



Mobility Data Spaces

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Transforming Europe into a climate neutral economy by 2050 in line with the [European Green Deal](#) places a particular responsibility on the transport sector, which accounts for a quarter of the Union's total greenhouse gas (GHG) emissions. Specifically, transport will have to collectively reduce its GHG emissions by 90% by mid-century compared to 1990 levels. This will require advancing digitalisation and the use of data in all modes of transport, including passenger and freight segments. Notwithstanding, data availability, access and exchange in the transport sector today continue to be hampered due to unclear regulatory conditions, the lack of an EU market for data provision, the absence of an obligation to collect and share data, incompatible tools and systems for data collection and sharing, different standards, or data sovereignty concerns, among others. The [European strategy for data](#) aims to establish a single market for data where data can be accessed and used efficiently. This will include the creation of a common European mobility data space to facilitate access, pooling, and sharing of transport and mobility data. In this special issue of the Network Industries Quarterly, invited authors critically discuss the opportunities and challenges of building such a mobility data space.

The first contribution by **Almasy** and **de Linde** discusses the transformative potential of common European data spaces, and highlights the benefits and challenges involved in implementing them, with a focus on the mobility and transport sector.

The second contribution by **Bücking, Drees, Gavaud, Gruber, Hoffmann, Thelisson** and **van Veenendaal** tries to define possible roles of National Access Points in the European Mobility Data Space.

Valkokari explores three layers of data sharing in the context of urban mobility by means of an illustrative case study.

Antoniola analyses Mobility Data Spaces from different angles (EU, national and local) with a focus on the role of local governments.

Matthias Finger
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Common European data spaces and their benefits for the mobility and transport sector

Kristof Almasy*, Zoe de Linde**

This article discusses the transformative potential of common European data spaces and highlights the benefits and challenges involved in implementing them, with a focus on the mobility and transport sector. It gives an overview of actions supporting the deployment of common European data spaces and some initial actions towards the creation of a common European mobility data space (EMDS).

Introduction

Under the European Strategy for Data, the EU will establish a single market for data, allowing data to flow freely across the European Union while respecting EU values, privacy and security requirements. This will contribute to better and enhanced use of data in all sectors, and notably mobility.

To harness the value of data for the European economy and society, the Commission supports the deployment of common European data spaces to facilitate access to, pooling of and sharing of data in strategic economic sectors and domains of public interest, including mobility. This will accelerate the digital transformation of these sectors in line with Europe's Digital Decade 2030 targets.

Digitalisation is a key enabler making the mobility and transport system smarter, more environmentally friendly and better adapted to the needs of its users, in line with the Sustainable and Smart Mobility Strategy. It can significantly contribute to the aim of reducing greenhouse gas emissions from transport by 90% by 2050, which requires a profound transformation of the sector.

The use of data is essential to make the transport system safer and more efficient, accessible and sustainable. A critical challenge for Europe is to unlock the potential of mobility data by making them easier to access and share. The common European mobility data space (EMDS) will help address this challenge by building on and enhancing the interoperability between existing and future transport and mobility data sources and ecosystems. This will enable better decision-making, coordination and innovation in transport services and infrastructure.

Creating common European data spaces is a complex and challenging task in all sectors. It requires a comprehensive and coordinated approach. This article presents the expected benefits of data spaces, some of the challenges they aim to overcome and key actions supporting their deployment.

The concept of common European data spaces

The notion of a data space refers to infrastructure that enables data transactions between different data ecosystem parties based on a common governance framework. A data space should be generic enough to support the implementation of multiple use cases.¹ Data ecosystem parties are legal and natural persons that engage in data sharing. Across Europe and beyond, many initiatives aim to facilitate and enable such data sharing by deploying and operating data spaces.

Common European data spaces, which were introduced under the EU Data Strategy, are specific data spaces that adhere to EU rules and values and contribute to the objective of creating a single European market for data. These data spaces, and notably the EMDS, will not be databases or pieces of hardware infrastructure. They will instead be decentralised, governed and standard-based frameworks enabling trustworthy data sharing between the data space participants. Common European data spaces will bring together

- Secure and privacy-preserving technical infrastructure to access, share and pool data;
- A governance framework with contractual and administrative rules in line with EU legislation and mechanisms to agree on and enforce common rules and standards.

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¹ Data Spaces Support Centre Glossary.

The actual form, building blocks, architecture and governance of these common European data spaces are still being defined. They will be based on the outcomes of a series of projects and in-depth consultations. Several key features can already be identified:

- Data holders should be in control of who can have access to their data, for which purposes they can be used and under what conditions;
- Data spaces should enable voluntary data exchange, with remuneration or for free, but can also facilitate access to and sharing of data that must be made available (e.g. under EU legislation);
- Data sharing and reuse should be based on fair, transparent, reasonable, proportionate and non-discriminatory terms;
- Participation should be open to any organisations and individuals, including actors around the world if they comply with agreed rules and standards.

Common European data spaces will build on existing data domains and initiatives. For example, in the field of mobility, national access points (NAPs) were established by Member States under the ITS Directive. There are also numerous mobility and transport data initiatives at the national level (e.g. the German Mobility Data Space, the Dutch Digital Infrastructure for Logistics), the regional level (e.g. Mobilidata in Flanders), the local level or driven by private actors (e.g. Eona-X). Common European data spaces should act as the 'glue' between different initiatives and help ensure interoperability.

