MOBIDATALAB

Labs for prototyping future mobility data sharing solutions in the cloud

D3.1 Actors' needs and cooperation framework report

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Summary sheet

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Abstract	**This task provides a description of the actors in the data sharing ecosystem in transport, actors' relationships and needs, and a proposed cooperation framework among actors inside a virtual data exchange ecosystem.**

Legal Disclaimer

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Executive Summary

Data sharing in the transport and mobility industries has begun to rise in recent years as stakeholders try to address key issues and challenges through collaboration. The MobiDataLab WP3 aims to analyse the state-of the-art of data sharing initiatives and enhance the potential impact of digitalisation and data sharing on different actors and on different areas of mobility and transport. This document D3.1 named "Actors' needs and cooperation framework report", aims to describe the market in terms of the actors' relationships and needs, and to describe a proposed cooperation framework inside a virtual data exchange ecosystem.

Through the literature review and the questionnaires' analysis, several challenges like data interoperability and data quality were identified that can be addressed through data sharing. Also, an exhaustive list of actors that would be able to enhance their products/services by participating in data sharing activities and their needs has been created. Interestingly, it was noted that even actors that are active in industries other than transportation could also benefit by accessing transport data. Consequently, their relationships have been analysed and a cooperation framework that could work as a starting point for data sharing has been proposed.

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Abbreviations and acronyms

Abbreviation	Meaning
ADAS	Advanced driver-assistance systems
D2D	Door to Door
KPI	Key Performance Indicator
MaaS	Mobility as a Service
NGO	Non-governmental organisation
PTA	Public Transport Authority
PTO	Public Transport Organisation
SME	Small Medium Enterprise
TSP	Transport Service Provider
UCM	Use Case in MobiDataLab
WP	Work Package

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Content

1. Introduction

1.1. Project Overview

There has been an explosion of mobility services and data sharing in recent years. Building on this, the EU-funded MobiDataLab project works to foster the sharing of data amongst transport authorities, operators and other mobility stakeholders in Europe. MobiDataLab develops knowledge as well as a cloud solution aimed at easing the sharing of data. Specifically, the project is based on a continuous co-development of knowledge and technical solutions. It collects and analyses the advice and recommendations of experts and supporting cities, regions, clusters and associations. These actions are assisted by the incremental construction of a cross-thematic knowledge base and a cloud-based service platform, which will improve access and usage of data sharing resources.

The main dimensions of the analysis will revolve around the state-of-the-art data sharing initiatives and Living Labs projects that exist. Also, the landscape of actors that are interested in data sharing will be explored along with their needs and motives to participate in data sharing schemes.

1.2. Purpose of the deliverable

The deliverable D3.1 "Actors' needs and cooperation framework report" will identify the main actors that partake in data sharing or the actors whose participation in data sharing activities will enhance their ability to deliver services to users, to optimise their operations or to increase the services provided to users and citizens.

1.3. Intended Audience

The dissemination level of deliverable D3.1 is public. This document is addressed to anyone that is interested to identify the actors involved in data sharing in transportation and the complex nature of their cooperation.

1.4. Structure of the deliverable and its relation to other work packages/deliverables

This document reports the work carried on by the T3.1 whose objective was to identify, classify and describe all the actors and stakeholders that may interact within a data sharing context and may use its services. The document is structured as follows:

- Chapter 2 provides the literature review and market analysis to define a list of actors involved in the transportation and mobility domain (based on market analysis, related previous projects and questionnaires' analysis);
- Chapter 3 shows the results of the analysis of the Delphi survey and of the Innovators' questionnaire, with main focus in exploring actors' needs and insights;
- Chapter 4 summarises the lessons learnt by the analysis and the recommendations for replicating the approach and for implementing the MobiDataLab Virtual Labs;
- Chapter 5 provides the conclusions and the final remarks;
- Annex A and Annex B include, respectively, the templates used for the Delphi survey process and for the Innovators' Questionnaire. Annex C summarize the full list of actors and their needs.

This document will serve as input to various tasks and WPs of the MobiDataLab due to its exploratory nature. Joint efforts with Task 1.5 (Expert Committee Management) have been done to enhance the participation to the Delphi Survey process. The actors' identified and the use cases introduced, are input for Task 2.6 (New Use cases and Requirements) which will determine how potential input data can be shared among heterogeneous infrastructures with different operational use cases. Also, the findings of the Delphi coupled with the findings of D3.3 (Market Analysis) monitoring will be especially important in clarifying which available or new solutions should be included in the Transport Cloud to satisfy users' needs in Task 3.3 (Gap Analysis). The findings of T3.1 Innovators' questionnaire along with findings of the Delphi in terms of actors' needs will serve as input for T3.4 (Business and Revenue Models in Data Sharing) and can provide a framework to support stakeholders to take advantage of the data produced from the transport network and improve their operations and services. Finally, the identification of the actors (users) and the data sharing scenarios that occurred in the analysis of D3.1 will be crucial for the definition of user stories and use cases, during the development of the Virtual Lab in Task 5.1 (Creation of the Virtual Lab – Extension of cloud's UI).

2. Literature Review

The purpose of D3.1 literature review is to gain a good understanding of the existing projects that engage participants in data sharing initiatives. The literature review involves scientific papers, journals, desk research, reports and deliverables from past or ongoing European projects and other data sharing platforms.

During our research, we needed to explore which domains in the transportation industry have been addressed through data sharing and which actors take part in it, in order to have a relevant input of the market and the most active actors in the industry. For this purpose, we analysed only data sharing platforms and Living Labs, as commercial data aggregators and products are part of the deliverable D3.2 "Data Sharing market technological developments monitoring" submitted in July 2021.

2.1. Data Sharing Initiatives

Throughout the search of innovative data sharing initiatives, we identified more than 35 data sharing platforms and digital frameworks – many of which are the result of European projects- that facilitate data exchange practices. The domains that are addressed in data sharing initiatives are:

- Big Data, which involves platforms that manage big data in the mobility and logistics market in Europe in order to increase operational efficiency;
- In-Vehicle Data, which involves projects that allow the exchange of vehicle data (driving cars, automated vehicles, micromobility vehicles);
- Electromobility Data, that involves projects that explore the potential for interoperable and seamless electromobility services;
- Logistics and Supply Chain, which contains projects addressing interoperability and connectivity of logistics operators;
- Public Transport, which contains projects addressing interoperability in the public transport sector by developing and implementing standards and models, to fulfil the needs of multimodal travel information service providers;
- User data, which contains a project that gathers user data in order to address riders' needs;
- Data Interoperability, which involves initiatives addressing standards to support providers in delivering a secure and interoperable infrastructure.

The most relevant data sharing initiatives that provides input related with the actors involved and the data sharing needs are presented in the Table 1. The data sharing platforms and digital frameworks that were analysed are summarised in the table below.

