mobility environment.

Digitransit is a collaboration project providing such an open source service platform for an intermodal public transport journey planner, based on OpenTripPlanner. Originally it has been conceived and developed in 2017 by Helsinki Region Transport (HSL), the Finnish Transport Infrastructure Agency (Väylä) and TVM LMJ Oy. As such, Digitransit is used mainly for providing digital transport information and connecting public transport with other means of mobility in Helsinki, but also as national journey planner for the whole country.

The mobility platforms implemented in the SHAREPLACE pilot regions of Ulm and Osijek are based on digitransit and aims at creating a sustainable, digital solution, which is easily transferrable to other cities and regions (Deliverable 2.5.1: 6). Both criteria plead for an open source solution and stand against proprietary data formats or APIs, because in open form it can be properly adapted to different circumstances, like for different cities, modes of transport, topography, customer needs, etc. At the same time open source software has shown to be the more resilient option compared to commercial platforms, for the reason that keeping developing your own solution makes you far less vulnerable to negative external impacts. (ibid.: 3) Consequently, digitransit also improves digital capacities of the administration and offers many ways of teaching and learning for city employees and transport officials in the age of digitalisation.

A factor of success for digitransit has been the solid community behind the open source project that guarantees further development for an active and continuous effort in improving the software. The more users the software stack gets, the more stable it becomes, the more organisations profit from improvements and the more brains can think about challenges and solutions together. Therefore, it is essential to align own developments as good as possible with the original digitransit code and bring new features upstream, so all the digitransit instances can profit. The code is openly accessible and allows all interested parties to copy it and participate in the on-going development of the service (ibid.: 21).

While the digitransit-project is still in its earlier stages of implementation and adjustment to practice, it is used all around Finland and continuously receiving more follower-cities, such as Ulm, Münster or Turino (OpenStreetMap 2020, online). Although there are many barriers, such as little awareness for open source software and reluctance to share and provide data in transport agencies, SHAREPLACE sees co-created open software solutions as the most sustainable way of implementing service innovations, especially in the



context of publicly funded projects: “Open-source allows for adaptations to changing circumstances, which does not only apply to future challenges cities and regions have to face but also to the different circumstances in a city or region.” (ibid.: 21).

Additionally, many more successful initiatives that are leading the way in open mobility data could be named here, such as

- DELFI as cooperation platform of federal states in Germany to connect their mobility services for customers to offer transport information across administrative borders (WIK 2020: 24).
- The Finnish Transport Code setting the national legislative groundwork for open transport data to enable MaaS (Mobility as a Service).
- The Open Mobility Data Platform Switzerland⁹, which stands as a data centre for public and individual transport, also offering access to interconnected services and open tools for developers and the open data community.

3.2.1. Advantages and potentials through an open data approach

The cases of MDS and digitransit combine and apply many elements of desirable technical executions for digital mobility services, led by public transport planning departments and mobility agencies: They enable exchange of information with private stakeholders through open APIs. Further, aggregated statistics and real-time info out of this can be published as open data and open source solutions developed, which are then shared on developer platforms to co-create the continuous improvement of the code. The two examples demonstrate the benefits of such an approach and underline the need and possibilities of open data programmes for cities and regions worldwide. There are many more leading initiatives and role models to name, between them global cities like New York, Singapore and London, which consistently have promoted open data for many years and help creating a wide and diverse range of mobility applications for citizens, without the need to directly fund all transport information systems. (Bailey 2020a, online) Some more advantages will be discussed below.

Improve services with open interfaces: By incentivising private mobility providers (or binding them by contracts) to share and exchange vehicle data stocks with public administration or the leading local transport operator, higher detail and diversity of real-time information helps to increase the service quality and thus travel satisfaction for the passengers. This allows discovering shifting patterns of use quicker, reacting to changes or peaks in demand and in the medium-term adapting offers and infrastructure in order to ensure the most efficient flow of urban mobility. When knowing more about the current positions and frequent routes of on-demand sharing systems, it gets easier to establish functional connections with existing bus and tramlines, laying the base for intermodal mobility hubs in existing public transport stations, and working to solve the still pending question of the “last mile”. With further development and implementation of more aspects included in the discussed APIs, they can become the foundation for the public domain to regulate and interconnect other privately offered means of transportation in the future, like automated cars, ridesharing or freight drones. Additionally, this opens ways for transportation regulators to nudge mobility companies by adjusting fees or taxes in order to make it more attractive to place their devices near public transportation stations before rush hours (Zipper 2020, online).