The benefits of common European data spaces

Enabling the use of data for more applications can bring numerous benefits to the economy and society. It can enable improved digitalised public services and help tackle societal challenges with innovation and research in fields such as climate change, health and green energy.

The EMDS is a good example of how data spaces are expected to bring concrete benefits to people, businesses and public authorities by improving the efficiency and sustainability of transport systems. For instance, combining data from different sources will increase the efficiency of freight transport and logistics. Providing a framework supporting the exchange and integration of data and in-

formation across different mobility providers will enable seamless cross-border multimodal travel.

Facilitating data access and sharing is essential to fully take advantage of the deployment of other digital technologies in all sectors. The rapid development and roll-out of internet of things (IoT) devices, 5G networks and cloud and edge computing have fundamentally increased the technical possibilities of collecting, storing, exchanging and processing data. However, if data holders and users cannot easily share these data, there is a clear risk that most of them remain in silos without being used to their full potential. AI is revolutionising many sectors. In the mobility field, applications range from connected and automated mobility to planning itineraries and dynamic traffic management systems. However, to be developed and operate, AI algorithms require large high-quality datasets.

The abovementioned features of common European data spaces will allow data from across the EU – from the public sector, businesses and citizens – to be made available and exchanged in a trustworthy secure compliant manner and at a lower cost. This will enhance the development of new data-driven products and services in the EU and reinforce the competitiveness of the European economy.

Numerous use cases also show the value of combining data from different sectors. For instance, increased access to data on mobility, energy, pollution and tourism will help local authorities to analyse the use of their infrastructure, anticipate future evolutions and needs and identify well-targeted measures. Facilitating access to and sharing of electromobility data at the EU level will help to inform users about available infrastructure and also enable forward-looking applications like local optimisation of energy use and renewable energy production thanks to bi-directional electric vehicle charging.

From the perspective of data holders, there can be several reasons to share more data. Stakeholders indicate that data sharing helps to obtain greater visibility across supply chains, and to support faster and more innovative product development. Incentives for companies to share data include increased access to the data of other contributors in exchange for giving access to their own data, monetising data assets, analytical results derived from the shared data, the availability of services such as predictive maintenance services, easier reporting to authorities and reduced time and costs of marketing products. Stakeholders may also be

willing to contribute to public good objectives, such as reducing greenhouse gas emissions or improving road safety.

Challenges in deploying common European data spaces

Despite their clear potential benefits, developing common European data spaces comes with challenges. First, data holders are often reluctant to share their data. They may for example consider that data is too commercially sensitive to share, or have concerns related to cybersecurity, unauthorised access or potential misuse. Common European data spaces should therefore enable secure and trusted data exchange. Data sovereignty, allowing participants to control who accesses the data they hold and under which conditions is essential. Overcoming this reluctance also requires identifying use cases with a clear value for participants.

Second, there is very high heterogeneity between and within sectors. An extreme diversity of actors, public and private, large and small, local and global, collect, use and exchange data. The types of data exchanged are also very different, from open data to sensitive commercial or personal data. Each domain has its own requirements and legacy. This is particularly true in the mobility and transport sector.

Numerous efforts already support harmonisation, including at the EU level, but often with limited scope in terms of use cases and geographical coverage. This is leading to a complex patchwork of architectures, technical standards and governance models, resulting in fragmentation and a lack of interoperability. Promoting convergence between these diverse initiatives and ecosystems is essential but it requires collaboration between various stakeholders, which can be complex and time-consuming. It is essential to take advantage of commonalities between different sectors and enable high-value cross-sectoral use cases. Without compromising solutions that already exist or are emerging in different domains, common European data spaces should therefore rely as much as possible on common concepts, models and building blocks to ensure their interoperability with other sectoral data spaces. This will drive adoption and save resources by avoiding redundant efforts.

Finally, equitable access to common European data spaces is also essential. In the data economy, large platforms tend to capture an increasing share of value. Smaller

operators and new market entrants must have the same opportunities as larger established players to utilise data spaces and contribute to their development. Ensuring a level playing field promotes competition, innovation and ultimately better services for all.

Measures supporting the creation of common European data spaces

The European Union is supporting the deployment of common European data spaces, notably for mobility and transport, with a coherent set of policies and initiatives under the Data Strategy.

First, data legislation applying to all sectors will create a fair, trusted, harmonised and predictable legal framework for data access and sharing in the EU and accelerate the development of common European data spaces. The Data Governance Act, applicable from September 2023, will increase trust in data intermediaries, strengthen voluntary data-sharing mechanisms and help overcome technical obstacles. It establishes a European Data Innovation Board (EDIB), which will support the Commission in issuing guidelines for common European data spaces and identifying standards and interoperability requirements for cross-sector data sharing.

The Implementing Act on High-Value Datasets, which was adopted in December 2022, makes available more high-quality public sector data with clear economic and societal benefits for businesses and for research and innovation, for instance data on inland waterways. Finally, the Data Act, currently under negotiation by the Council and European Parliament, will allow companies and consumers to have better control over data and ensure a fair distribution of value generated by data along the data value chain, for example data from connected vehicles.

Second, investments under European programmes, mainly the Digital Europe Programme, will support the development of common European data spaces. The approach combines actions specifically dedicated to data spaces in key sectors and horizontal activities.