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Table 1: *Data sharing Projects*

Project	Duration	Description from website	Domain	Actors involved
Optimum Project	2015-2018	The EU-funded OPTIMUM project establishes largely scalable architecture for the management and processing of multisource big data, to improve transit, freight transportation and traffic connectivity throughout Europe. Through tailor-made applications, OPTIMUM is striving to bring proactive and problem-free mobility to modern transport systems by introducing and promoting interoperability, adaptability and dynamicity.	Big Data	Research centres and universities, public authorities, public transport operators, environmental centre, consulting companies.
Transforming Transport	2017-2019	TransformingTransport was an EU-funded public-private project that aims to demonstrate how Big Data can transform the mobility and logistics market in Europe in order to increase operational efficiency, deliver improved customer experience, and foster new business models.	Big Data	Partners in the project are private for-profit entities active in air and land logistics, research centres, universities, one municipality and one mobility authority.
LeMO	2017-2020	Leveraging Big Data to Manage Transport Operations (LeMO) project will address these issues by investigating the implications of the utilisation of such big data to enhance the economic sustainability and competitiveness of European transport sector. The project will study and analyse big data in the European transport domain in particular with respect to five transport dimensions: mode, sector, technology, policy and evaluation.	Big Data	Non-profit research and development institute, International Legal Practice, policy research, market research and consultancy for authorities.
Big Data Value Association (BDVA)	Permanent Structure	The mission of the BDVA is to develop the Innovation Ecosystem that will enable the data and AI-driven digital transformation in Europe delivering maximum economic and societal benefit, and, achieving and sustaining Europe's leadership on Big Data Value creation and Artificial Intelligence.	Big Data	Big Players like SIEMENS and PHILIPS, private entities active in cybersecurity and IoT, and European platforms dedicated to software and data.
ADASIS	Ongoing (Commercial Project)	ADASIS defines an appropriate interface for exchanging information between the in-vehicle map database,	In-Vehicle Data	Partners in the project are Vehicle manufacturers,

		ADAS and automated driving applications.		Navigation System Manufacturers, ADAS manufacturers and Map and Data Providers.
SENSORIS	Ongoing	SENSORIS is committed to deliver and maintain technical specifications that define the format and content of sensors and campaign data in the cases mentioned under scope. This implies vehicle-to-cloud data upload format for vehicle-based data only, cloud-to-cloud exchange format for vehicle-based data and other data needed for mobility services, and cloud-to-vehicle "campaign" request format for specific data at specific locations and times only.	In-Vehicle Data	Coordinated by ERTICO, the project is being brought to life by vehicle manufacturers, navigation system manufacturers, ADAS manufacturers, telecom & cloud infrastructure providers and technology institutions.
Vianova	Ongoing (Commercial Project)	Along with the benefits of micro-mobility and other mobility solutions, cities face growing challenges as they integrate new and fast-developing modes of transportation. Vianova uses connected vehicles data to help cities and mobility operators build more efficient and sustainable transport systems. Vianova is building the digital layer between cities and operators to foster collaboration and facilitate modal shift toward more sustainable and accessible modes of transport. Vianova helps cities digest as well as make good use of complex mobility data.	In-Vehicle Data	Partners in the project are micro mobility provider, ride hailing companies, engineering companies, public authorities and public transport operators.
GAIA-X	Permanent Structure	GAIA-X is a project that aim to develop common requirements for a European data infrastructure. Therefore openness, transparency and the ability to connect to other European countries are central to GAIA-X. An open digital ecosystem is needed to enable European companies and business models to compete globally. This ecosystem should allow both the digital sovereignty of cloud services users and the scalability of European cloud providers. Within GAIA-X, the foundations for a federated, open data infrastructure	Data Interoperability	Public Transport Providers, Local Authorities, Mobility Service Providers

		are developed based on European values. GAIA-X connects centralised and decentralised infrastructures in order to turn them into a homogeneous, user-friendly system. The resulting federated form of data infrastructure strengthens the ability to both access and share data securely and confidently.		
FENIX	Permanent Structure	To develop a European federated architecture for data sharing serving the European logistics community of shippers, logistics service providers, mobility infrastructure providers, cities, and authorities, the FENIX federation fulfils the general aspects of connectivity, interoperability, security and trust. FENIX will provide the appropriate digital framework to help them in performing collaborative planning, efficient and sustainable operations and execution monitoring in various Corridor scenarios and contexts. This will be facilitated through the provision of interoperable planning and optimisation tools and services utilising shared, enhanced, secure and reliable data and information resources.	Logistics and Supply Chain	The team that will bring it to life consists of 43 beneficiaries, 2 member states and 23 implementation bodies supporting the development, validation and deployment of the digital information systems along the EU transport Core Network
DIAMOND	2018-2021	DIAMOND project analyses and converts data into knowledge with notions of impartiality to support gender inclusion in current and future transport systems from the perspective of women as transport users and as professionals in the sector. The project makes use of data mining and analytics, together with the use of elicitation techniques in order to gather and analyse gender desegregated data, including new sources, to identify, design and evaluate specific measurements for fulfilling women's needs and expectations from the transport sector. The knowledge gathered is to be fed into a self-diagnoses tool, a practical decision support system and for the production of diverse materials, providing recommendations on how to achieve fair gender inclusiveness in different scenarios and promoting female employment in the sector.	User Data	The consortium is composed of transport operators 4 Universities, 2 RTO, 2 Associations, 2 Companies and 1 Public authority.

2.2. Living Labs

Living labs are open innovation initiatives that often operate in specific contexts to allow co-creation, exploration and evaluation of concepts, services, and related technological artefacts, (Almirall, Wareham, 2011) as cited in (Jani-Pekka Jokinen1*, 2018). The goal of Living Labs is to facilitate technological development of transportation services in cooperation with companies, research organizations, public authorities and the travelling public.

Since the MobiDataLab is concentrated on a holistic approach of data exchange that will involve actors ranging from municipalities to private entities and citizens, we wanted to examine whether a living Lab approach would be suitable for the scope of our project. Living labs have already been identified as useful tools and are well established in various fields of research. National and European funding programs use "Living Lab" approaches to support cooperation between public and private sectors as well as research initiatives. Focus is put on the integration of potential users, where innovation processes should be accelerated, as a quicker step from an idea to a market-ready and demand-oriented product or service (Muck et al, 2019). The outcome has been acknowledged based on the Living Labs approaches presented in the Table 2.