Cultural shift from procurement towards co-creation with open source communities: Providing open data needs much more than just the technical hardware. It implies an institutional cultural shift of the transportation company, working hard to enhance openness and transparency of data and involved processes. This requires an effort of internal institutional learning that is not to be underestimated.

⁹ <https://opentransportdata.swiss/de/>



Obviously, this institutional evolution needs internal resources and active support from the management. However, existing open data projects have shown the dividends of this endeavour (ODIN, 2019: 10). Adding up to the internal benefits named for local and regional public authorities in section 3.1.1, mobility providers profit from a positive image as modern transportation company, signalling to be open to external influences and interested in the needs and of their customers and other partners. A company shows that it is welcoming to new entrepreneurial thinking and raises its attractiveness towards technical talent to implement forward thinking digital programmes within the institution (Bailey 2020a, online).

A factor for success for the development of open source software, such as MDS and digitransit, is having a solid **community**, which helps co-creating the code and testing it in practice. It is central to understand developers and re-users' needs and platforms for exchange of information and ideas. One example are Hackathons, which can be targeted at specific present problems: At the end of March 2020 a three-day-long digital Hackathon was organised in Austria, where more than 500 participants worked on 50 projects, based on existing open data and focussing on 40 pre-defined challenges. The winning project developed an app that allows public transport providers to distribute passengers within train compartments, thus guaranteeing sufficient physical distance between one another (Krabina 2020, online).

Establishing common open data formats and standards bottom-up: Daily activities of transport providers are often connected with the need of reacting appropriately to newly upcoming challenges. Proactive and prompt initiatives, like the open source solutions of the Los Angeles Department of Transportation and the Finish transport agencies, can set practical foundations, where none have been before, and are consequently build up on and distributed on a global level. In that way problems can be tackled in a timely manner and the open documentation of gradual learning processes can help other cities to leapfrog up to applicable and functional software for the improvement of own services. As discussed above, the worldwide extending network of MDS comes with similar or identical specifications, which make coordination for private transport service providers that operate in different countries, with the public sector much less complex. Obviously, the downside of such a bottom-up process is that formats and standards are propagated, which are not formally coordinated and regulated on an international level - and therefore could make harmonisation more difficult afterwards. At least first applications in practical and real-life contexts allow for (comparatively) quick reactions on a local level and set this topic on the agenda of high-level regulation governance.

Open source creates fewer dependencies on commercial software houses: Open source solutions have to be adapted and constantly implemented within the very specific to unique case of a local institution. This comes with considerable costs for trained and specialised technical staff as well as for the proper hardware. Accordingly, the main argument for open source and open data approaches can only never be fewer costs than proprietary software. However, it gives the respective institution control over the process, the possibility to create the closest fit to local problems and - on a bigger level - helps other cities and regions to then use it for their own situation. As such, it is not a problematic new cost centre, but should be rather seen as an investment in the digitalisation and modernisation process of the institution.

3.2.2. Challenges through an open data approach

Shouldn't data be sold? For mobility companies that work profit-oriented, it seems to be counter-intuitive in the first moment to provide data for free, which firstly generate costs when collected and processed, secondly cause again expenses when being offered and updated on a platform and thirdly traditionally have been a source of income in some institutions (see also section 3.1.2 on that). Fourthly, at the same time other stakeholders can use the data for own product development and financial return. Is that justifiable?

Against the first and second arguments speak the much higher return for mobility enterprises, in newly created services (developed without a cost), better structure and increased quality of data, build-up of



technical expertise internally and increased image and external attractiveness for talent connected to IT-topics. The third point is dominated by two misunderstandings: On the one hand, there is a phenomenon of “income-illusion”, which describes the common practice of underestimating the effort for selling data and overestimating its revenue. On the other, many factual data (such as automatically gathered sensor data) do not actually fulfil the criteria of copyright, as there is no creative process involved, and thus are not protected. When purchased from an institution, the data could be passed on without legal limitations - thus breaking a market-place approach. (Bertelsmann Stiftung 2020: 21f) Finally, value is not created by merely collecting, but essentially by using data. A limited-access strategy delays innovation, while open access to information makes developing applications or data analysis possible.