Regarding the EMDS, a preparatory action, PrepDSpace4Mobility, started in October 2022. The project, coordinated by acatech (German National Academy of Science and Engineering), has made significant progress in mapping mobility and transport data ecosystems across Europe and identified nearly 400 data sharing initiatives. An in-depth analysis of these initiatives will help identify data

gaps and overlaps and propose common building blocks. Early results reveal that data ecosystems employ a variety of reference architectures, with consensus on the importance of common data models, application programming interfaces (APIs) and data access and usage policies.

A deployment action for the EMDS will follow. This will primarily support use cases across Europe based on mobility data access and sharing, and build on the preparatory action with a focus on sustainable urban mobility indicators and urban-level traffic and travel information. This will promote real-life implementation and adoption of the emerging EMDS framework. A similar approach, with preparatory actions followed by deployment calls, has been adopted in other sectors, for example tourism, energy, manufacturing, Green Deal and smart cities and communities. Coordination is essential to take advantage of synergies.

The upcoming Communication on the creation of the EMDS will publicly announce its objectives and a proposed way forward. It will be based on in-depth consultations, notably through a call for evidence and multiple stakeholder workshops.

The Data Spaces Support Centre coordinates all actions on data spaces, including those on the mobility data space described above. It will make available a blueprint architecture, data infrastructure requirements, technologies, processes, standards and tools that will facilitate the deployment of data spaces and the reuse of data across sectors. It will also support the work of the EDIB. The project started its activities in October 2022 and will run until 2026.

In parallel, the Commission is procuring an open-source smart cloud-to-edge middleware platform (Simpl) that will address the needs of different data spaces and enable realisation of the European Cloud Federation. The platform will provide secure modular basic building blocks that will serve as an enabling layer and a basis for the deployment and interconnection of sectoral data spaces. The call for tenders closed in April 2023, and a minimum viable platform is expected to be available in early 2024.

Conclusion

Facilitating data access and sharing in all sectors is crucial for Europe to achieve carbon neutrality, competitiveness and resilience. In the mobility and transport sector, the EMDS is expected to bring numerous benefits to busi-

nesses, authorities and mobility users. The European Commission encourages public and private stakeholders to participate in related European initiatives and programmes to contribute to this vision. The participation of stakeholders is essential to develop data spaces that respond to their needs.

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Possible Roles of National Access Points in the European Mobility Data Space

Maryse Bücking¹, Holger Drees², Olivier Gavaud³, Damaris Anna Gruber⁴, Timo Hoffmann⁵, Eva Thelisson⁶, Annet van Veenendaal⁷

National access points (NAPs) are a key component of the Member States' digital infrastructure for exchanging mobility data in Europe. The role of NAPs in the upcoming European Mobility Data Space is to be defined by the NAPCORE project, with some thoughts from initial discussions as set out here.

The ITS Directive and National Access Points (NAPs)

In the EU-wide deployment of intelligent transport system (ITS) services, a coordinated and coherent way of making (both static and dynamic) mobility-related data available and accessible is key.

The ITS Directive (2010/40/EU) provides a framework for deployment of ITS in the field of road transport and for interfaces with other modes of transport to support a coordinated and coherent deployment and use of ITS in the European Union (European Union 2010:1). It defines priority areas and actions for the development and use of specifications and standards and uses delegated regulations.

The delegated regulations cover the priority areas of “Optimal use of road, traffic and travel data” and “ITS road safety and security applications” (European Union 2010:4) and describe the requirements to provide data to enable the development of Europe-wide services in the above-mentioned priority areas. The requirements concern the availability, exchange, reuse and updating of relevant static and dynamic mobility-related data.

The delegated regulations require each Member State to set up a national access point (NAP), a single point for access to the listed data categories. A NAP is defined as a “digital interface where [...] data [...] or where the sources

and metadata for these data are made accessible for re-use [...]” (European Union 2015:25). It should feature discovery services and appropriate metadata. Each Member State decides independently which type of NAP it implements (European Union 2010, European Union 2013a, European Union 2013b, European Union 2015, European Union 2017).

NAPs function as digital interfaces where data (or the sources of these data) or metadata for these data are made accessible for (re)use. It turns out that the features and functionalities of the NAPs which have been set up over the past 10 years greatly differ, from simple web-link repositories to fully functional data warehouses. With a vision to increase the interoperability and harmonisation of NAPs to enable Europe-wide service creation, NAPCORE started to set up coordination mechanisms as an EU-funded project involving all 27 Member States and additionally Norway, Switzerland and the UK (NAPCORE 2023).

Why a European Mobility Data Space (EMDS)?

In recent years the volume of data generated by humans and machines has been increasing exponentially. Most data are unused, however, or their value is concentrated in the hands of relatively few large companies. Therefore, the EU Commission wants to facilitate the exchange and (re)use of data to use their full potential. To realise this, in the European Strategy for Data (2020) the EU Commission announced its intention to build Common European Data Spaces.

Common European Data Spaces will enhance the creation of an EU single market for data based on free data flow. They will also contribute to making the EU a leading global data-driven society because fostering data access is essential for innovation and growth. To achieve this, it is planned to link data in different strategic sectors and

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domains into one EU-wide common interoperable data space. To do this, the EU Commission plans to build several data spaces for different sectors and domains, which should all be interoperable. One of these data spaces will be for mobility data, the European Mobility Data Space (EMDS).

The legal framework for the EMDS

From a legal perspective, two legal frameworks play pivotal roles: the Data Governance Act (2020) and the Data Act (2022).

