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RESEARCH ARTICLE

Digital platforms for transport research – status quo and future perspectives

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Abstract. This research article systematizes the current state and future perspectives of digital platforms in transport research, driven by increasing digitalization and data availability. Following an interdisciplinary expert workshop and a desk review of 36 non-commercial platforms, the study identifies EU regulatory frameworks (e.g., the ITS Directive) and viable commercial business models as primary drivers for data provision.The findings reveal a fragmented landscape where public and private mobility data availability is improving, yet significant deficits persist for specific research-generated data like travel surveys and field observations. The authors classify platforms by content and functionality, noting that most lack advanced analytical tools. The study concludes that establishing dedicated, secure platforms for research data, addressing privacy concerns and standardization is essential to maximize public funding impact and foster synergies between academia, urban planning, and private innovation.

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1 The importance of digital platforms in transport research

Mobility and transport revolve around the movement of people, goods and data. Thanks to digitalization, the boundaries between these three types of movement are becoming increasingly fluid. Firstly, physical movement is increasingly being replaced by digital alternatives. For example, people who work from home no longer commute to the office, but instead generate data streams. Goods can be purchased in shops or can be ordered to be sent home, with either people or goods traveling. Secondly, digitalization also means that an increasing amount of data are available from travelers, public authorities, mobility service providers, vehicle manufacturers, and other stakeholders, including for example mobile phone companies. These new data sources and communication methods are enabling the development of innovative user-driven and demand-responsive Mobility-as-a-Service (MaaS) concepts that are tailored to individual users' needs, while offering viable business models. These new data sources also enable the continuous

monitoring of transport systems, with a better coverage of all system elements in terms of supply and demand, with a higher level of detail and timeliness, thereby supporting evidence-based strategic planning and policy-making. Finally, digitalization enables a shift in which transport users are no longer mere “passive particles” moving around in given transport systems that are taken for granted, but instead become active designers of these systems. Travelers request services, provide trip data and feedback on their travel experiences, and make suggestions for improving and tailoring the systems to their individual needs.

All these three developments arising from digitalization in transport come with great opportunities for research and planning practice. At the heart of these opportunities are digital platforms that provide all relevant stakeholders with information and data, as well as physical and digital mobility services. We define the term “digital platforms” for this study based on Steinberg (2022) [1] with two main variants:

- The layered stack model refers to a platform “as something upon which one stands” [1], this might be for example computer hardware, software, websites or social media. The platform is considered here as a “building block upon which organizations build complementary products or technologies”. [1]
- The horizontal intermediary model considers a platform to be a „mediatory device enabling third party transactions to take place”. Credit cards or the Uber app are examples of this concept. [1]

Both types of digital platform are currently experiencing significant changes and growth. At the European level, the ITS directive (Intelligent Transportation Systems) [2] and the supplementing Delegated Regulations ([3],[4][5],[6],[7]) have formulated obligations to make data available to third parties and thus facilitate data exchange. National Access Points (NAPs) have been established in the EU Member States to implement this European legal framework, initially with a focus on road transport (truck parking [3], Safety-Related Traffic Information (SRTI) [4], and Real-Time Traffic Information (RTTI) [5], [7]. Other modes of transport are increasingly also considered (see e.g., the Multi-Modal Traffic Information Services, MMTIS), resulting in a substantial increase of institutions that now are requested to make their data publicly available. The Federal Highway and Transport Research Institute (BASt) has been established as the NAP in Germany. The “Mobilithek” will be the platform used for data provision, in collaboration with the emerging Mobility Data Space, which is a virtual marketplace for the exchange of sensitive mobility data.

This means that public institutions engage in defining the legal framework for digital platforms, thereby ensuring that these platforms contribute to societal goals.[1] In addition, public institutions increasingly engage in the development of digital platforms for providing the own data, and also data from private companies. Private companies are investing in the development of digital platforms because they recognize the potential for profitable business models in the provision of data and mobility services.

Transport research will benefit significantly from the improved data availability, new research questions will emerge around innovative user-driven mobility services, and entirely new fields of research can be expected around the platforms themselves, including, for example, profitable

business models for platform operation or the regulatory framework. At the same time, transport research will increasingly be required to make its own data and research results available to others. This needs digital platforms for hosting and providing the often sensitive data generated in transport research. The landscape of existing digital platforms relevant to transport research is fragmented, and to the best of our knowledge, there is no systematic overview. However, such an overview and systematization would be necessary to capitalize on the opportunities arising from the three digitalization trends presented above, to decide which platforms are suitable for providing data from transport research projects, and, where appropriate, to contribute to the strategic further development of existing platforms or the development of new ones.

This study was designed to address these gaps. It aims to examine and systematize the current state and future prospects of digital platforms relevant to transport research, and to explore related research opportunities. This systematization should cover all relevant aspects, including data types, stakeholders and platforms. We are interested in both aspects of (1) data and services provided at current and possible future digital platforms, and (2) platforms that might host data collected in the own transport research projects.

To achieve these goals, we first organized an expert workshop with an interdisciplinary audience of researchers who are using data and services from digital platforms for their own research, and/or who conduct research on digital platforms themselves. The goals of this workshop were to compile an overview of current and possible future digital platforms, identify opportunities and risks related to these platforms for transport research and planning practice, and to exchange ideas on related research opportunities. Second, we conducted a desk research on existing digital platforms with relevance for transport research, this desk research is called environment analysis in this article.