Limits to open data: Still (perceived) competition, one-sided data exchange and lack of trust between competitors, often hinder the provision of open data and opening up interfaces. Own data stocks are seen as the main advantage in competition. Here a clear need to communicate and explain the possibilities of provision becomes visible, e.g. solved in differentiated licencing agreements - from CC-NC (non-commercial use only) and CC-BY (need for attribution) to CC0 (free licence). There can also be limits to open data, when personal data is involved or data about core business activities, like occupancy rates of trains (Deliverable 2.2.1: 17).

Lack of awareness: Currently a lack of “knowledge about open source, open source business models and risks with open source” can be observed (ODIN, 2019: 10). Open source still seems to be perceived in the domain of nerds, other than of business people. This calls for strategies to create awareness and communicate plans and examples on open source solutions. Forums and events can deliver on that, where opportunities to connect with technical administrative directors can be initiated and exchange of experiences be arranged. At the same time, relations with NGOs and NPOs, lobbying for open data and open source solutions, should be established and nurtured (ibid.).

Need for harmonisation: As discussed above, harmonisation will always be lagging behind implementation of formats and standards. There is a clear need for better coordination of internationally used data standards for specific applications of data - on all levels of government, from the local to national, from EU- to the global level. The existing discrepancies range from different levels of detail, to ambivalent content under the same definitions and varying interpretation of standards, to incompatible metadata specification or classic language barriers (especially with qualitative data, like reasons for transport service interruptions). (ODIN, 2019: 8; Baily 2020b, online) Additionally, transport agencies can decide to boycott international coordination and keep on opting for own standards. An example is VDV, the umbrella organisation of the German public transport operators: They refrain from implementing international data standards, rather focussing on own German standards (Deliverable 2.4.5: 3).

Difficulties for implementing data exchange with private mobility providers: When adherence to data exchange patterns, like MDS, is made a prerequisite for companies to obtaining local permits and being able to use public space for their offers, contractual issues have to be considered. Existing contracts in public transport are often concluded on a long-term basis and close to, none will already have included regulation on the provision of open data. These need to be reviewed and adapted accordingly - if possible. Furthermore, in many countries transport organisation and operation is shared between a number of agencies on different levels, with varied responsibilities and proprietary systems. This fragmented governance makes it difficult to find a common denominator and cooperative procedure for open data provision and exchange on national or on regional level. Here, a one-size-fits-all approach does not seem fit (Deliverable 2.2.1: 17).



3.3. The mobility user perspective

In the centre of the activities of public transport, planning departments and mobility providers should stand users of offered mobility services. This group is not directly addressed or involved in the open data governance discussion per se, but is the benefited third party when new applications are developed that run on static and real-time open mobility data. Mobility users are looking for ways to make their daily trips more comfortable - involving less effort - and cheaper as well as reducing waiting time, saving precious hours over the year for more central activities than commuting or travelling.

3.3.1. Advantages and potentials through an open data approach

Mobility users mainly profit from two types of practical digital applications of open data and interfaces: Firstly, **apps that give access to and promote multimodality**. Digital tools that make different transportation offers more transparent, help comparing them (e.g. in costs, time needed and CO₂ emitted) and connect them visibly in one holistic offer (e.g. showing routing information or different means of transport within a certain reach) are paving the way for a more flexible and sustainable lifestyle. The underlying goal is to bring public massive transport services together with private on-demand (micro) mobility options, to a holistic concept known as “Mobility as a Service” (MaaS). Frequent users of sharing offers will receive a better overview of the optimal mobility option for this moment in time. Less experienced users will have access to car-, ride- or bike sharing as well as to e-scooters in one app for the first time. Such tools can also be used to nudge passengers towards more efficient or sustainable forms of transportation, providing users price reductions or other compensations for specific means of transportation or for avoiding peaks of capacity in rush hours.

Secondly, mobility users benefit from the **creativity and practicality of solutions created by the open data community**. These usually focus on hands-on solutions for specific problems or make it easier to take public transport for groups with special needs, promising more personalised information and a better journey experience. The following are examples from the Viennese context for such gradual improvements and additions for existing mobility services (Wiener Linien 2020, online; Krabina 2020, online):

- Depicting nearby stops of public transport on a map and - when clicked on them - showing current departure times of subway, tram and bus lines.
- Visualisation of real-time information on maintenance and disturbances of elevators for passengers with restricted mobility (e.g. disabled, wheelchair users, parents with babies).
- Door-to-door routing with alarms for when to leave your location to reach the transport.
- Combinations of public transport and parking regulation zones as well as garages in the city.
- Distributing passengers within train compartments, thus guaranteeing sufficient physical distance between one another in times of COVID-19.