- The Data Governance Act is a key pillar of the European strategy for data. It seeks to increase trust in data sharing, strengthen mechanisms to increase data availability and overcome technical obstacles to the reuse of data. The Data Governance Act creates processes and structures to facilitate data sharing by companies, individuals and the public sector. In particular, the Data Governance Act provides regulation processes for data intermediation service providers and data altruism organisations, both being intermediaries between data users and data subjects. It supports the set-up and development of common European data spaces in strategic domains, involving both private and public players, in sectors such as health, environment, energy, agriculture, mobility, finance, manufacturing, public administration and skills. The Data Governance Act entered into force on 23 June 2022 and, following a 15-month grace period, will be applicable from September 2023.

- The Proposal for a Data Act (2022) complements the Data Governance Act. It aims to maximise the value of data in the economy by ensuring that a wider range of stakeholders can gain control over their data and that more data are available for innovative use, while preserving incentives to invest in data generation. It harmonises the rules on fair access to and use of data and clarifies who can create value from data and under which conditions. It also introduces rules concerning the use of data generated by connected devices. Users of connected devices can then be able to share data produced by these devices with data users through data intermediation service providers or data altruism organisations put in place by the Data Governance Act.

What role can NAPs have in the EMDS?

We need to take a closer look at the functionalities in the EMDS. The specific design and governance of the EMDS

is still open. Governance measures are necessary because the endeavour also brings with it new issues and responsibilities for the beneficial use of mobility data and automatic information processing tools. Further literature review of the design principles for data spaces and an in-depth analysis of their relevancy, technical feasibility, potential and use in the NAPs of Europe is needed. In the following text, the OPEN DEI Design Principles for Data Spaces (Nagel and Lycklama, 2021) are used as a starting point for structuring further discussion. They propose data space building blocks (see Figure 1), which are grouped in four categories: interoperability, trust, data value and governance.

If we take a closer look at the four groups of building blocks for a data space, which of these building blocks might be NAPs in the mobility domain, at least for data covered by delegated regulations deriving from the ITS directive: real-time traffic information (roads), safety-related traffic information, safe and secure truck parking and multimodal travel information services?

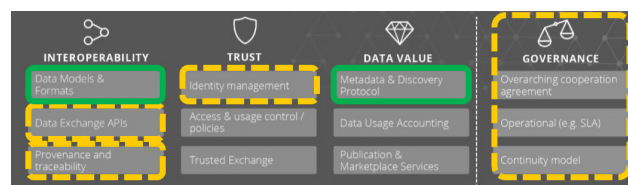


Figure 1: OPEN DEI building blocks for Data Spaces (from Nagel and Lycklama, 2021) and their relevance to NAPs (solid green: current NAPCORE activities with high relevance; dashed yellow: potential future relevance).

Some of the functionalities in the Data Space building blocks are already assigned to NAPs by the EU Commission, at least for mobility data that are incorporated in the different delegated regulations that derive from the ITS Directive. These functionalities are (in green in Figure 1):

- Data models and formats
- Metadata and discovery protocol.

Data models and formats

When it comes to data models and formats, the delegated regulations under the ITS Directive described in section 1 specify many data types which are to be provided in specific data formats. For most data types in the road traffic domain, DATEX II and TN-ITS are declared the favoured data formats. Both standards are continually being specified further and evolved by NAPCORE. Moreover,

profiles have been created to further harmonise datasets provided by NAPs. This means that subsets of comprehensive data models have been created indicating required and mandatory data elements in the relevant data types.

Other data types declared in the delegated regulations like TRANSMODEL, NeTEx and SIRI are developed by other organisations. For all the data types used in NAPs, NAPCORE provides recommendations for data providers concerning data models and formats in order to ensure aligned usage of the data by data consumers. This will help data consumers integrate data from NAPs in their services.

Metadata and discovery protocol

The minimum functionality of a NAP is as a metadata repository. NAPs are useful for stakeholders searching mobility data in a specific Member State. To ensure discoverability, data space concepts demand metadata-linked principles (Nagel and Lycklama, 2021). NAPCORE has issued a formal metadata specification based on DCAT-AP, which will enable automatic exchange of metadata between NAPs and other data platforms in order to make datasets findable on various data portals.

There are some functionalities in data space building blocks that have not yet been assigned to NAPs by the ITS Directive and the delegated regulations that derive from it. An investigation into the possible role of NAPs in other functionalities will help shape future interfaces between them and the EMDS. NAPs might play important roles in the following functionalities.

- *Provenance and traceability, and identity management*

The provenance and traceability of data will be a major focus in the coming years. For example, when aggregated data are offered, the data consumer needs to know the business rules implemented to aggregate the raw data in order to adequately assess whether the quality is sufficient for the intended use. To make this possible, data lineage can provide transparency about the rules and processes that were used to aggregate data. However, as data lineage can reveal sensitive information about users, processes and systems and be used to identify system vulnerabilities and the location of sensitive data resulting in data leaks, appropriate measures must be taken to safeguard the security and confidentiality of information systems. The data lineage process should preferably be harmonised. Therefore, this

could also be an issue in which NAPs can play a role and can be aligned on within NAPCORE (or NAPCORE's follow-up). In order to allow proof of provenance for data users and traceability options for data providers, identity management of the organisations involved is necessary to verify the authenticity of data.