Table 2: *Living Labs approaches*

Living Lab approaches	Duration	Description
Eccentric Civitas	2016-2020	To make mobility more sustainable, ECCENTRIC implemented solutions to bring clean transport and urban freight to people living in such areas in five places across Europe. Each city had its own Living Lab focused on one neighbourhood where measures were tested. Local consortia were formed in each city, integrating a variety of stakeholders from administrations, private companies, universities and civil society.
SELIS	2017-2019	SELIS is aimed at delivering a 'platform for pan-European logistics applications' by: • Embracing a wide spectrum of logistics perspectives and creating a unifying operational and strategic business innovation agenda for pan European Green Logistics. • Establishing an exceptionally strong consortium of logistics stakeholders and ICT providers, that can leverage EU IP from over 40 projects so as to create proof of concept Common Communication and navigation platforms for pan-European logistics applications deployed in 8 living labs representing the principal logistics communities. • Establishing a research and innovation environment using the living labs to provide data than can be used for discovery of new insights that will enable continuous value creation supporting the large-scale adoption of SELIS.
AEOLIX	2016-2019	To overcome the fragmentation and lack of connectivity of ICT-based information systems for logistics decision making, as well as to fill in the information gaps between logistics actors, the AEOLIX project proposed a demand-driven approach to enable various actors (at different levels, of different sizes, with different systems and

		platforms or even without own in-house systems, e.g., SMEs) to better manage, (re-)plan and/or synchronize facilities in the supply chain.
FEDeRATED	2019-2023	FEDeRATED is an EU-funded project with focus on EU logistics. Its objective is to provide an infrastructure provision containing a set of agreements and technical applications to enable data already available in existing IT systems (platforms) of companies and public administrations to become available to authorized users through a publish and subscribe approach. The scope of FEDeRATED is a federated network of platforms, including the sharing of both data and services, that covers end-to-end transportation chains, from the consignor to the consignees, thus ensuring enhanced visibility and transparency and enabling value adding service development for third parties. The project plans a number of virtual labs where to experiment the federation. Some of the considered technical and non-technical dimensions include, among others: Trust, Accessibility, Legislation and legal framework, Data quality and integrity, (Cyber) Security, Operational management, Sustainability objectives, Data sovereignty Accessing data at its source, Investments, Governance.

2.3. Findings

Throughout the data sharing initiative analysis, plenty and multidomain projects that attempt to solve transportation and mobility challenges were explored. Platform research and analysis shows that the main issue that is addressed is data interoperability and standardisation in all transportation domains. Naturally, each data sharing initiative focuses on one aspect of the challenges since the volume of data that need to be processed is immense. Data sharing initiatives seem to create a scalable environment for the management of pan European data challenges. On the other hand, Living Labs oriented initiatives have a more local character, but their approach is a more holistic one, where multiple stakeholders can contribute to the development of transport solutions with direct and indirect benefits.

Regarding the industry that contains the most research projects, logistics and supply chain is the primary one and in-vehicle data follows. The sharing of PT data is commonplace (see the open data portals of many cities and PTAs, e.g., PT routes, timetables, real-time arrival, etc). However, the sharing of logistics and in-vehicle data is rarer, hence the need for research.

- The logistics and supply chain industry could benefit from EU Funding (both in H2020 and in CEF programs) that pushed the creation of data sharing facilitators. Moreover, the Logistics and Supply Chain domain welcomes the recommendations and guidelines of the Digital Transport and Logistics Forum (DTLF), a group of experts that brings together stakeholders from different transport and logistics communities, from both the private and the public sector, with a view to build a common vision and road map for digital transport and logistics. The DTLF's overall objective is full-scale digital interoperability and data exchange in a shared,

secured and trusted transport and logistics dataspace. For this purpose, the DTLF splits currently into two strands of work organised under two subgroups: subgroup 1 focuses on the preparation of the proposal for the EU Regulation on electronic freight transport information (eFTI) and continues to have an essential contribution to the related implementation work; subgroup 2 strives for building a common data exchange framework connecting easily and in a collaborative and trusted environment existing transport and logistics data sources and platforms.

- The "in-vehicle" data sharing is pushed by the fact that the greater proliferation of connected and automated mobility applications and intelligent transport systems tools, the value of data from vehicles is getting strategic, not just for the automotive industry, but in a wider scope, and it is not limited to the onboard systems and services. This trend is relevant at the European level as it may allow to increase the competitive advantage of the EU automotive industry.

Therefore, it is crucial to identify which challenges occur from the complexity of such networks and whether all categories of actors (not only organisations, but also commuters and citizens) have an incentive to join. Lastly and more importantly, we need to identify whether the combination of a Living Lab with a virtual infrastructure – Virtual Lab, could solve the interoperability challenge which is the most prominent and which cooperative framework could help this cause.

3. Delphi Survey and Innovators Questionnaire

This chapter provides the methodology and approach used in MobiDataLab to map the landscape of transport's stakeholders and their needs for data sharing. Two processes have been performed: the first was conducted with the Delphi Survey Technique and was addressed to experts of the industry; the second was a questionnaire addressed to innovators. The Delphi Survey process attempted to explore the actors' landscape and aimed to create an exhaustive list of actors interested in data sharing. Along these lines, the Delphi survey's purpose was to acquire industry knowledge by industry experts and break down the data sharing challenges among with actor's needs. The second questionnaire aimed to be addressed to innovators of the industry (including start-ups and SMEs) and aimed to explore their needs and motivation to join a data sharing ecosystem. The expected result of our research is the creation of a data sharing cooperation framework for multiple actors in the transportation industry.

3.1. Delphi Survey

The Delphi Survey Technique is particularly well suited to solve complex and multi-layered problems that require the attention of multiple stakeholder groups; therefore, it appears as a good choice to address such a vast landscape like transportation actors and their needs.

Procedure-wise, the Delphi relies on a sequence of questionnaires distributed to selected experts in a process managed by a survey coordinator (Hirschhorn, 2019). Rowe and Wright as cited in (Hirschhorn, 2019) identify four core elements in a Delphi survey:

- Anonymity for all participants so that they can express themselves freely, under no influence of potential dominant figures or group conflicts;
- Iteration so that all panellists can reassess their responses under the light of the group's opinion;
- Controlled feedback after each round, when panellists are confronted with the group's opinions and encouraged to re-evaluate their own responses;
- Statistical aggregation of group responses: at the end of the survey, the group's opinion is taken as the statistic average (mean/median) of overall opinions of panellists in the final round.

The sample sizes in Delphi studies range from 10–12 to several hundred, with typical samples ranging from 30 to 60 individuals, ((UNEW), 2017), while (Rob C. de Loe, Natalya Melnychuk, Dan Murray, Ryan Plummer, 2016) found that over 90% of Delphi studies, had sample sizes of less than 100. In Delphi exercises, a minimum of 12 respondents is generally considered to be sufficient to enable consensus to be achieved (Christina Vogel, Stephen Zwolinsky, Claire Griffiths, Matthew Hobbs, Emily Henderson, Emma Wilkins, 2019).

An indicative structure of this survey technique is to ask the respondents to assess the expected probability, desirability and expected impact of projections or scenarios to speculate how the future may look like, (Urlike Kluge, Stefan Spinler, Juergen Ringbeck, 2020). However, since the orientation of the MobiDataLab is problem-solving, we decided to focus on the technique that can explore current challenges, which can be used to rank and prioritise topics, support policy making, generating ideas, establishing facts, and for other research purposes.