Additionally, users profit indirectly from a more active position and involvement of the public sector in digital data policy and management. Companies like Google have been the first to make commercial use of the internet, mainly by collecting data on users of their (quasi) monopolised services in order to optimize relevance and degree of detail of publicity. Public institutions seem to have reacted too slowly to the general need for data and left the digital world almost exclusively to private profit-oriented firms. The “Manifesto in favour of technological sovereignty and digital rights for cities” lays the groundwork for cities actively participate in this arena (Bria/Bain 2020, online). It urges city authorities to create appropriate frameworks that, while protecting privacy of the individual and recognising the abilities of commercial business models, deliver these data sets across the urban mobility space. The central aspect for mobility users in this manifesto are the **digital citizen rights**, which should “include the rights of privacy, security,



information self-determination and neutrality, giving citizens a choice about what happens to their digital identity, who uses their data online, and for which purposes.” (ibid.).

Open data can be the source of own information, analysis and illustration of (mobility) data for interested transport users and citizens. This brings transparency to the discussion - especially in the case of citizens’ initiatives that organise against public infrastructural projects - and can help to make measures taken more comprehensible.

Finally, open data supports the development of a more comprehensive role of the user. Besides using existing data as a consumer, they also produce more and more data. Hence, the role becomes a more active one, being not only a consumer but also a producer of open data. Existing examples for these developments are Open Street Map data, and digitransit. The open data provided by the user is an essential part of such systems and helps them to strive and becoming better services.

3.3.2. Challenges through an open data approach

Concerns on privacy and non-discrimination: An important barrier for the use of newly developed services can be privacy concerns. Nowadays, users expect their location data and personal information to be collected and utilised further on by the operator of a mobility service for own commercial purposes. The notion that (some of) this data then leaves the company’s data bases in form of open data, to be easily found and accessed online - even if in anonymous or aggregated form -, might still need some effort to explain and dispel fears. Public institutions and transportation agencies have to communicate the essence and benefits of open data actively and build up awareness that this only involves non-personal, non-sensitive information and mostly aggregated data. Protecting personal privacy has to one of the highest priorities in public policies (LADOT 2020: 18).

Problems with self-developed applications: The quality of new services that are powered by open data can vary quite much. Big initiatives, which also involve the public transport providers, like applications for MaaS, are meticulously developed, constantly updated and severely secured. Nevertheless, a number of small, self-developed apps are limited in reach and mostly only add one detail to the general picture on the one hand. On the other hand, many are created by people with a personal interest in this topic, where priorities can change over time. Some of such neglected apps are consequently connected to risks of security breaches caused by outdated specification and coding.

3.4. The developers perspective

In addition to the relevant stakeholders highlighted in the three subchapters above, also the group of developers working in the field of (open) mobility data management has to be considered. It is essential to create structures and processes to invite private developers in order to cooperate and tackle together with the public sector the challenges in the transport sector that is coming with the urgent need for decarbonisation and digitalisation. Additionally, developers, and the open data community are important stakeholders because they can be relevant drivers for software but also for hardware developments.

Especially if public administrations are aiming for an open mobility data governance and management approach, following specifics must be named and implemented into strategic programs and action plans. Developers are among the technological experts and based on the availability of open mobility data they can bring in their expertise to enhance the quality of an open mobility data governance and management approach within public administrations. A higher level of transparency and trust can be developed. Moreover, offering open mobility data can enhance the creation of economic value through their use by developers.



Providing an overview of open mobility data to third-party developers on which data is available, on its quality and on the originating institution - including the design and diffusion of scalable support functions like “published examples, documentation, libraries and other support-tools” can support cooperation with private developers. In this cooperation, also university engagement and (online) collaboration with other institutions can be implemented. The goal of cooperation is to collect and interchange developers experience to improve the data offer. Events and innovation contests as part of an engagement with interested data communities should be supported (ODIN 2019: 11).

3.4.1. Advantages and potentials through an open data approach

There are many advantages for developers using an open data approach within the mobility sector. First, the access to open mobility data offers the possibility of economic activity to such private developers. Open data does not mean that there are no economic possibilities and markets and everything is free of charge. Economic opportunities based on an open data approach can be increased, because not everything can be done within the departments of public administration. Even if they have, in the best possible case, well-trained staff and familiar with open mobility data management. The knowledge of professional developers usually is at the newest level of information in a specific topic or sector. In addition, usually the expertise in the institutions is lower compared to professional developers.