- *Data exchange application programming interfaces (APIs)*

For technical interoperability, harmonised data exchange APIs are key. Currently, data exchange APIs are not harmonised with NAPs and their datasets. In particular, exchanges of time-critical data like safety-related data could benefit from this. Of course, when developing these APIs, trust and security are paramount. This is to ensure a continual delivery of service in a trusted environment.

- *Governance building blocks*

Interoperability, trust and data value governance building blocks need to be supported. For example, service level agreements (SLAs) could make data integration even more convenient for service providers. Version management and change management for all the above-mentioned building blocks need to be continually provided. NAPCORE is already developing governance concepts. Alignment with emerging EMDS specifications could significantly support sustainable governance of NAPs.

Conclusion

NAPs give access to a specific range of data defined by the delegated regulations in the ITS Directive. Most of these data are provided by public authorities such as road and transport authorities, but some of them are provided by private entities such as service providers and holders of in-vehicle generated data.

Easy findability and accessibility of data are key in a data space. However, with NAPs and many new data intermediation service providers and data altruism organisations, the principle of an easy-to-find single national access point may disappear. Data space building blocks will make the data ecosystem more decentralised. For those who want to find data, those who are looking for data and stakeholders it will be beneficial to find references to datasets on various platforms on a NAP, while the data exchange itself remains decentralised.

This could foster healthy competition between data brokers, ensure a supply of quality data to users and give better visibility to data altruism organisations. NAPs can also mirror lists of registered data intermediaries in accordance with the Data Governance Act.

NAPs could also evolve to include marketplace functionalities. As marketplaces, data intermediation service providers could develop more advanced data retrieval services than NAPs. At the same time, marketplaces could also create negative externalities like anti-competitive practices and result in consumers being locked into a small number of applications and high prices for data access due to concentrations of mobility data in a small number of private actors able to purchase mobility data at a high price and the computational power needed to offer mobility services. It is also a concern for public authorities to ensure a level playing field for all data holders. This will require the creation of incentive mechanisms to engage all stakeholders in data sharing, ideally without purchasing the data or making data sharing legally binding. This perspective envisions a cooperation mechanism to promote the reciprocity of data sharing and data circularity strategies in the data space ecosystem.

In a mobility data space, NAPs could give access to rules and tools to foster interoperability between different data spaces and quality frameworks (including certification processes), and transparency regarding data lineage. This would improve the value of NAPs in increasing the quality of data, and the efficiency of data sharing and data analytics. This requires standardisation of technical specifications and trustworthy data governance mechanisms to handle data and ensure high-quality data pools are available for use and re-use.

All the above-mentioned mechanisms should ensure that the European values, rules and fundamental rights enshrined in the EU Charter of Fundamental Rights are effectively implemented. For sustainable development of mobility data space governance, mechanisms should also ensure the safety, transparency and auditability of mobility data spaces. This could be put in place using the new European framework developed in the Digital Decade Policy Programme 2030.

The governance of data spaces is currently being discussed at the EU level. It would be beneficial to expand the mobility data ecosystem and the NAP network with data space design principles at the international level in order to build

a harmonised framework for international service providers and to foster new mobility services.

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How to enable data-sharing ecosystems in the context of urban mobility?

Katri Valkokari*

This paper explores three layers of data sharing in the context of urban mobility by means of an illustrative case study. It identifies three essential features of future solutions: they need to be 1) end user-proofed and support fair use of personal data; 2) business-proofed and enable well-functioning data-sharing relationships; and 3) policy-proofed and allow cross-sectoral local, regional and European policies.

Setting the scene of the data economy

The rise of the data economy has led to a variety of concepts that enable data flows, such as data marketplaces,¹ data platforms² and data spaces.³ Digitalisation is transforming products and services into networked systems. This transformation is impacting companies, their value chains and other stakeholders. As products and services are increasingly integrated in interconnected data-intensive systems, data are increasingly at the core of companies' competitive advantages. At the same time, hype around data is tempting actors to protect their data rather than share them, thereby hindering the growth of data-intensive businesses. In any case, data-intensive environments are constantly changing. Creating value in such environments requires complementary perspectives and dynamic strategies.

The purpose of this paper is to explore the dynamics of data-sharing involving a variety of actors in the context of urban mobility. As data-driven digital services have become an integral part of optimisation of urban mobility and the customer experience, they are of paramount importance when looking for more sustainable solutions. By means of

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1 Data marketplaces are traditionally large closed ecosystems in the hands of a few established leading players or a consortium that decides on the rules and policies. This limits the number of data offers that can be included and creates barriers to a more open data economy (Zappa et al., 2022).

2 The data platform business concept highlights multi-sided platforms, where a digital intermediary connects data providers, data purchasers and other complementary technology providers (Lampathaki et al., 2022 based on the HBR 2006 article, [Strategies for Two-Sided Markets, hbr.org](https://hbr.org/2006/01/strategies-for-two-sided-markets)). In comparison, the technology-oriented research stream refers to data platforms as architectures and repositories of interoperable hardware/software components, which follow a software engineering approach to enable the creation, transformation, evolution, curation and exploitation of static and dynamic data in data spaces (Curry and Ojo, 2020).

3 Data spaces can be considered an umbrella term for ecosystems benefiting data sharing technologies, with a suitable regulative framework and innovative new business factors (Scerri et al., 2022).

an illustrative case study, the paper aims to build understanding of the value of data in mobility data ecosystems from the perspectives of actors. In order to explore the value of data, three layers of data sharing ecosystems have been identified (Figure 1), following of layered structure explaining the architecture of data spaces (Otto, 2022).