This article presents the concepts and main results from the workshop and the environment analysis, followed by a synthesis and an outlook for further research and recommendations for shaping the future landscape of digital platforms with relevance for transport research and planning practice in order to maximize their benefits for research and planning practice.

2 Workshop “Digital platforms for transformative urban mobility”

2.1 Concept

The workshop “Digital Platforms for Transformative Urban Mobility” was held at TU Dresden, “Friedrich List” Faculty of Transport and Traffic Sciences on 27-28 April 2023. The following key questions were formulated for this workshop:

- What digital platforms are currently in place in the transport sector, and what platforms should be in place in the future, in order to facilitate innovative research and to maximize the benefits of digitalization for travelers, mobility service providers, public authorities and society as a whole?
- Which institutions and stakeholders should operate the platforms?
- What are the appropriate legal and economic frameworks to enable private engagement and economic success of digital platforms while contributing to societal ambitions, such

as the Sustainable Development Goals (SDGs) adopted by the United Nations [8]?

- How are digital platforms transforming human labor, mobility, and habitats?
- To what extent do digital platforms increase precarity and/or prosperity?
- How to design digital platforms and governance schemes that can successfully engage travelers to contribute to these platforms with data, activities, suggestions, etc., and thus ultimately participate in the design of future transport systems?

Interdisciplinary researchers working on digital platforms in general, and more specifically on digital platforms in mobility and transport were the main target audience for this workshop. Potential participants were actively screened and approached with personalized invitations, resulting in a group of 22 early to advanced career researchers from six countries and a range of disciplines, including transport, humanities, social sciences, economics, political science, data science, law and urban planning. The group was complemented by a legal expert and a representative of the German Federal Highway and Transport Research Institute (BASt), so that the perspective of the German National Access Point (NAP) according to the EU ITS (Intelligent Transportation Systems) Directive was also present.

The program was designed as a combination of keynote speeches by renowned researchers, presentations by participants and interactive group work. In the two interactive sessions, participants were divided into two respectively three groups. The first session focused on the current situation, while the second session invited participants to look ahead and formulate expectations and requirements for future platforms. Similar questions were used for both group work sessions:

Stakeholders:

- Which stakeholders engage today / will engage in the future in setting up platforms for data and services in mobility and transport?
- What interest do / will they have?
- Which platforms do / will they operate?
- Which types of data, services do / should they provide?
- Which relevance do / should these platforms have for research and for practice?

Platforms:

- Which platforms for mobility data exist today / should exist in the future?
- What kind of data and services do they provide / should they provide?
- Who runs / should run these platforms? With what motivation?
- What relevance do / will these platforms have for whom?

Data and services:

- What types of data and services exist / will exist in mobility and transport (items to be provided on platforms) and how is this data provided / how should this data be provided by whom?

Challenges and opportunities:

- What are the challenges and opportunities for current / future digital platforms in the context of mobility and transport?

Research perspectives: What research needs do you see? What ideas do you have to address these research needs?

Participants were invited to discuss the questions and document the discussion with cards on pinboards, grouped into: stakeholders, platforms, data and services, challenges and opportunities, and research perspectives. The expected outcomes of the interactive sessions were pinboards with cards grouped into the categories introduced above (see 5.2). In the second session, high priority was given to developing ideas for future platforms, including features such as functionalities and governance schemes, and to noting related research ideas.

2.2 Summary of keynote speeches and participants' presentations

Four keynote speeches by renowned researchers offered interdisciplinary perspectives, gave inspiration and broadened the horizons of all participants.

Prof. Charlotte Halpern from Science Po, Centre for European Studies and Comparative Politics (Paris, France), spoke about "Data as a critical resource for governing sustainable urban mobility". Drawing on her background in political science and her own previous research (see e.g. [9]), she outlined current governance arrangements in urban and transport planning and provided future perspectives. Resources for implementing policy measures and capacity building for local stakeholders, including data literacy, are key to evidence-based planning, which is a prerequisite for achieving societal goals. The emergence of new data sources and platforms offers promising opportunities for innovative governance schemes and evidence-based planning. However, the public administrations and also policy makers, particularly in smaller and less affluent cities, are not yet well prepared to make use of these opportunities. Future research could support the development of frameworks that incentivize digital platforms and the provision of data to support societal goals, rather than focusing solely on the success of individual companies.

Prof. Marc Steinberg from Concordia University (Montreal, Canada) spoke about the "Automobile Lineages of the Platform Economy", based on his critical research on the various forms of platforms and their effects on the economy, society and political discourse (see e.g. [1]). He introduced layered stack models and horizontal intermediary models as the two main variants of the platform concept, and identified parallels and interdependencies between automobile production and platform capitalism. Both are based on the concept of platforms as layered stacked models and horizontal intermediary models, both use the term platform, both place a high priority on just-in-time and lean delivery of their products and services, both are data-driven and outsource risks to external partners such as suppliers or Uber drivers. The relationship between platforms and organizational practices was also highlighted.