Another important advantage, for both sides, the public administration but also for the developers is the fact that the open data approach supports and increases the possibility of new and creative solutions. Creativity to find new ways to solve problems is a benefit when focusing on an open mobility data approach.

Focusing on an open mobility data approach also increases transparency, which is a benefit also for both sides. It also helps to build trust among the stakeholders.

An open mobility data approach can help to reduce costs. For the developers because they have access to relevant data free of charge. Also for the public administration because if the data is used more often, the costs for collecting, storing, managing and providing the data can be much better argued and economically represented.

An open data approach also improves the data dissemination from the private sector to the public sector. This cooperation works much better if it is on an eye level.

3.4.2. Challenges through an open data approach

It is often still the case that public administrations, institutions and organisations have little experience with the open mobility data approach. However, the development is improving over the last couple of years. This approach is accompanied by and based on a cultural change. This development takes time, persuasion and persistence because it goes against habits that are in place for decades. This slow process or even worse the absence of this cultural change can be barrier to work with the open mobility data approach.

An open mobility data approach should not be seen as only going from the public administration to the private sectors such as developers and other experts in the field of digitalisation. However, this is often the case because private companies want to protect their business models and their economic interests. This prevents them to embrace an open mobility data approach with an open exchange of mobility data among stakeholders. Building trust and confidence is a tedious process and key to this approach. Moreover, the establishment of trust and confidence holds the opportunity to serve all stakeholders in this field in a positive way. Short-term thinking, such maximising the own economic interests prevents such a process. The goal has to be to contribute with data to an open mobility data system without endangering own business models. In this way trust and confidence can be built.



4. Building and nurturing an ecosystem for open mobility data governance and management- Guidelines for cities and regions

This chapter aims to highlight helpful guidelines for cities and regions to improve their situations in the field of open mobility data governance and management. Various advantages and barriers have been described in the chapters above. Here, the focus will be set on how these barriers can be tackled and lowered and what preconditions must first be created in order to be able to fully use the potentials of open mobility data governance and management.

The guidelines are structured in the following way: The first part focuses on the governance and policy level and aims to respond to what needs to happen on the policy side to overcome existing challenges and make the vision of connected mobility a reality. The second part concentrates on the operational/technical level and gives guidance to tackle barriers for providing open mobility data on this level.

Within these two sections, the guidelines are clustered along relevant aspects for implementing and improving an open mobility data governance and management approach:

- Fulfilling European legislation and frameworks
- Realising and making use of synergies
- Technical aspects for open mobility data
- Staff related training and learning
- Reach a full cooperation in mobility systems and data input from public and private service providers

4.1. The policy and governance level

Fulfilling European legislation and framework

It is worth to start with and highlight some guidelines and recommendations on the EU level that are relevant for open data mobility governance and management, because they help understanding the wider framework as in what direction political action should and - most probably - will head in the next couple of years:

- The EC plans to “Set up a European platform for data sharing in both sectors (personal transport and goods logistics) that, in the long run, replaces national solutions and national access points.” (Bitkom 2020b: 10)
- “Invest in the digitalisation of public authorities” (ibid.)
- “High-value data such as real-time data from the mobility sector.” (ibid.: 4)
- “The new data infrastructure project GAIA-X aims to establish a sovereign European open data infrastructure ecosystem and should serve as reference also for a data driven European mobility ecosystem.” (ibid.: 3)



Realising and making use of synergies

It is recommended to connect open data initiatives with a Smart City strategy and digital agendas to strengthen synergies between them. Likewise, it is advisable to combine and cluster similar projects and activities in different administrative departments and to integrate and take part in open data initiatives in higher administrative levels (regional, national level) to learn more and have a continuous exchange of ideas (WIK 2020: 33f).

Due to limited technical capacities, resources and a lack of awareness, developments are often questioned. These limitations can be reduced when cooperating with other likeminded municipalities and when learning from existing good practice examples (ibid.).

Technical aspects for open mobility data

The establishment of a central (national) open data hub, as independent institutionalised caretaker and main national competence centre for the holistic advancement and evidence-based implementation in the topic of open data, can be an institutional solution. The main tasks of such a centre could be providing intersectoral and interdisciplinary links between stakeholders from public and private sphere, science and civil society, elaborating and disseminating examples for good practice and driving exchange of learnings and cooperation on the international level. Establishing curricula for trainings and qualification measures, especially for municipal actors, will help to improve the expertise and awareness for open data (Bitkom 2019: 7f).