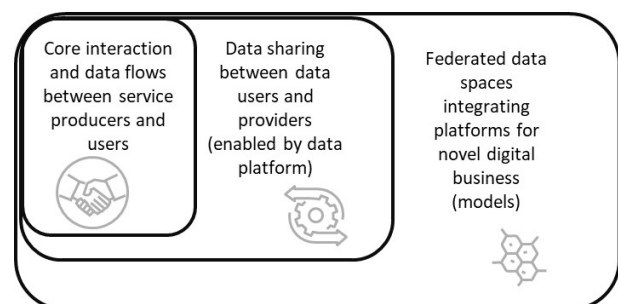


Fig. 1. Three layers of data sharing ecosystems

The first layer, in which services are offered to mobile citizens, is based on core interactions between actors, i.e. service providers, and users (Sorri et al., 2019). These services expand the mobility experience of end users and allow both public and private service providers to manage traffic flows. Then, in the second layer, data platforms integrate different data users and owners, boost the emergence of novel data-driven businesses providing a plethora of new services following every step in the lifecycle of data (Langley et al., 2021). At this level, the data consists, for instance, of timetables, availability of shared vehicles, utilisation of buses and trams and the travel preferences and plans of individuals. Integration of different data sources may enable smooth utilisation of different means of transport, i.e. networked business models for mobility as a service (MaaS). Finally, in the third layer, federated data spaces could integrate data-sharing ecosystems bridging cross-sectoral data spaces for industrial renewal and competitiveness. There, deeper insights are required to understand the complex structure of systems that pro-

duce dynamic behaviour, including the market characteristics, needs and behaviours of each side of the platform, and platform design choices (Pussinen, Wallin and Hemilä, 2023). Such a system approach is crucial in building a common European data space, where several sub-systems with different business logics have their own markets, actors, needs and behaviours.

Exploring the layered structure of mobility data ecosystems

In the first layer, the value of data must be understood from the perspectives of users and service providers. When we dive deeper into core interaction in one application area, we should understand that roles in the core value chain (between service producers and users) and the data (sharing) value chain are likely to be different (Sorri et al., 2019; Pussinen et al., 2023). For instance, in the context of urban mobility a micro-mobility operator and service provider, [TIER](#), collects data on urban mobility through internet of things (IoT)-integrated electric vehicles. Based on end user agreements, it has the rights to collect and share these data. Although TIER already shares its data with the cities it operates in, universities and public transport operators, as a business operator it emphasise the need for commercially sensitive data to be protected. This may hinder data sharing if thinking is strongly based on current rather than future business opportunities. On the other hand, from the perspective of local authorities developing mobility as a service (MaaS), rights to integrate different data sources and co-create broader understanding, i.e. knowledge on urban mobility, are central. Consequently, data-sharing between actors requires transformation of traditional *dyadic customer-supplier relationships into more equal collaboration*, in which the rights and responsibilities for data usage are clearly stated. This is an essential prerequisite for a data economy, and therefore deeper understanding of the dynamics in this change process is required. In addition, although companies acknowledge the potential value of data and even consider them as treasure, they are not always able to exploit this potential. Identifying mechanisms for creating value, implementing changes and extracting value is a complex task.

In the second layer, the starting point is that the value of data can only be revealed when they are used (Otto, 2022). Therefore, the value of data is context-specific and often linked with the value of data-driven service opportunities (Kortelainen et al., 2019). The full potential of this data-based business can be captured in collaboration

with a variety of external actors, i.e. collaborative data value chains and ecosystems. In any case, data-based services require *dynamic configurations of resources* (people, technology, organisations, information) between networked actors. In the context of urban mobility, this could mean a smoothly operating urban mobility application created for all and with all involved. It should be based on advanced data sharing models and incentive schemes in order to build a sustainable urban mobility ecosystem. On the other hand, there are a variety of requirements for these data (integrating) platforms. They must meet regulations, be flexible with change of use patterns and ensure data sovereignty (Otto, 2020). Therefore, in the second layer of data platforms, special attention should be given to communicating these *complex legal structures to all stakeholders*. This requires bridging a holistic overview of the regulatory environment and analysis of the contractual settings in different data-sharing settings (e.g. identifying the roles of actors, operations and processes in the service and data platform layers). There are currently different conceptualisations of data spaces and a variety – over 30 – of ongoing initiatives in the context of mobility data spaces. These often include their own solutions for data governance, architecture, harmonisation and divergent definitions. As a result, it is difficult to obtain a clear picture of the various developments. This hinders building coherent data-driven business models, in particular SMEs have limited resources to keep up with developments and further implement novel roles in the data economy. Therefore, it is important for intermediaries to share success stories and lessons learnt.

Finally, in the third layer of federated data spaces, it is crucial to understand that the business logics in different application areas – from global logistics to local mobility chains – are different, which has led to fragmentation and different standards in application areas. Although standardisation of the technical building blocks could drive development, data sharing and governance rules need to be aligned with actors' current and future business models. Addressing this complexity requires multiple lenses, i.e., technology, people, business and society. This is key to navigating the complexity and ambiguity of internal and external business environments. There are a variety of end users in the data-sharing ecosystem, and typically all actors in the value chain are both users and owners of data, leading to changes in relationships between actors. To figure out the future roles of actors and the development paths in data-sharing ecosystems, this should be understood. Therefore, one of the key questions is how to *cope with the architectural complexity of data systems* since companies have developed their architecture practices under fast-evolving

integration pressure imposed by digitalisation (Lankhorst, 2017). On the other hand, network effects are often seen as an automatic feature of platform businesses, although they should be enabled by (successful) platform design which requires a thorough systems-oriented approach (Pussinen et al. 2023). Consequently, both top-down and bottom-up approaches are needed when building (mobility) data spaces and successful ecosystems.