The Delphi survey of T3.1 was structured in three different rounds: (i) brainstorming in the first round where respondents could freely answer with open-ended questions, (ii) narrowing down (respondents shortlisted most relevant elements from previous stage) and (iii) rating (respondents rated shortlisted elements). In each of these rounds one questionnaire was used. This design was mainly inspired by the ranking-type Delphi, although it does not strictly follow the structure and steps proposed by Schmidt as cited in (Jörn Kobus, Markus Westner, 2016) and others who have employed this variant.

The survey's main Research Question was "What is sustainable cooperation framework for Living Labs and/or the Virtual Lab"? and our Supportive Research Questions were the following:

- Q1: Who are the actors interested in data sharing?
- Q2: Which data can the actors provide?
- Q3: Which data do the actors need access to?

AETHON prepared the questionnaire, held a workshop with members of the consortium to discuss the flow and scope of the questionnaire which was agreed by all members. For the purpose of the

survey, 10 different cases (Table 3) were presented in order to provide some context to the panellists who were called to discuss such a broad topic as data sharing.

Table 3: *Use cases of Delphi Survey*

#	Use Case MobiDataLab (UCM)
1	Transport Planning Activities for multimodal systems
2	Daily commuting congestion and low emission zones management
3	Real-time environmental data monitoring for Green Cities and Green Logistics
4	Machine Learning and Artificial Intelligence for better operations
5	Better journey planning through 3rd-party data integration
6	Decision support through data sharing
7	Transport planning activities to improve area accessibility
8	Facilitating connections for critical infrastructure and emergency vehicles
9	Georeferenced and geo-represented (better maps) data to support planning and operational activities
10	Real-time data sharing across modes for better operations

In the Delphi Survey the panellists had different backgrounds and had various years of experience. Of the 98 experts invited to participate in this Delphi study, 50 participants completed Round 1 (51% response rate), 29 of 50 completed Round 2 (58% response rate) and 20 of 29 completed Round 3 (68.9 % response rate). The panellists of the first round were 74% male, 24% female, while 2% of them would rather not say. The majority of them had 8-15 years of experience and came from different backgrounds. For more information related with the detailed questions of the survey and the demographic characteristics of the participants you will find in the Annex A – Delphi Survey and in the Table 10.

3.2. Innovators' Questionnaire

A second questionnaire was conducted in order to gather the views of relevant stakeholders that could not be recognized as experts either due to their experience or their role in the data sharing environment. This questionnaire was addressed to innovators - start-ups and SMEs. The dissemination was executed through contacts of the consortium and the F6s platform. The scope of this questionnaire was to recognize challenges in terms of data sharing and identify incentives and needs to join a data sharing initiative. The main research questions were:

- Which incentive would urge a user to join a living or virtual lab?
- Which challenges do users face in terms of data sharing?
- Which type of data do users need in order to provide solutions and/or expand their business?
- Which features of data sharing platforms are the most important?

The questionnaire included closed type questions, was disseminated through Survey Monkey and more than 239 recipients were reached. The survey had been answered by 131 participants and the

52% of the answerers had more than 11 years of experience. Moreover, the 25,96% of the participants were working in Engineering Consulting companies. More details related with the sample characteristics can be found in Annex B – Innovators' Questionnaire.

3.3. Analysis of the results

On the 7th of June 2021, 239 answers were collected from the innovators survey, while 50, 29 and 20 panellists participated in the first, second and third round of the Delphi Survey accordingly. The analysis identified major themes, eliminated redundancies, and produced long inventories of indicators and organisational features based on the experts' opinion.

Analysis to quantitative questions was held via a group statistical response: all opinions reflect the final response and typically they are measured quantitatively and statistically. This section presents the findings of the analysis of the questionnaires and specifically the validated use cases that should be explored in terms of data sharing, the identified actors that could enhance their offerings (product/service) by participating in data sharing activities and their needs and the proposed data sharing scenarios built on their needs.

3.3.1. Delphi Survey-Use Cases

As described in section 3.1, the Delphi questionnaire included 10 generic use cases related to the transport and mobility challenges, in order to provide to the panellists and answer to questions that could be related to their experience. The panellists were asked to identify which ones would be more interesting to address in a data-sharing environment and the Table 4 presents the use cases and the expressed preferences.

Table 4: *Use Cases MobiDataLab (UCM)*

#	UCM	Weighted Average
1	Transport Planning Activities for multimodal systems	4
2	Daily commuting congestion and low emission zones management	4
3	Real-time environmental data monitoring for Green Cities and Green Logistics	3.96
4	Machine Learning and Artificial Intelligence for better operations	3.78
5	Better journey planning through 3rd-party data integration	4.04
6	Decision support through data sharing	4.26

7	Transport planning activities to improve area accessibility	3.72
8	Facilitating connections for critical infrastructure and emergency vehicles	3.58
9	Georeferenced and geo-represented (better maps) data to support planning and operational activities	3.68
10	Real-time data sharing across modes for better operations	4.26

UCMs 5, 6, and 10 were identified as the most significant in terms of data sharing (highest Weighted Average). For this task, panellists were also asked to identify actors related with each UCM (Use Case MobiDataLab) so that we could create an exhaustive list of the actors' ecosystem. As we will see in chapter 3.3.2 and chapter 0, UCMs 5,6 and 10 not only were voted as the most interesting, but also contained the most actors compared to the rest. So, UCMs 5, 6, and 10 had more than 30 actors which showcases the consensus of the panellists for the importance of the use cases and the actors that should participate. UCMs 2,4,5,7, 8 had between 10 and 30 actors, while UCMs 9 and 3 had less than 10.

It is interesting to note that the 3 aforementioned most interesting UCMs also showed similarity in terms of the actors. Figure 1 below shows the degree of similarity among the actors between 2 UCMs based on the findings of the first round. The darker the colour, the more similar the actors of the use cases are. Each square represents the similarity of the actors between 2 use cases (read the use case number on the x and y axis). Use case 5 and 10 appear to have similar actors (similarity = 0.6) as well and 6 with 5 too (similarity = 0. 7) and 6 and 10 (similarity = 0.83). It could be stated that use cases 5, 6, 10 have similar stakeholders and they could all be involved in the implementation of the 3 use cases.