Such an institutional approach could also be developed on a regional or local level and could consider and integrate the specific situation of a certain city or region better. In general, a long-term strategy with concrete tasks on the way will have the most influence in improving the status quo in cities and regions. The focus has to be on training and skill development as well as improving the digital infrastructure.

Digital service teams, through which municipalities build up technical competence in administration and internal skills of public authorities, is as important as enhancing and extending the digital infrastructure. Hence, on the one hand questions on the level of IT-competence of the staff (e.g. can people in the administration write scripts and handle data), and on the other hand questions on infrastructure such as data processing in the traffic area (e.g. traffic sign register, curbside inventory, parking areas, real-time traffic counts, handling of MaaS services and data sharing agreements or regulatory solutions for data provision by private sector actors) must be considered and answered. Answers on these questions can be the basis for regulatory targets, including allocation regulations such as a "Minimum Viable Policy" as the regulations equivalent to a minimum viable product in the field of innovation. A city or region could define 100% open (non-personal and aggregated) data of their public sector as the main goal, accompanied from the beginning as a showcase, always with the focus on training, infrastructure and regulations.

In terms of developing, setting up and improving a helpful infrastructure recommended action No. 3 from the "MaaS MiA" process and working groups can be cited: *"Access to dynamic information in the mobility system is to be made possible by opening service interfaces based on the OJP standard. These service interfaces are to be provided by national "white label" services (e.g. VAO, EVIS AT)."* (ITS Austria 2019: 67).

Regarding access to mobility data, the same paper can be cited with recommended action No. 7: *"Framework conditions for agreements as well as core content for the design of access to data and public services for MaaS providers are to be designed."* (ibid.: 68).



Staff related training and learning

The development and support of regional central competence centres as information, learning, training, support and networking hubs for open data (governance and management) should be the focus, because open data activities should not stop at administrative borders. A sufficient funding and staffing can be made possible through the combination with existing initiatives for digitalisation, such as Smart City, and other digital agendas (Bitkom 2020a: 5).

A national initiative for training of open data managers (e.g.: 11.000 in total which is one per municipality in Germany) in open data competence clusters, or the integration of open data topics in specific administrative trainings and certificates as decentralised multipliers of know-how could improve the situation considerably. Furthermore, establishing this position formally on national level within usual administrative hierarchies helps to increase visibility and incentives to get certified for it (Bitkom 2020a: 6).

Reach a full cooperation in mobility systems and data input from public and private service providers

Confronted with limited financial resources, which is very often the case in public administration, the focus should be laid first on offering less but high quality data that is most interesting and offers the highest potential value for other stakeholders (e.g. real-time data in mobility) (WIK 2020: 33f).

The actors involved with the establishment of a local or regional open data platform should take on the role of multipliers and raise awareness for advantages and benefits of open data. Furthermore, they should put an emphasis on interaction and co-creation with user communities and create events to exchange opinions and collect feedback in order to improve own processes of open data provision, thus maximising societal impact. Specifically self-organised hackathons with local open data could push interest and awareness. These hackathons could be supported by local or regional administration. It is essential to incentivise and support physical experimental spaces, where data providers (city administration) and data users can come together and learn from each other. Furthermore, there also must be space for experimenting and collecting experiences with digital techniques and innovations. In addition, virtual experimental areas, like Big Data Test Infrastructure (BDTI) for Open Data, where methods and tools for data analysis are offered and experience with big data technologies can be done first hand (Bitkom 2020a: 7).

Agreements with public transport and other service providers can help to extend access to open data. At least a better collaboration within the region between different service providers would be helpful. The cooperation has to be at eye level between private and public actors to enhance trust among the stakeholders. All these efforts help to improve the readiness for testing and piloting within organisations and departments by increasing the capacity to absorb innovation processes and methods.

4.2. The implementation level (technical/operative)

In this chapter, the goal is to highlight relevant guidelines on a more operational level, on the technical implementation level. Focus are here again cities and regions.

Fulfilling European legislation and framework

Cities and regions have to prepare and elaborate digital basic rules as foundations for how private operators can use and behave on public streets. At the same time, they have to set a frame to support clean and safe mobility. Control and data sovereignty are critical and essential for a decisive mobility data governance. A useful and supportive starting point for cities and regions could be the definition of such an overall goal. Some cities have done this already, such as Barcelona, by stating technological independence (including data sovereignty) and protecting digital citizen rights as their overall goal of digital activities. This can be



seen as a specific institutional approach by one city but it also is already in line with the efforts on European level to establish a sovereign European open data infrastructure. A second step is to formulate a common action plan for mobility data governance and management. Then, the next step could be an inventory of existing data, together with a wish list for new data sets, and data sharing agreements to formulate a task list. This task list can be the basis for a roadmap for new data sources. In addition, the question of what do stakeholders need, is essential at the beginning of the process. Followed by a co-creation and development process set up together with the community and stakeholders.