Prof. Orit Halpern works in the fields of history and cybernetics, bridging the history of science, computing, and cybernetics with design. In her keynote "Models and Cities: Re-imagining Smartness", she outlined key concepts related to platforms and the smartness mandate.[10] Platforms should not be reduced to devices that serve specific purposes (e.g., smart phones, cars,

homes, cities) but rather be seen as ways of managing life with serious implications for society, politics and the environment.[10]

Prof. Travis Waller's background is in transport network modeling, based on innovative methods, data, and ethics-based metrics for evaluating the different possible solutions. In his keynote speech "Moving Into the Future: Infrastructure as Platform and Mobility as a Resource", Prof. Waller introduced the novel concept of Mobility as a Resource (MaaR), based on the hypothesis that mobility has moved from a product (e.g., vehicles) to MaaS, and is now evolving towards a resource (MaaR). The MaaR concept envisions a future where mobility and infrastructure can be commoditized and flexibly allocated to different uses, and thus managed as a resource. Prof. Waller outlined key characteristics of the MaaR concept, possible applications and research needs in the fields of transport network management, demand behavior, mixed mode use, and equitable mobility. [11]

Overall, the four keynote speeches with their interdisciplinary perspectives, novel ideas and open questions, provided great inspiration for the subsequent workshop discussions.

The participants' presentations were grouped into three main themes: (1) MaaS concepts, (2) regulatory frameworks, and (3) innovative data and platforms. Most presentations focused on the first theme. Participants shared their perspectives on MaaS as a concept in which different passenger transport services are brought together through an online platform that includes services such as trip planning, payment, ticketing and real-time information for all the different services. Key characteristics of MaaS include a focus on customer needs, bundling of services, cooperation and interconnectivity of transport modes and service providers.[12] Examples of MaaS services, their impact on travel behavior and system-wide effects were presented ([13],[14],[15],[16]). The goal of sustainable mobility was used as a normative framework in most presentations, leading to the question of how MaaS platforms need to be designed to contribute to progress towards the sustainability goal.[16] The importance of appropriate institutional frameworks and governance arrangements was also highlighted.[17]

Presentations in theme (2) provided an overview of the current legal frameworks and future perspectives, with a focus on the ITS directive (Intelligent Transportation Systems) [2] and the supplementing Delegated Regulations ([3],[4][5],[6],[7]) . Innovative data and platforms were presented in theme (3). The VAMOS-lab at TU Dresden (Verkehrsanalyse-, Management- und Optimierungssystem / traffic analysis, management and optimization system) was established in 2003 and has since developed into an innovative and powerful tool for monitoring and controlling road traffic in the city and region of Dresden. Approximately 1,800 sensors feed their data into the VAMOS lab, measuring vehicle volume, speed, traffic quality (Level of Service) and parking activities. The vision for the VAMOS lab is to establish a premier data platform that provides high-quality processed traffic data as a basis for innovative research and educational activities. Open geodata infrastructures and digital planning tools to support mobility transitions were also presented, and ways to incentivize the provision of data necessary for the successful operation of any platform were discussed.

2.3 Results

Workshop results can be grouped into (1) stakeholder groups and roles, (2) groups of digital platforms, (3) data types and sources in transport research, (4) challenges and opportunities in operating digital platforms in transport, and (5) perspectives for future research.

(1) Stakeholder groups and roles: The following seven main interest groups are to be considered according to the workshop participants:

- Travelers mainly want to reach their destinations comfortably, safely, flexibly, reliably and at low cost. They use data and services from digital platforms and possibly also contribute to digital platforms, e.g., with data or service requests.
- Public authorities provide transport systems and services. They need to make sure that all person groups reach their destinations, and they need to minimize negative effects from transport (e.g., noise, air pollutants, greenhouse gases).
- Public authorities also provide the legal framework (legislature) for the development and operation of digital platforms and the use of data, which should support societal goals.
- Public transport companies are mainly private companies, but still obliged to offer services for all person groups and parts of the city. Like commercial companies, they have to think in business terms while also serving the public interest.
- Commercial companies include operators of mobility services, providers of navigation services and IT infrastructure, and industry. These companies seek to maximise their revenues, which can be generated through the provision of platforms, data and/or services.
- Political decision-makers need data and services from digital platforms as the basis for evidence-based decision-making in the management and further development of transport systems.
- Researchers benefit from data provided at the digital platforms for their own research, and collect data themselves, which should be made available.

Most stakeholder groups can take on several roles. Table 1 provides a summary of the identified stakeholder groups and their roles in the context of digital platforms in mobility and transport.

Table 1: Stakeholder groups and their roless

Stakeholder group		Operate platforms	Provide data	Provide services	Use data	Use services	Set legal framework
(Potential) travelers		(x)	x		x	x	
Public authorities		x	x	x	x	x	
Public transport operators		x	x	x	x	x	
Commercial companies	Operators shared mobility services	x	x	x	x	x	
	Operators ridesourcing, ridepooling	x	x	x	x	x	
	Providers navigation services	x	x	x	x	x	
	Providers IT infrastructure	x					
	Industry	x	x	x	x	x	
Legislature							x
Policymakers					x	x	x
Researchers		(x)	x	x	x	x	

"x" current and possible future roles, "(x)" only possible future roles

(2) Groups of digital platforms: Table 2 provides an overview of the identified groups of digital platforms with relevance for transport research. Platforms are mainly operated by public institutions or private companies, interesting business cases exist already today and new business cases can be expected in the future. Only one platform providing research data was named by

participants, this is the VAMOS platform run by the Chair of Traffic Process Automation at TU Dresden.