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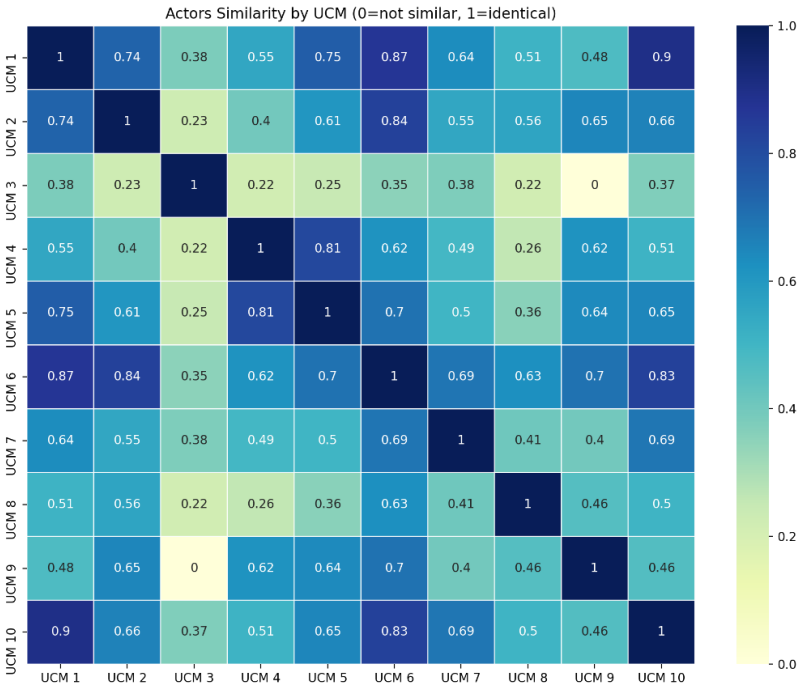

Figure 1: *Use cases similarity*

3.3.2. Actors

In the first round of the Delphi the respondents identified 96 different actors as main stakeholders for the implementation of the ten use cases proposed in the Delphi. This number includes categories of actors (e.g., TSPs), specific job titles (e.g., urban planner, engineer) and specific organisations (e.g., HERE, Google) as well. Since we are not interested in specific organisations but an exhaustive list of actors, we decided to group the identified actors in broad categories, according to the taxonomy proposed by (Pena, 2019) in Table 5: Actors' taxonomy by De la Pena.

Table 5: *Actors' taxonomy by De la Pena*

Broad Categories	Actors Involved
The travelling public	**Citizens, passengers, tourists**
Government transportation agencies	Government departments of transportation (DOTs) plan, build, and manage the physical transportation system, curb use and parking. They collect regulatory information, pedestrian and vehicle counts and vehicle flow information.
Public transit agencies	Public transit includes regional, county, metropolitan or city agencies that run trains, light rail, streetcars, buses, ferries, and other high-capacity vehicles.
Emergency services	Police, fire, and emergency medical services
Port, freight and courier services	Government or quasi-government bodies run port services. They collect data on shipment and vehicle volumes coming into and out of port areas, and on heavy haul routes and freight impacts on traffic flow. A mix of public and private companies provide logistics and courier services.
Urban goods and food delivery services	App-driven distributed-delivery services.
Private transportation franchisees	Private transportation providers include contract carriage (taxis, limousines, for-rent vehicles) or subcontractors of public transit (bus or shuttle service franchisees), or private shuttle services such as employee buses or airport shuttle services.
Mobility service providers	a. Car-share companies like Zipcar and ShareNow b. Ride-hail companies (also called transportation network companies, or TNCs) c. Vanpool and shared-ride services d. Micro-mobility companies like bike share (docked and dockless) and e-scooter shares
Information service providers	a. Navigation and map services b. Intelligent transportation system (ITS) vendors c. Payment gateway services d. Platform and analytics services e. Beacon low-energy location services f. Information brokers

However, the taxonomy could not help us classify all actors identified, as some did not fall under any category. Therefore, we added 2 more categories and we were able to classify all actors in broad categories according to their service. The 96 actors identified, were narrowed down to 47, as shown in Table 6: Categories of actors

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Table 6: *Categories of actors*

Research Entities	Travelling Public	Contextual Data Providers	Authorities	Government Transportation Agencies	Port, freight & courier services	Transport Service Providers	Service Providers	Information service providers	Manufacturers	Emergency services
1.Research centre	3.Citizens	6.Tourist Agencies	14.Regional policy makers	22.Traffic management centre	25. Logistics operators	27.Ride-sharing companies	32.Parking operators	35.Pricing /payment platform	43.Autonomous vehicles manufacturers	45.Fire Service
2.Universities	4.Commuters Passengers	7.Hoteliers	15.European Policy Makers	23.Urban Planning Department	26. Public Logistics operator	28.Public Transport Operators	33. Leasing companies	36. Navigation services providers	44.Car Manufacturers	46.Ambulances
	5. Tourists	8.Weather data providers	16.Municipalities	24.Road operators		29.Micro-mobility operators	34. Air traffic Control	37. Cloud Providers		47.Police
		9.Climate change NGOs	17.Public Transport Authority			30. Airlines		38. Trip Planners		
		10.Tourism Associations	18.Government / ministries			31.Transport Agencies		39. Data Aggregators/ Brokers		
		11.Mobile Phone Operators	19.Bus Authority					40. Software providers		
		12.Points of interest (museums etc)	20. Rail Authority					41.Analytics Providers		
		13.Trade Association	21.Airport					42.Search Engines		

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Moreover, the actors occur with different frequency. Figure 2 below shows the set of 21 actors that have been selected by the panellists more than once and were voted as most significant. The bar plot shows that 4 actors occur more than others. Indeed, Public Administrators, Public Transport Operators, Mobility Service Providers, and Government Transportation Providers shows up in the respondents answers more than 20 times across the entire set of respondents (n=47). Within these group of actors Municipality was picked more than 40 times, almost the double of times of Mobility Service Providers and Government Transportation Providers which have around 20 preferences. Transport Operators is another relevant actor, and it was selected 24 times. Other relevant actors ranging from 10 to 20 are Information Service Providers and Public Transport Authority. It is worth mentioning the actors that were selected more than 5 but less than 10 times are Government, Travelling Public, Consultants, Authorities, Research Entities, IT providers, Car Manufacturers, Communication Services, and Port Freight and Courier Services.