Such defined target driving plans or action plans, with task lists and divided accessible packages, support cities and regions to get into action and avoid getting overwhelmed by the complexity of this topic. Awareness raising for a complete implementation (e.g. formulating the way to 100% open data at least according to DV 1926/2017) and for an internal cultural change regarding open data and open interfaces is highly recommended as an ongoing process. It should not be seen as a burden, but as an opportunity for long-term organizational development and improvement and as a design tool (e.g. open data automated to play out continuously).

Realising and making use of synergies

Forming alliances is also key on the implementation level. Having relevant interest groups of cities and regions on your side, such as e.g.: the Association of Towns and Municipalities in Austria, as supporters and enablers towards open mobility data governance and management is essential. Forming and building up governance partnerships holds the possibility of feedback loops and iterative learning. Mobility round tables or similar exchange and co-creation formats between interested citizens and municipal actors should be promoted and sufficiently funded. This also helps to activate local knowledge and technical expertise.

Technical aspects for open mobility data

The central goal of open data is to move from a fragmented field towards a holistic data and information policy framework. A first step of starting the process is to develop a strategy of how to open up data silos internally, and coordinate this procedure with other relevant stakeholders. By now, there are plenty of international learnings and good practice on data formats, licences and standards, where the experience made in other cities and regions can be applied. After formulating a guiding strategy, which contains set cornerstones about goals, definitions, benefits as well as challenges, and operating principles, a concept to bring these ideas to life has to be developed. This should focus on an operator model, together with a finance plan, data governance and technical requirements. Krabina (2020, online) describes an exemplary case of the necessary steps towards publishing open data:

1. **Self-screening:** Making an inventory of existing data and roadmap for new data sources and data sets. Considering what has been already published - also in formats that are not fit to open data standards (e.g. PDF) in order to provide this data in a more accessible way. Also, raising awareness and ensuring support within different levels of the own administration.
2. **Screening others:** Examining what other municipalities or regions have already published as well as checking existing open data portals to reflect on own possibilities and set main areas of interest.
3. **Taking in the stakeholder perspective:** Engaging with transport agencies, civil society, users, developers and businesses to find out, which data these stakeholders need and what is relevant for the different target audiences. An important part is getting in touch with the local data community through surveys and events to enter into a meaningful exchange to feedback and co-create the whole process continuously.



4. **Prioritisation and legal check of data:** First, setting the order of publication according to the internal capacities and stakeholder interests. Second, checking the legal details, being mainly the level of secrecy, the question of personal data involved, and the right to use the data within the publishing institution has to be examined. Third, establishing an internal support system for technical and legal questions to help building up expertise with the administrative actors has to be set up.
5. **Publication:** Focussing on open data criteria (especially on open licence and format, plus metadata) and making the information accessible to a broad public on an appropriate platform (Bertelsmann Stiftung 2020: 10f).
6. **Mid to long term focus:** Improving internal processes and capacities, integration of new tools (e.g. open APIs, open source route-finding), extending technical in-house know-how and resources. Ensuring cooperation in mobility system and data input from public and private service providers.

Additionally, and concerning technical, operational and infrastructure related aspects the following guidelines and actions are a helpful support. Within the SHAREPLACE project, some workshops and meetings were held on topics related to open mobility data management such as training of stuff, infrastructure and open data access and exchange. Based on the workshop on Mobility data, hosted by Ulm (Deliverable 2.4.5¹⁰) following learnings should be considered:

- Documentation of data flows is a prerequisite for knowing how to export data and securing access to third parties. Use for third parties is to be secured by either licensing data in the public domain (CC-0 or DL-DE Zero) or, in the case where author's rights need to be protected under European copyright law, they should be secured with CC BY Creative Commons licenses. If IT service providers are assigned to implement solutions, it is viable to clearly state those licensing terms in the contract.
- Creative Commons licensing terms guarantee that data is still accessible once requirements change unexpectedly, rigid systems may no longer work or a change of service provider is necessary.
- A focus set upon (ideally international) standards (GBFS, NeTEX, GTFS) and open interfaces ensure adaptability to changing circumstances over time.