Table 2: Groups of digital platforms with relevance for transport research, provided data and services

Groups of digital platforms	Provided data and services
Open data portals cities, digital twins	All types of data owned by local public authorities (e.g., Dresden, Berlin), digital twins mainly include built environment data (e.g., Helsinki, Transport for London)
Platforms providing research data	Various data types, e.g., traffic counts/traffic speed/occupancy of parking garages in VAMOS
Platforms with crowd sourced data	Infrastructure data, Points of Interest (POIs), e.g., OpenStreetMap, Mapillary
Commercial platforms providing map data	HERE, Google Maps, Microsoft Bing, Apple Maps, etc.
Commercial platforms providing navigation services	Moovit, Google, DB Navigator, smartphone apps by local stakeholders, etc.
Commercial platforms providing mobility services, including passenger and commercial transport	Public transport services (lines, departure times, ticketing etc.), on-demand services (ridepooling, ridehailing etc.), shared services (cars, bicycles, scooters)
Commercial platforms providing data on users and uses of transport systems	Floating Car Data (FCD) (e.g., TomTom), Floating Bicycle Data (FBD) (e.g., from the City Cycling-Campaigns in Germany, from sports platforms such as Strava)
NAPs, Mobility Data Space	Mainly public data according to the ITS Directive
Social Media Platforms	Communication and location data (e.g., Instagram, Bluesky, Mastodon, LinkedIn)

(3) Data types and sources in transport research: Figure 1 provides an overview of the types and sources of data identified in the workshop discussion and subsequently systematized by the authors for this paper, including data that are already provided or should be provided in the future. For transport demand, data types describe the moving subjects and objects, their movements from origins to destinations, and the resulting traffic flow, such as the traffic volume of a particular mode of transport on a particular road section. For transport supply, data types describe infrastructure and services. Data describing the determinants and effects of transport activities are also relevant. The many sources of data relevant to transport demand and supply are shown on the right-hand side of Figure 1. A wealth of data is available for transport systems, and data availability can be expected to further improve in the coming years thanks to digitalization trends.

(4) Challenges and opportunities in operating digital platforms in transport: Several challenges and opportunities were named by the workshop participants. By far the greatest importance was assigned to (1) privacy issues and (2) the relevance of data.

1. Privacy issues: The establishment and continued adoption of the legal framework on privacy issues is therefore of utmost importance, as stressed by all participants. A balance needs to be struck between ensuring privacy and allowing platforms to operate and data

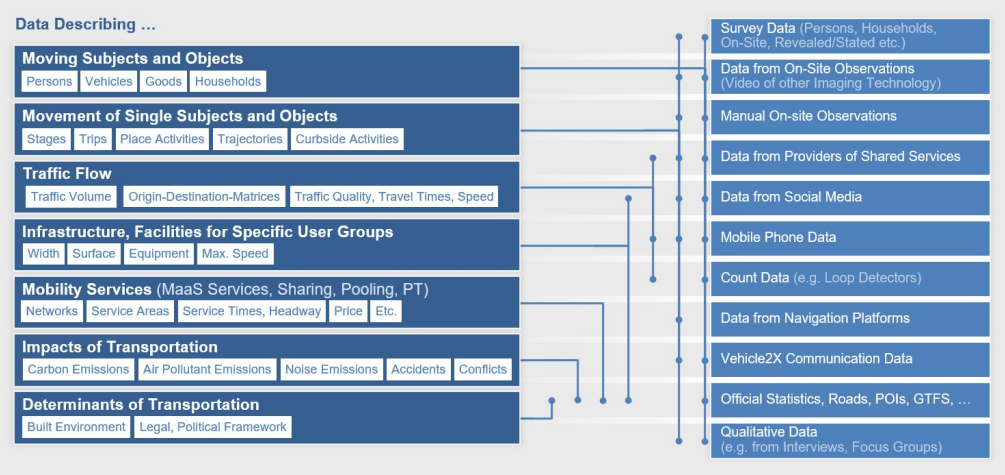

Figure 1: Data types and data sources in mobility and transport

to be exchanged. Variation in the temporal and spatial level of detail of the data was mentioned as one way of achieving this balance; the establishment of data trustee centers could be useful to make data available at a more detailed scale. Overall, data should be available as openly as possible, with access restricted where necessary. This is a key prerequisite for trust in data and services; trust is needed to motivate stakeholders to use data and services and to contribute their own data.

2. Relevance of data: Platforms, data and mobility services are not ends in themselves. Rather they should support societal goals and be relevant. Tech4Good was mentioned several times, and a societal discourse is needed to define what the meaning of ”good” is in this context. A common vision should be developed as the basis for all political decisions on which digital platforms should be established, who should operate them, and on how they should be regulated legally to optimally support societal goals. The focus should always be on the user and on providing the best possible mobility services and transport systems.

(5) Perspectives for future research: The following themes were discussed in terms of perspectives for future research:

- Standardization should receive more attention to improve compatibility of data formats, interfaces etc. Collaboration with the various initiatives in research data management (e.g., NFDI) might help to make progress in this field.
- Test beds, living labs, open urbanism – such collaborative formats can be supported by digital platforms and higher availability of mobility data. Innovative governance systems and participatory planning processes can support the scaling up of such experiments and data-driven, evidence-based planning.
- Challenges and opportunities are interlinked; only interdisciplinary research can address them comprehensively; current silos in government and policy-making need to be broken down to take advantage of the opportunities associated with the emerging digital platforms.
- Data literacy in research and practice needs increasing attention in the education of future transport professionals and also in filling open positions in the different relevant institutions.