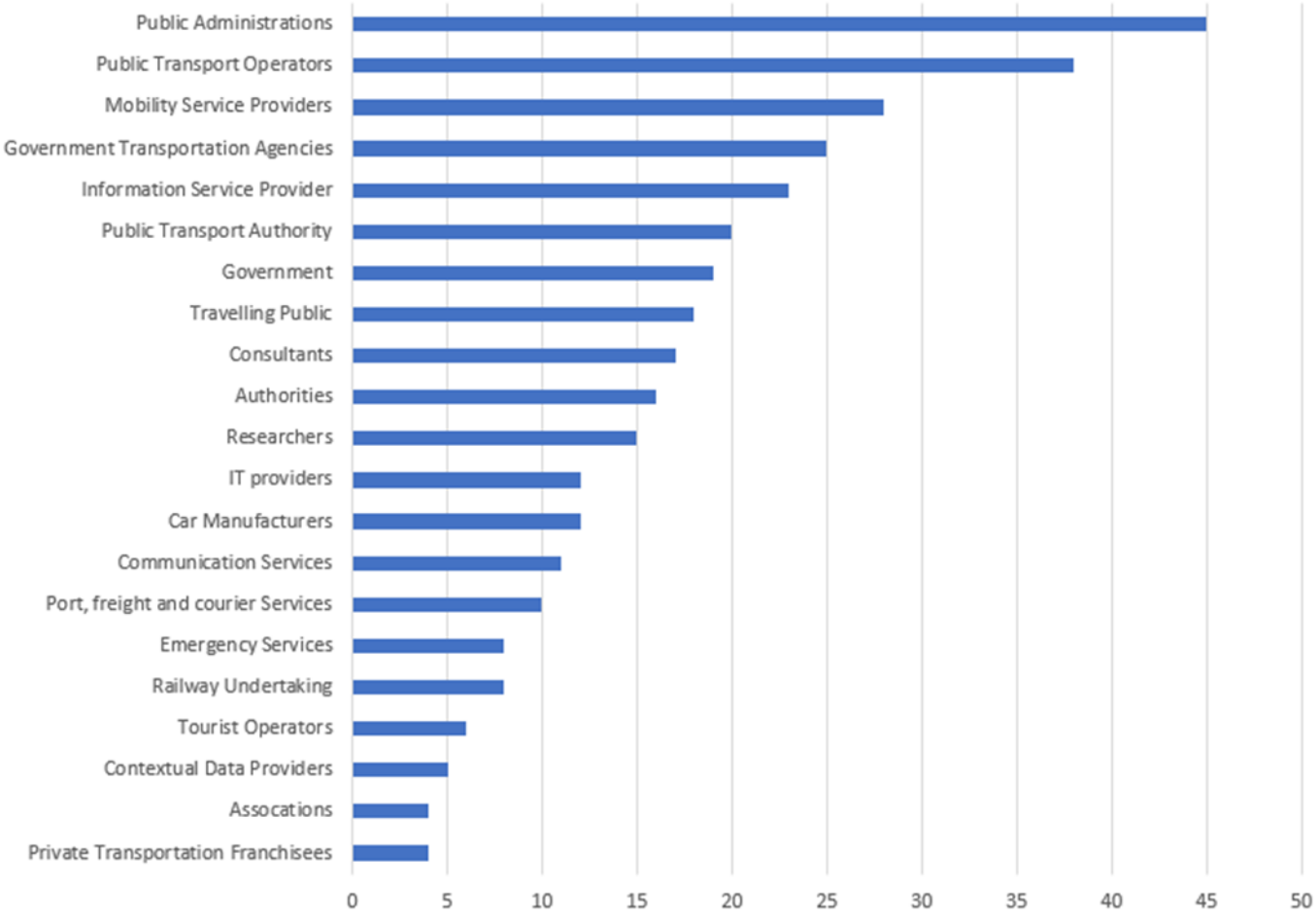

Figure 2: *The 21 most important Actors*

For the second round we decided to orient the topic to the most important UCMs and combine them with the stakeholders that are considered most important inside a Virtual Lab environment, as voted by the panellists. The panellists were asked to vote the most significant actors per UCM, 5,6 and 10, and reach a consensus on the most important actors that arose from the first round. In this round consensus on the actors was achieved. For all three UCMs discussed, the most important actors appeared to be Transport Service Providers, Regions/Cities/Municipalities, Navigation Service Providers, Ride-Sharing Operators, Transport Authorities, Trip Planning Services, Micromobility Operators and Traffic Management Centres.

The panellists also identified actors outside of the transport industry that are interested in the data produced from transport operations. These industries are listed below:

- Health care: Capacity-based and load-based routing to avoid overcrowded vehicles in the sense of pandemic control and health protection.
- Energy: Energy providers, in light of the growing adoption of electric vehicles, will have to face issues related to power grid capacity. Therefore, data about parking usage can help the investment in the e-vehicle charge infrastructure . Having access to shared information about movements and plans of the circulating vehicles might help the overall management. If the information could be shared also in the opposite direction (energy providers share the expected power grid load in the next hour or so) vehicles could also plan recharge trying to minimize load issues.
- Tourism: Tourism in rural or internal areas may benefit in creating better accessibility to Hotels and B&B through D2D seamless journey from/to main transport hubs and/or other attractions. It could increase demand in those areas. Also, tourism and travel search/booking sites would benefit from the use of accessibility indicators. This could be a great way for travellers to have accessibility information of the points of interest they want to visit and choose hotels based sustainable travel modes that will serve these locations within an allocated time travel budget.
- Insurance: This sector could greatly benefit from access to emission data and accident rates in specific regions so as to enhance their portfolio of services.
- Advertising: Use of travelling public data can be beneficial for more efficient and strategic advertising placement according to ridership and users' demographics.
- Real estate: This industry could valuate physical stores or restaurants using transport travel time and accessibility. In the same manner, business owners could identify areas worth pursuing for commercial activities.
- Urban planning: Fleet management and traffic management services can be enhanced with additional data addressed to perform specific traffic strategies. The availability of movement data of different actors can help to plan for emergency situations e.g., disaster response actions and can support the reduction of potential usage conflicts (e.g. HGV and bicycle traffic). Furthermore, capacity-based and workload-based routing would increase the performance of the mass transport system through traffic management.
- Pollution: A better understanding of mobility demand leads to more appropriate infrastructure design, new tools to monitor health and well-being in cities and reduction of pollution. Traffic influences the quality of life of people living near congested roads, airports, thus transport data

can be used to define indicators that allow monitoring the current impact of noise and air pollution on the quality of life and connect it with population's mobility during a day.

- Telecommunications: Mobile phone operators could identify areas where a better signal coverage is needed by accessing ridership and passenger data.

3.3.3. Actors' Needs

Throughout the Delphi Survey and the innovators' questionnaire many types of needs occurred. From the challenges described by the panellists and the answers collected from the innovators, we can deduct their concerns and needs in terms of data, cooperation incentives, business goals and standardisation and interoperability.

- Interoperability issues

One fundamental problem that was recognised was data interoperability which begins from the unavailability of data sharing platforms, lack of public data repositories and lack of data management support tools. But even when such platforms occur there are many technical problems that hinder their adoption such as that high volumes of data cannot be handled in streaming.

- Reliability issues

The major problem recognized both by the panellists and the innovators is data reliability that can appear in many forms. Data reliability depends greatly on data quality and maturity, which is affected by the lack of real-time data and the accuracy and update frequency of historical data. Another factor that impedes data quality is the lack of effective tools and processes to grade the data, preventing it to be improved. Another concern is the lack of discoverability due to the multiplicity of access points, which leads to a distinct problem that is the inability to assess the quality and reliability of the data and keep trace of their provenance.