Putting the pieces together

When it comes to developing new businesses, the illustrative example of urban mobility data ecosystems demonstrates that often cross-sectoral collaboration is required, and in this area the support of public actors is needed to enable interoperability between different independent data platforms. The primary question is then who makes the rules of the game. The rules of the game are set at multiple levels, from policies to business ecosystems and technology standards. Coordination – or even transparency – between these levels is crucial. In this context, it is important to note that business actors in current value chains often emphasise a need to federate existing models rather than to create new ones. Therefore, integrating existing pieces, such as data sources, is as important as building new ones.

Each of the three layers discussed above has special requirements for successful mobility data spaces and ecosystems. For this reason, future solutions need to be:

1) user-proofed and provide working connections to personal data spaces and fair use of personal data;

2) business-proofed and enable well-functioning data-sharing ecosystems with unique and transparent objectives; and

3) policy-proofed and allow cross-sectoral local, regional and European policies with social goals and missions.

The common European mobility data space is not an ocean of data; it is about creating a network of networks enabling relevant, although not always open, access to various already existing data sources. In summary, it is important to emphasise that data spaces are not only about technical factors but also about collaboration between different actors who have different expectations, interests and capabilities.

An important avenue for further research is *whether domain-specific or more wide-ranging data models drive the*

development of data spaces, their architectures and data ecosystems. Subsequently, the realisation of a fair data economy is layered, and development should bridge these layers. This requires more equal relationships enabling core-interactions, data sharing models enhancing the novel value of data and cross-sectoral data spaces for sustainability of ecosystems.

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The Future of Mobility Data Spaces. The role of local governments

Matteo Antoniola*

Mobility data spaces can help facilitate data access and sharing in order to provide more accessible, safe, sustainable and efficient transport systems for all. At the same time, policymakers are called on to promote a level playing field to ensure the development of multimodal digital mobility services for end users in a fair, reasonable and non-discriminatory business ecosystem. By synergically combining global, national and local policies, we can accelerate the success of multimodal digital mobility services and MaaS in well-functioning and open ecosystems, producing social, economic and environmental benefits for our communities.

The Context of Mobility Data Spaces

According to the European Commission, the common European mobility data space (EMDS) is intended to facilitate data access and sharing in order to provide more accessible, safe, sustainable and efficient transport, by ensuring interoperability of data and services, and building on existing and future initiatives and platforms.

As was recently discussed during the ‘10th Florence Intermodal Forum: Creating a Common Mobility Data Space,’ we recognise that “*Unlocking the full potential of mobility and transport data is indeed essential to accelerate the transition towards a more sustainable and smarter mobility system while offering valuable insights to policymakers. Digital technologies are already enabling innovations and disrupting all sectors of the economy. In transport, for instance, connected, automated and electric vehicles have seen major advances in recent years, while shared mobility and Mobility-as-a-Service (MaaS) are transforming the way we move both people and goods. Data have an instrumental role to play in all these trends. In addition, there is a growing need to enable data re-use across sectors, notably between mobility and the health and energy sectors.*”¹

The common European Mobility Data Space (EMDS) will allow EU-wide added value in the transport and mobility industry by increasing interoperability to aggregate and share data from different sources and use these data for operations, business intelligence and artificial intelligence. As an ultimate aim, the common EMDS will foster acceleration of the digital and green transformation of the European mobility and transport sector, helping mobility stakeholders fully benefit from the huge increase in the amount of data generated, stored and exchanged.

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1 For more information, visit <https://fsr.eu.eu/event/10th-florence-intermodal-forum-creating-a-common-european-mobility-data-space/>

From Data to Services

We have clearly understood the relevance of data sharing in the digital economy. This is why at the time being there are plenty of initiatives worldwide aiming to better enable the right market conditions by unlocking data sharing and fulfilling green ambitions, and paying great attention to the field of mobility. Most of them are particularly focused on mainstream data access and data sharing as building blocks for further service development.

Ownership of and access to data in the digital economy may create a competitive advantage and therefore lead to market dominance. Data sharing and data exchange models can be designed to be proportionate, fair and fit for purpose.

Several regulatory initiatives are currently in progress, especially in the European Union, which take into account the necessary (but not sufficient) conditions of availability and access to high-quality transport and mobility data.

The regulation which is most relevant to the EMDS dates back to 2017 and is the revision of Delegated Regulation (EU) 2017/1926. It establishes the necessary specifications to ensure the accessibility, exchange and update of standardised travel and traffic data and distributed journey planning to provide EU-wide multimodal travel information services (MMTIS).

More recently, the European Commission’s Multimodal Digital Mobility Services (MDMS) initiative, which is planned for the end of 2023, aims to better integrate and align all mobility services, both long distance and urban, within the mobility space to achieve seamless multimodal passenger transport as a way to deliver the EU Green Deal. The initiative aims to allow better understanding of the challenges and barriers against the development of multimodal digital mobility services, including features enabling planning, booking, payment and ticketing. These are

the foundations of MaaS (Mobility as a Service), the new transformative concept for our mobility of tomorrow.