- The high relevance of quality management, especially for commercial data, was mentioned several times. Public authorities should provide support in identifying biases in data and in enforcing transparency and high quality also for data and services provided by commercial companies.
- The transition between the digital and the physical systems is fluent as demonstrated by Steinberg[1], meaning that interdependencies should be considered in research and practice.
- Increasing redundancy and overlap between data and services provided by different platforms can be expected in the future, particularly in fields with viable business cases. Such overlapping data offers the opportunity to analyze the same indicators (e.g., traffic volumes) based on different data sources and thus to search for systematic patterns in the similarities and differences between the different data sources.
- Research on incentive schemes for donating data and engaging in citizen science will be helpful to motivate relevant stakeholder groups efficiently.
- The importance of IT infrastructure providers will increase with more complex platforms with more functionalities, interactions, etc.

Overall, there was consensus that the opportunities associated with the emergence of digital platforms outweigh the risks. The increasing number of sensors (e.g. in vehicles and infrastructure) and data sources opens up promising opportunities to improve the performance of transport systems in terms of safety, efficiency and other criteria according to the preferences of local stakeholders.

3 Environment analysis

3.1 Approach

Participants' feedback from the workshop was complemented by a subsequent systematic desk review of non-commercial digital platforms with datasets relevant to mobility and transport to increase coverage and to ensure that relevant platforms are considered comprehensively. First, we searched the meta repositories Registry of Research Data Repositories (re3data), the NFDI4Ing Data Collection Explorer and the Zenodo Generalist Repository Comparison Chart [18] with the search terms "transport", "mobility" and "traffic". Second, we added platforms that we knew from our own expert network. Third, we added the platforms mentioned during the workshop to the list. In total, 36 platforms were identified with this combined approach. They were assessed based on the following grouped criteria[19]:

- organization and operation
- thematic focus and provided data types
- functionalities for data storage and provision
- support of the FAIR principles
- data access and

- user management
- options for statistical evaluation

3.2 Results

In addition to the comprehensive overview of the relevant information infrastructures, a key finding of the analysis is the identification of various approaches to characterize and classify the different platforms with relevance for mobility and transport:

Platforms providing data from public authorities
These platforms exist at all levels, from the local to the international level, with a wide variety in the scope of the provided data. Open data portals are operated by multiple municipalities (e.g., Berlin, Dresden, London), states (in Germany "Bundesländer") (e.g. Sachsen at https://www.opendata.sachsen.de/), national authorities such as the Federal Statistical Office of Germany (e.g., GENESIS) and at the European level (e.g. European Union Open Data Portal, INSPIRE Geoportal). The scope of the provided data corresponds to the responsibility of the institutions: It is broad for the municipal open data portals and the platforms from statistical offices, while the scope is narrower for specialized institutions such as the German Federal Motor Transport Authority with its focus on the road vehicle fleet in Germany. Specialized repositories with relevance for transport also exist, for example the German crash data map (Unfallatlas), maps showing traffic states (e.g., for Berlin at https://viz.berlin.de/) and data from automatic count stations (e.g., from the Federal Highway and Transport Research Institute BASt). Data from National Travel Surveys (NTS) (and other surveys addressing the two upper left-hand boxes in Figure 1) are provided via dedicated platforms in many countries. Data are usually provided upon request in a manual procedure to account for the high sensitivity of these data in terms of privacy. The Clearingstelle at DLR was responsible for this in Germany until the end of 2024, when BASt took over this task.[20]

The higher-level platforms often aggregate data from lower-level repositories. For example, the Federal Geoportal in Germany (operated by the Federal Agency for Cartography and Geodesy, geoportal.de) collects metadata from various sources, including municipal open data portals and specialized institutions. Similarly, the INSPIRE Geoportal of the European Commission aggregates metadata from national and regional repositories, providing a comprehensive overview of geospatial data across the EU, including transport-related data. While these higher-level platforms can address the issue of data fragmentation across various platforms, this often comes at the cost of specificity and discoverability of relevant data.

Platforms providing transport research data
General repositories without any specific disciplinary focus are provided by individual institutions, and also at national and international levels. We identified only one open repository with a dedicated focus on transport research data, this is the FID move repository. Besides, we have identified only very few platforms with a dedicated focus on research data from transport and they provide mainly data collected at a specific institution (e.g. ETH travel data archive (which seems not to be updated anymore), pedestrian dynamics data archive) or they have been established within EU-funded research projects and seem not to be updated after the projects have ended (e.g. TinnGO, SUITS). General repositories such as GESIS for social science data have also

been assessed and were found to provide very few datasets with relevance to transport research.

Crowd-sourced data platforms leverage citizen-generated data

Unlike traditional data sources, these platforms collect data voluntarily contributed by users through digital channels, offering data that are often unavailable through official datasets. This includes at least three types of platforms: (1) Collaborative mapping (e.g., OpenStreetMap) provide user-generated data about infrastructure and the mobility space, often under free licenses. (2) Social media provides a massive source of movements of people due to its deep user penetration. (3) Specialized mobility platform applications continuously collect user-contributed information about service usage, quality of service, and more. These applications often operate in mixed forms (e.g., Moovit and Google Maps combine official as well as crowd-sourced data).

Furthermore, the analysis has shown that the portals can be classified according to the data they allow to be uploaded and according to their subject-specific focus (see figure 2).