- Security issues

Moreover, in terms of infrastructure there are major concerns regarding data security and protection by external attacks, which is also a matter of business perspective; the degree that an organisation trusts the data encryption processes. In more technical details, regarding data sharing, focus should be given to the management of proper definition of role, rules and processes for data governance. It is frequent to come across insufficient data governance which leads to information asymmetry inside the same organisation and consequently to lack of operational awareness

Consequently, the needs that arise from the panellists' discussion begin with a) the creation of open-source tools to validate datasets and guide producers on how to improve them or better, and b) the creation of grading schemes to assess the quality of data beyond automatized validation.

On the other hand, the innovators voted for more functionalities like APIs and data interoperability was in the middle of their choices. Innovators also did not find crucial data governance discussion as they have less complex structures and roles compared to large organisations.

- Policy Issues

The panellists recognised the need of new policies regarding data exchange. One major issue is naturally the User Data Privacy, which is the first obstacle to user data acquisition. A big discussion was conducted between stakeholders about the unavailability of data and the concentration of data in public organisations. Private companies cannot access the information that public organisations concentrate (as it is not allowed due to policy issues) leading them to collaborate with data brokers and increasing cost of data acquisition.

An interesting point was raised twice by the participants who argued that there should be policy to allow data sharing for research purposes for free.

- Business Issues

In terms of business purposes, the panellists mentioned that the most significant obstacle is the lack of cooperation culture among private organisations, which first arises from the lack of understanding about the value of real/live data and secondly the mistrust among the organizations about data ownership the fear of giving edge to competitors. In the same manner, the risk of monopoly from large companies is also an existing risk.

Parallel to that, data applicability across countries is a major concern and that is why the participation in large data sharing schemes is not useful for SME and regional organisations or authorities.

An investment in participation in data sharing platforms can be very expensive due to the need for new IT infrastructure. More than that, many organisations, especially the public ones lack the technologic experience required, especially when different data formats are involved. Finally, one participant mentioned the hesitation to participate as there is no trust in contextual or predicted data because it might change the flow of real time operations, which have not been tested. Also, in the same spirit, they discussed the scepticism of the travelling public to share their data.

Also, a very popular opinion among the panellists was that in most cases data sharing initiatives do not offer clear business models. Coupled with the fact that organisations are afraid of sharing their own data and give edge to competition, organisations hesitate to participate. Therefore, the panellists discussed those hesitant organisations need incentives in order to take part in data sharing initiatives, namely innovative business model that offer incentives for all organisations and show concrete use cases that reflect the value of data sharing, and the degree organisations can reduce risk through informed decisions. Another opinion mentioned is the lack of "ownership" of the data pipeline on the producer side: every section of the public organisations (PTA, PTO) touches the data, but everybody and nobody is in charge, preventing real change and real improvement.

Since the Delphi survey explored in depth the actors' needs, we decided to ask the Innovators questions relating to motives to join a cooperation Framework like a Virtual Lab. The innovators perspective on data sharing from a business scope was that it is very important. Since small companies and start-ups do not usually have access to many sources of data, it is important to find open sources for them. The biggest incentive for innovators to participate in a virtual framework would be to find ideas to optimise their products and/or services and to access data that are not widely available and would be hard for SMEs to acquire.

- Data Needs

The majority of the panellists in the Delphi Survey (n=41) identified data needed that could be used to implement use cases and applications. Overall, the respondents identified 89 different types of data needed, which were then divided in 28 broad categories and Figure 3 below shows those that occur more than once. Vehicle data and transportation service data are the most frequent occurring respectively 14 and 18 times. In the range between 5 and 7 preferences there are several interesting data such as those identifying parking spots, time of arrival and departure of different transportation services (like buses, trains, and airplanes), traffic data and cell phone data. Other noticeable data needs are both users' origin/destination, and users' modal shift preferences. Data needed with small rate of selection can be browsed in Figure 4, and a complete list of all data needs per actor in Table 12: Complete list of Actors and Needs in Annex C.