Considering the bigger picture of the MaaS transformation, policymakers are then called on to promote a level playing field to ensure the development of multimodal digital mobility services for end users in a fair, reasonable and non-discriminatory business ecosystem.

In this perspective, the European Parliament has recently adopted two legislative initiatives, the Digital Services Act (DSA) and the Digital Markets Act (DMA). These were developed by the European Commission between 2020 and 2022 with the aim of creating a safer digital space where the fundamental rights of users are protected, and of establishing a level playing field for businesses while preventing market dominance, both in the European Union and globally. The Digital Services Act primarily concerns online intermediaries and platforms, including online travel and accommodation platforms, meaning that future widely deployed MaaS applications will have to be fully compliant with the new Digital Services Act package.²

In any kind of market, and of course in the mobility industry, the aim is to create fair conditions for all market operators, with no operator being at an advantage (or disadvantage) compared to others, and all playing by the same set of rules. As transport is considered mainstream to reach several sustainable development goals (SDGs),³ and especially SDG 11 on sustainable cities and communities, innovative trends in the mobility ecosystem and growth in multimodal digital mobility services for end users might become powerful tools to help make mobility smarter and greener in communities worldwide.

A level playing field can therefore be supported by a framework of common rules and standards that prevent businesses from gaining unfair competitive advantages over others and ensure equal opportunities for newcomers. This approach should then lead to the development of a plurality of multimodal digital mobility services provided by different business players and customised according to the needs of different target users.

From the point of view of users, multiple digital mobility offers should be able to better match the needs of a variety of different target user groups, by widening their freedom of choice of mobility-on-demand services and ultimately enhancing quality while also lowering prices.

² For more information, visit <https://digital-strategy.ec.europa.eu/en/policies/digital-services-act-package>

³ For more information, visit <https://sdgs.un.org/topics/sustainable-transport>

At the same time, from the public authority perspective, fair competition and a plurality of services, if properly orchestrated, can also help reach societal goals for the benefit of communities, such as increasing the accessibility and inclusiveness of mobility services, reducing carbon emissions and promoting more sustainable mobility choices, and optimising public spending on mobility.

A complementary approach to regulation

We all agree that regulation and public policies play a key role in fostering innovation in the mobility space by accelerating the digital transformation, improving sustainability and helping change the way we move.

Mobility can be seen as a grid. A grid made of dots and connections. The dots are the local mobility ecosystems, be they urban, metropolitan or regional, while the connections are the global mobility services connecting these dots through short- medium- or long-distance travel.

Users can then move and commute within their specific dots, or follow connections between dots, or a combination of both. This is why users need different solutions for different needs, and multimodal digital mobility services providers are in a position to develop both global and local MaaS services. It is also the reason why we need both global and local regulatory tools to cope with the challenges that will arise from deploying large-scale MaaS services.

It was clearly stated by the MaaS Alliance in their recent position paper on the MDMS that “*Public authorities should take the lead in working on the deployment of MaaS to facilitate the required outputs in such a way that they can fulfil public responsibilities. Setting the correct regulation is required so that all mobility service providers – public and private – are connecting and operating with the same rules. The European Commission will set the guidelines on EU digital interoperability that will be deployed by national authorities and local public authorities. To make sure we align on interoperability, the governance between EU-national-local frameworks should be clear and facilitated.*”⁴

Regulation is on the one hand a mechanism for creating a level playing field by building trust among different stakeholders and for facilitating the development of the industry, while on the other hand it is a powerful tool to guarantee user rights.

While following the European guidelines and regulations which set the framework of principles and rules, when we come to national and local authorities they are responsible to a certain extent for ‘filling the gaps’ where specific local

regulations apply. This is the case, for instance, when defining public service obligations for local public transport operators, or when establishing rights and obligations for any mobility service provider operating a shared mobility service in its community in exchange for the use of public resources (space, roads, restricted zones, etc.).

In conclusion, we recommend designing and implementing complementary regulatory frameworks between the international, national and local contexts to enable a complete and beneficial digital transformation in the mobility space. In Europe the European Commission can set the guidelines of EU digital interoperability, which can be further specifically deployed by national authorities and local public authorities. More generally, global initiatives in this regard should then be complemented by appropriate national, regional and metropolitan policies, in line with local specificities.

This multi-level complementary regulatory approach will allow the right conditions to be set and trust to be built among relevant stakeholders, and will also help reach sustainability goals, according to common priorities. We believe that a synergic combination of global, national and local policies can accelerate the success of multimodal digital mobility services in well-functioning and open ecosystems, which can generate social, economic and environmental benefits, and so ultimately contribute to the common good.

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“ATM Financing”

Presentation of the next issue

This special issue of the NIQ will explore ways and means to finance ATM (Air Traffic Management) in Europe in the future. Questions about such financing recently arose in the context of COVID-19 whereby ATM appeared to be too big or rather too important to fail, without however a clear financial supporting scheme being in place. And beyond COVID questions persist as to how ATM can be sustainably finance into the future.

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Vol 25 Iss 1 (May)

Regulating Digitalization in Türkiye

This special issue of the Network Industries Quarterly features five short articles which mainly explore the potential effects of the changes in the E-commerce Law and the Competition Law. This issue also presents an analysis on the recent developments and challenges in the regulation of data privacy in Türkiye.decommissioning.