	Upload of own data possible	Only data from the platform or its sources
Cross-disciplinary content	4TU.ResearchData / figshare / Research Data Repository RADAR / Zenodo	BAW-Datenrepository / Bfa Statistik, CODE-DE / data.gouv.fr / darta.gov / data.gv.at / Data Portal Sydney / EU Open Data Portal / GENISIS-Online / GOVDATA / Open Data Berlin / OpenDataPortal Dresden / opendata.swiss / Statistikportal / TU Wien Research Data / UK Data Service
Transport and Mobility-specific content	FID move / mobilithek	Caltrans PeMS, Clearingstelle Verkehr, CMISST, ETH Travel Data Archive / FDZ Kraftfahrt-Bundesamt, MobilDataBW, Mobilität in Städten - SrV / Mobility Data-Campus / NHTS Data Center / Open Data BALM / Open Data ÖPNV / Pedestrian Dynamics Data Archive / SUITS Data Repository / TInnGO Open Data Repository

Figure 2: Overview and classification of the analyzed data platforms

We have also assessed the functionalities of the identified platforms, distinguishing between the following four levels:

- Level 1: Long-term and stable data storage.
- Level 2: Level 1 + Robust rights management.
- Level 3: Level 1-2 + Advanced search functions and visualization tools.
- Level 4: Level 1-3 + Advanced functionalities for the analysis and combination of datasets.

Most of the identified repositories are at level 1. The few identified repositories at levels 2 and 3 have a broad scope and do not focus specifically on transport. None of the identified repositories belong to level 4.

4 Synthesis and outlook to further activities

In summary, the results of the workshop and the environment analysis identified two main drivers for digital platforms relevant to transport research: the regulatory frameworks at the EU and national level, and viable business models for the provision of mobility data and services.

The regulatory framework for the EU and its member states requests the establishment of digital platforms for data collected by public authorities and also private companies such as providers of sharing services. The ITS Directive requires EU Member States to establish NAPs and to make pre-defined data types openly available. In the future, the EU Regulation on the development of the trans-European transport network (TEN-T) approved in 2024 might also be relevant [21]. The TEN-T regulation defines 431 cities in the EU as “urban nodes”, which are requested to submit “urban mobility data [..] in the fields of sustainability, safety and accessibility” to the European Commission for the first time by the end of 2027 [21]. The data and indicators to be submitted in this context have not yet been finally specified but it can be assumed that they will cover most of the boxes in Figure 1. Overall, it can be expected that in the coming years, an increasing number of digital platforms will be available to provide transport data from public authorities to meet the requirements of current and future regulations at EU, national and local levels.

Two main types of commercial platforms as viable business cases were identified:

1. Commercial platforms providing data (e.g., map data, FCD) come with promising opportunities for research and planning practice, and also with challenges. Data collection and processing methods are often not transparent and there may be hidden biases in the data. Quality standards or benchmarks set by public authorities or other neutral institutions could help to ensure the trustworthiness and quality of such commercial data, to the benefit of providers and users.

2. Commercial platforms offering mobility services focus on their services. Mobility service providers set up the platforms to interact with their (potential) customers, but are less interested in providing data. Uber, on-demand services (e.g. Moia, https://www.moia.io) or carpooling services (e.g. scooters or bicycles) are examples of such commercial platforms. User-driven mobility services provided on these platforms can complement services provided (and funded) by public authorities for the benefit of society. At the same time, these platforms offer great opportunities for research into the impact of current services on travel behavior. Public regulation of these commercial platforms ensures that their services contribute to societal goals, and that data and services meet standards in terms of quality and transparency.

Most mobility services will fall within the scope of the ITS Directive. Service providers will therefore be required to make their data available (e.g., locations of bike/car sharing stations, availability of shared vehicles). Some municipalities are already imposing conditions on the provision of sharing services in their area and requiring operators to provide the municipality with data (e.g. on the availability of their services). Overall, the availability of data on mobility services is expected to increase in the coming years.

Looking back at Table 2, these two main drivers mainly support digital platforms provided by public authorities and private companies. This is also in line with the overview of stakeholders and their roles summarized in Figure 1. Public authorities, public transport operators, private companies providing on-demand mobility services, and industry (e.g., mobile phone companies) are all mandated (by the regulatory framework) or interested in operating digital platforms, while at the same time relying on digital platforms as a basis for ensuring access to destinations and to social participation for all population groups and/or for running successful businesses.

Such strong drivers do not exist for data collected in transport research, where data are mainly a means to an end. Data are collected, processed and analyzed to answer research questions, to complete research projects and doctoral theses. The motivation and resources to establish dedicated digital platforms for transport research data have so far been low. This is at odds with widely supported goals such as “open science” and “open data”. The workshop identified only one platform providing research data, the VAMOS platform operated by TU Dresden (see Table 2). In the environment analysis, the FID move repository was the only identified stable platform with a focus on transport research data. Three main reasons have been identified for these deficits in the availability of digital platforms focused on transport research data:

- The transport research community is small and fragmented because of its interdisciplinary nature: researchers from different disciplines, with all their specific interests, vocabularies, and practices study transport systems as a domain.
- Data in transport research is very often sensitive in terms of personal characteristics and location information. Such data cannot and must not be made openly available without restrictions, and methods of data processing and user management must be in place to facilitate the provision of such data as openly as possible and as protected as necessary to comply with data protection legislation.
- The availability of data in transport research has only recently improved significantly thanks to digitalization, mobile devices, sensors, etc.