Staff related training and learning

Training and skills development within administration departments is essential. For example, abilities to classify and assess interfaces and their practical suitability in offers should be trained, supported and further developed. Additionally, sharing and pooling of resources in the city departments is important as internal trainings and education of public employees in those departments.

Reach a full cooperation in mobility systems and data input from public and private service providers

Based on the framework of regulations highlighted in the chapters above also testing and piloting as an essential part of integrating new approaches at eye level among public administrations and private (sharing and MaaS) providers and transport companies in temporal, spatial or thematic experimental spaces will help improve mobility data governance and management on the implementation level.

¹⁰ CE1126_SHAREPLACE_D.T2.4.5_WorkshopMobilityData_Ulm



Furthermore, preparing open data from third-party sources and making it available to the public (e.g. simple shell scripts) should be focused on. Simultaneously setting up, documenting and maintaining such processes is essential.

The connectivity to and implementation into existing systems such as existing GIS in cities should be considered and evaluated. In addition, measuring traffic volumes in the road network depending on traffic mode (MIV, NMIV, and public transport) in real time can be set up, tested and implemented. Experimentation with new technology and instruments for traffic counts should be supported and focused on. Specialist procedures et al. should be assigned in such a way that open interfaces for automated open data export are mandatory; down to the parking guidance system et al.

If establishing, maintaining and improving an (open) data platform to facilitate data exchange between mobility stakeholders is the specific goal of a city or region, consider **privacy, data ownership, security, trust, and trade** as essential topics to cover and clarify. Furthermore following conclusions for open data portals toward different users should be considered (NYC Open Data Initiative 2017: 38-49):

- Provide maximum transparency on how data is collected, complied and maintained.
- Organize web content according to different levels of technical knowledge and experience - as easy as possible, as complex as necessary.
- Work together with (city or regional) agencies and their web presentation to connect visibly to the open data umbrella website, since most inexperienced users check specialised agencies first instead of open data sources.
- Engage in learning communities and events to draw users to open data. Build relationships and foster collaborative ecosystem of open data. Elaborate ways to connect skilled users with the ideas and needs of newcomers. Get in touch with multipliers (teachers, educators, community leaders) to present the open data portal and its uses and co-create adapted lesson plans.
- Define clear use cases and illustrative examples and identify support systems for users with low connection to open data and data skill level. Establish a platform for topic-specific trainings and demos.



5. Summary and Outlook

As described in previous deliverables within the SHAREPLACE project (Deliverables 2.2.1 and 2.2.2), there is a lack of open mobility data in almost all pilot regions on the one hand. On the other hand, there is a lack of mobility services. This is true for static but also for dynamic data such as real-time information about network's status, information about intermodal exchange between different means of public transport and information about ticket prices. Where open data exists there is the problem of diverging data formats between regions. Another challenge in the regions represents missing collaboration between different mobility service providers and public authorities and administrations. This is also true for the access to open mobility data, as there are many operators but with little interest in cooperations so far.

This report describes potentials and barriers in the field of open mobility governance and management, from the perspective of the most relevant stakeholder groups such as cities and regions, mobility and transport providers, the group of users and the developers'. Consequently, this results in the formulation of guidelines for the implementation of a holistic and transparent open mobility data governance and management.

Technological sovereignty, supported by a proactive digital policy approach in cities and regions, can have various advantages for the mobility system, as was outlined. It was shown that the most important tasks for cities and regions in the field of open mobility data governance and management are piloting and testing, implementing public interest, the integration of mobility data governance and management also in other planning strategies such as SUMP, Smart City, and the development of urban low emission zones as well as the focus on data infrastructure, sharing procedures, data specifications.

With an open data approach as a foundation for mobility data governance and management within cities and regions, the data situation can be improved and governance is not given out of hand. Open data is not only accepted by specialists in the field of digitalisation, IT and computing. It is already an accepted part of a bigger scheme and part of strategies in the time of digitalisation, for example within the Smart Cities approach. In addition, it plays an important role within new European legislation in the field of digitalisation. Data should not be seen as the new oil. Instead, they should be seen as the new common groundwater.¹¹ The more data are circulated, used and contextualised the more benefit data brings to society and economy. This line of thought represents the key idea and motivation of the open data approach.

¹¹ <https://netzp politik.org/2018/daten-sind-das-neue-oel-lasst-uns-die-richtigen-metaphern-verwenden/>



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