Looking back at Figure 1, different data types and sources in transport research are affected differently by the identified drivers and barriers. The three top boxes, which can be summarized as travel demand data (moving subjects and objects, movement of single subjects and objects, traffic flow), are the main focus of transport research and are therefore most affected by deficiencies in platforms providing these data. Regarding the data sources on the right side of Figure 1, data on travel demand are mainly collected through travel surveys, field observations (e.g. based on video recordings or other types of imagery) and, increasingly, through social media platforms and commercial platforms offering mobility services. For example, researchers can download location data from shared vehicles at a high frequency, generating new data about the users and usage of these services. All these data are highly sensitive in terms of privacy, both in terms of the characteristics of travelers and the places they visit. At the same time, the increased availability of these data offers promising opportunities. Thanks to the ITS Directive location data will be increasingly available from shared service providers. Travel survey data will become more detailed, thanks to smartphone apps, which are increasingly being used to collect these data. Image data from local field observations can increasingly be processed automatically (see e.g. emerging tools such as OpenTrafficCam) to generate traffic volumes, trajectory data and

conflicts for all user groups. The establishment of digital platforms for these data can facilitate their re-use of the data in research, for example for comparisons over time and between different locations. Transport research data from such platforms can also be used for comparison and benchmarking with similar data provided by private companies (e.g. mobile phone companies or car manufacturers) or for training Large Language Models (LLMs) focused on the transport domain. Overall, public funding, which is a main source of transport research, will be used more efficiently if platforms make the data collected and/or processed in the funded projects available to the public. The question is which institutions could take responsibility for creating such platforms focused on transport research data. Candidates for this role include research institutions with sufficient resources to establish and sustain such platforms (e.g., universities, DLR), the German research data management initiatives (Nationale Forschungsdateninfrastrukturen, NFDI, and also the NAPs under the ITS Directive. The discussions at the workshop, as well as the results of the environment analysis, clearly show that investments in platforms providing sensitive transport research data are worthwhile and will pay off with significant benefits for research, planning practice, and private companies.

5 Appendix

5.1 Workshop program

Day I (27/04/2023)

1. Keynote - Dr. Charlotte Halpern: Data as a critical resource for governing sustainable urban mobility
2. Presentation Session A - Moderation: Charlotte Halpern
   - Valeria Caiati: Does privacy concerns and trust influence users' intention to subscribe to MaaS platforms? Evidence from a hybrid choice model
   - Miloš N. Mladenović: Adaptive governance of emerging mobility technologies: A framework for policy innovation and integration
   - Paulo Jorge Teixeira Fernandes: Transforming urban mobility: An eco-routing service leveraging Internet-of-Things (IoT) technologies and Mobility as a Service
   - Alejandro Tirachini: Ridesourcing and ridepooling in Latin America: research findings and policy developments
3. Keynote - Prof. Marc Steinberg: Automobile Lineages of the Platform Economy
4. Interactive Session
5. Presentation Session B - Moderation: Pascal Kerschke
   - Christina Wolking: Overcoming challenges in implementing MaaS-Platforms
   - Gernot Liedtke: MaaS in the context of transport sector development
   - Meng Wang: Data-driven mobility research enabled by VAMOS lab
   - Marc Widemann: Current regulatory framework and future developments on traffic and travel data in the EU
   - Sam Hind: What now? An appraisal of 'post-pandemic' shocks to platform mobility in Tel Aviv

Day II (28/04/2023)

1. Keynotes
   - Prof. Orit Halpern: Models and Cities: Re-imagining Smartness
   - Prof. Travis Waller: Moving Into the Future: Infrastructure as Platform and Mobility as a Resource
2. Presentation Session C - Moderation: Travis Waller
   - Konstantin Krauß: A framework for designing Mobility-as-a-Service business models
   - Holger Drees: National Access Points for Mobility Data in Europe – Regulations, evolution and the example of the German NAP

- Sebastian Pretzsch: Mobility Data Spaces
- Erion Murati: Incentivizing the sharing of mobility data via a MaaS data governance decision model
- Denis Reiter: Open geodata infrastructures and digital planning tools to support mobility transitions

3. Interactive Session

5.2 Pinboards from interactive group work in the workshop

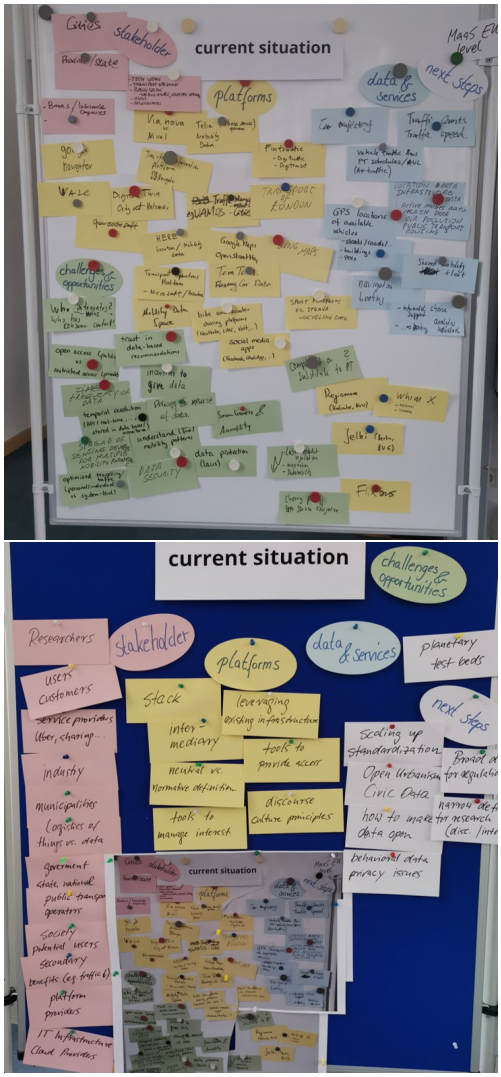

Figure 3: Pinboards current situation

Figure 4: Pinboards future perspectives

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References

[1] M. Steinberg, “From automobile capitalism to platform capitalism: Toyotism as a prehistory of digital platforms,” *Organization Studies*, vol. 43, no. 7, pp. 1069–1090, 2022. DOI: 10.1177/01708406211030681.

[2] *Directive 2010/40/eu of the european parliament and of the council of 7 july 2010 on the framework for the deployment of intelligent transport systems in the field of road transport and for interfaces with other modes of transport*, Official Journal of the European Union, 2010. [Online]. Available: https://eur-lex.europa.eu/eli/dir/2010/40/oj.

[3] *Commission delegated regulation (eu) no 885/2013 with regard to the provision of information services for safe and secure parking places for trucks and commercial vehicles*, 2013. [Online]. Available: http://data.europa.eu/eli/reg_del/2013/885/oj.

[4] *Commission delegated regulation (eu) no 886/2013 with regard to data and procedures for the provision of road safety-related minimum universal traffic information*, 2013. [Online]. Available: http://data.europa.eu/eli/reg_del/2013/886/oj.

[5] *Commission delegated regulation (eu) 2015/962 with regard to the provision of eu-wide real-time traffic information services*, 2015. [Online]. Available: http://data.europa.eu/eli/reg_del/2015/962/oj.

[6] *Commission delegated regulation (eu) 2017/1926 with regard to the provision of eu-wide multimodal travel information services*, 2017. [Online]. Available: http://data.europa.eu/eli/reg_del/2017/1926/oj.

[7] *Commission delegated regulation (eu) 2022/670 with regard to the provision of eu-wide real-time traffic information services*, 2022. [Online]. Available: http://data.europa.eu/eli/reg_del/2022/670/oj.

[8] United Nations, *The sustainable development goals (sdgs)*, 2015. [Online]. Available: https://sdgs.un.org/.

[9] C. Halpern and S. Persico, “Historical transport policy developments in five european capital-cities: Do policies matter?” Centre d’études européennes de Sciences Po, Tech. Rep. D4.1, 2016. [Online]. Available: https://shs.hal.science/halshs-01390262v1.

[10] O. Halpern and R. Mitchell, *The Smartness Mandate*. MIT Press, 2023.

[11] S. T. Waller, A. Polydoropoulou, L. Tassiulas, et al., “Mobility as a resource (maar) for resilient human-centric automation – a vision paper,” *Data Science in Transportation*, vol. 7, no. 1, 2025. DOI: 10.1007/s42421-024-00115-z.

[12] P. Jittrapirom, V. Caiati, A.-M. Feneri, S. Ebrahimigharehbaghi, M. J. Alonso-González, and J. Narayan, “Mobility as a service: A critical review of definitions, assessments of schemes, and key challenges,” *Urban Planning*, vol. 2, no. 2, pp. 13–25, 2017. DOI: 10.17645/up.v2i2.931.

[13] A. Tirachini and A. Gomez-Lobo, “Does ride-hailing increase or decrease vehicle kilometers traveled (vkt)? a simulation approach for santiago de chile,” *International Journal of Sustainable Transportation*, vol. 14, no. 3, pp. 187–204, 2020. DOI: 10.1080/15568318.2018.1539146.

[14] A. Tirachini and M. del Río, “Ride-hailing in santiago de chile: Users’ characterisation and effects on travel behaviour,” *Transport Policy*, vol. 82, pp. 46–57, 2019. DOI: 10.1016/j.tranpol.2019.07.008.

[15] V. Caiati, S. Rasouli, and H. Timmermans, “Bundling, pricing schemes and extra features preferences for mobility as a service: Sequential portfolio choice experiment,” *Transportation Research Part A: Policy and Practice*, vol. 131, pp. 123–148, 2020. DOI: 10.1016/j.tra.2019.09.029.

[16] S. Jang, V. Caiati, S. Rasouli, H. Timmermans, and K. Choi, “Does maas contribute to sustainable transportation? a mode choice perspective,” *International Journal of Sustainable Transportation*, vol. 15, no. 5, pp. 351–363, 2020. DOI: 10.1080/15568318.2020.1783726.

[17] M. N. Mladenović, D. Stead, D. Milakis, K. Pangbourne, and M. Givoni, “Governance cultures and sociotechnical imaginaries of self-driving vehicle technology: Comparative analysis of finland, uk and germany,” in *Advances in Transport Policy and Planning*, vol. 5, 2020, pp. 235–262. DOI: 10.1016/bs.atpp.2020.01.001.

[18] S. Stall et al., *Generalist repository comparison chart*, Jul. 2020. DOI: 10.5281/zenodo.3946720. [Online]. Available: https://doi.org/10.5281/zenodo.3946720.

[19] R. Gerike, S. Heik, M. Fuchs, M. Begoin, J. Weber, and S. Hubrich, *Environment analysis about digital platforms for transformative urban mobility*, [Accessed 02-04-2026], 2026. [Online]. Available: https://nbn-resolving.org/urn:nbn:de:bsz:14-qucosa2-1036244.

[20] *MobilityData-Campus — bast.de*, [Accessed 02-04-2026], 2024. [Online]. Available: http://www.bast.de/cs-verkehr.

[21] *Regulation (eu) 2024/1679 on union guidelines for the development of the trans-european transport network (ten-t regulation)*, 2024. [Online]. Available: https://eur-lex.europa.eu/eli/reg/2024/1679.