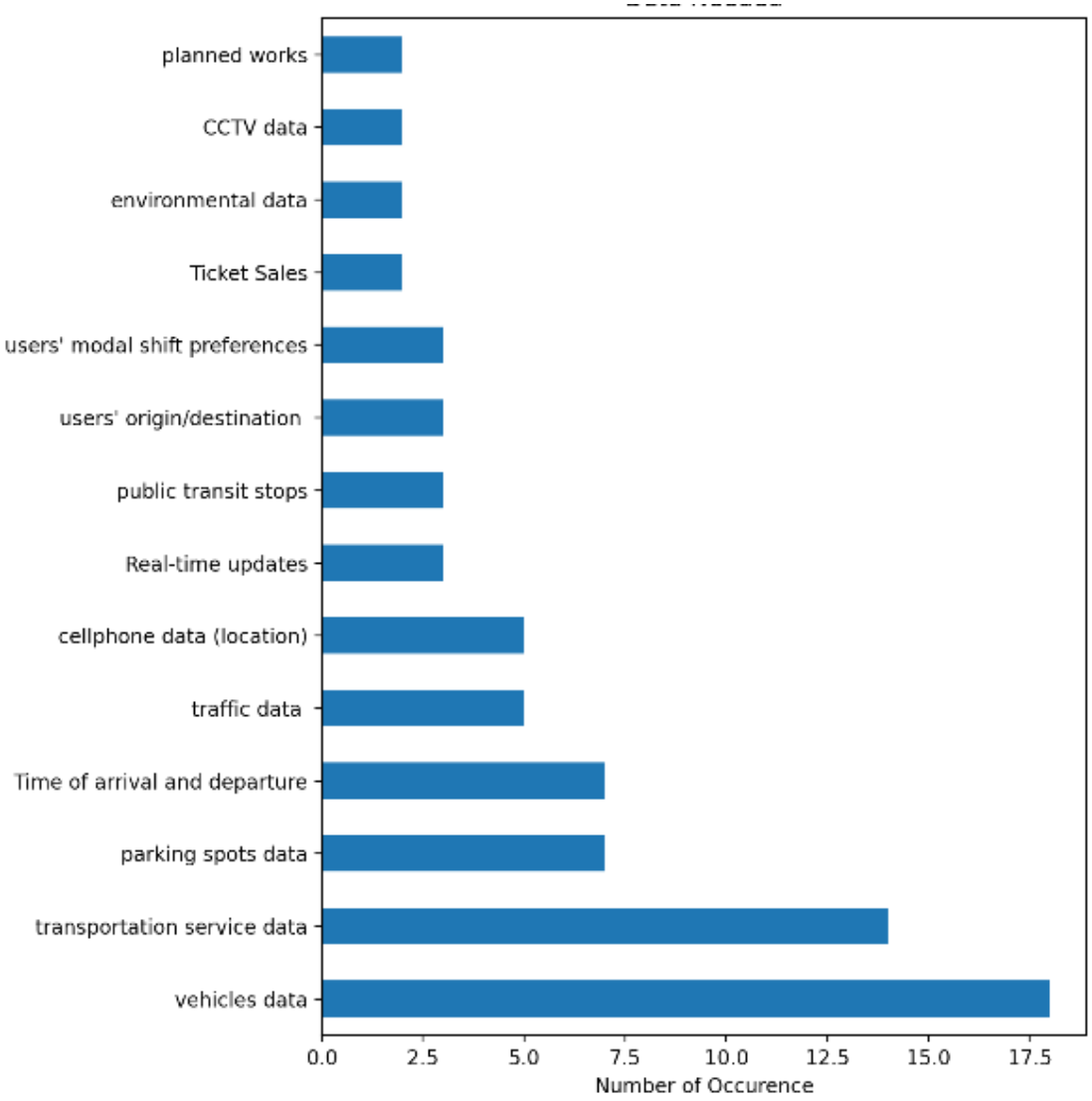

Figure 3: *Data occurring more than once*

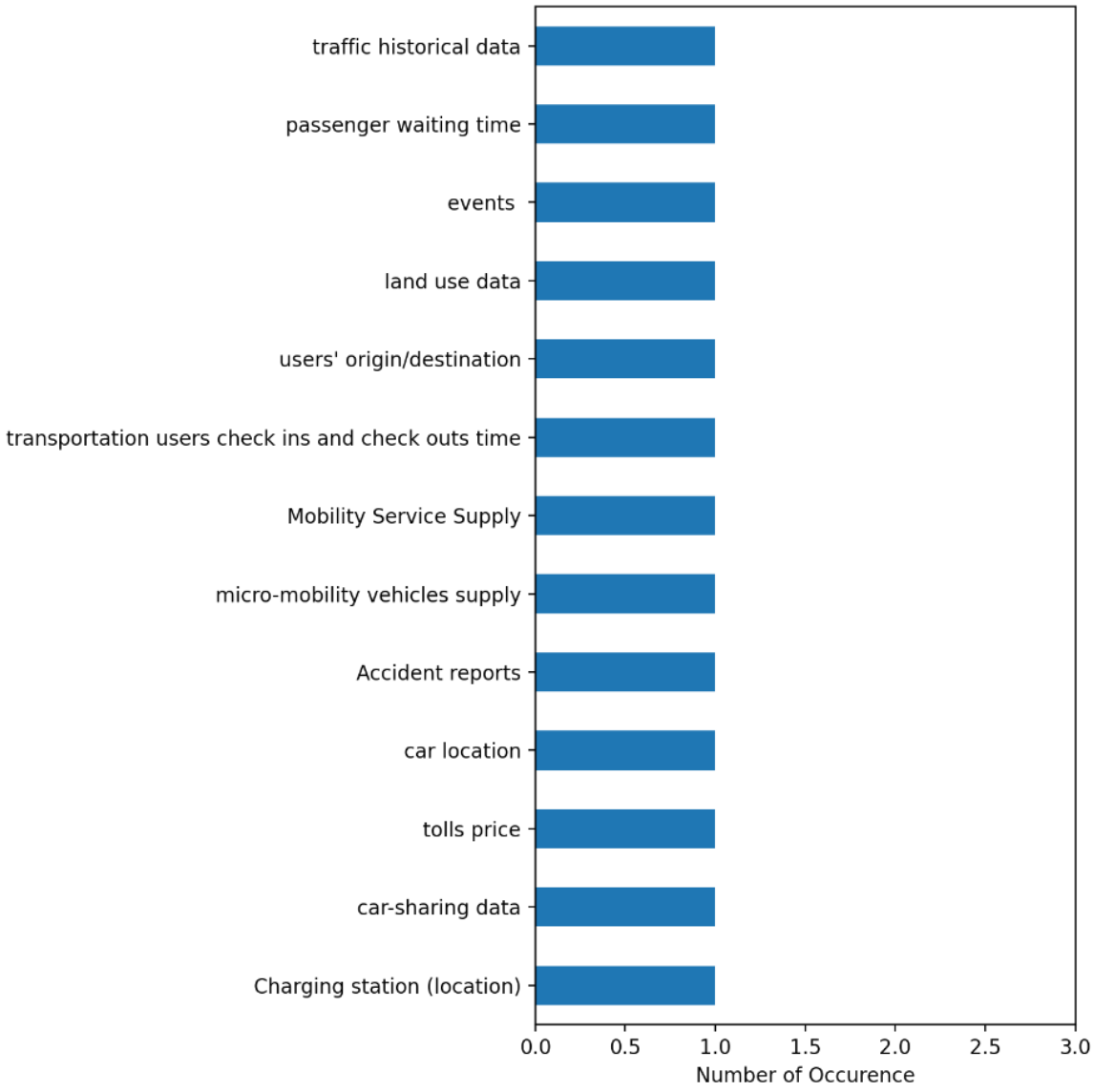

Figure 4: *Data occurring once*

In the second round of the Delphi Survey, the panellists were asked to vote on the most significant data sets for UCMs 5,6 and 10. For all UCMs, the same data sets appear as more important, namely the following 6:

- Real-time demand in public and private transport
- Demand analysis through mobility habits
- Geolocation data on parking availability
- Real-time schedule updates in public transport
- Delays and disruptions in public transport
- Traffic Data

3.3.4. Data Sharing Scenarios

From the analysis of the questionnaires and the insights from literature review, a cooperation framework is proposed based on the most significant data needs per actor and their incentives for collaboration in a data sharing context.

The cooperation framework is built on three data sharing scenarios that are based on the UCMs 5,6 and 10. The UCMs involve similar actors as was shown in Figure 1: Use cases similarityTherefore, we can assume that actors can have multiple incentives to join the Virtual Lab. While in each scenario several actors participate in order to cover their needs, we will stage each scenario around 1 actor category each time, namely a) the travelling public, b) Authorities and c) Transport Service Providers, so as to propose incentives for many actors to participate in a virtual Lab. Each scenario was developed by combining the actors who were involved in each UCM along with their data needs. In each table we provide the original stakeholders and data sets for each use case and then the actor that could provide the data sets.

For each scenario we provide a) the context, b) scenario highlights, that describe how the 6 most valuable data will be used and c) the relationship among actors and the purpose of data exchange.

3.3.4.1. Scenario 1: Better journey planning through 3rd-party data integration

- Context

This scenario will involve data exchange among all relevant actors regarding the needs of the travelling public. Public and private actors will need to cooperate in order to deliver better and efficient journey planning through the participation of citizens as well. In this scenario, the digital players – transport service providers, trip planners, navigation service providers will collect travelling public's data (feedback, positions, mobility patterns), to enhance their services. Moreover, the use of contextual data like weather data will help the travelling public make more informed decisions. Also, research labs and universities will be able to leverage data from the private actors and the travelling public in order to create models for planning and forecasting. Finally, the innovators will be able to acquire the data they need in order to provide innovative services/products.

- Scenario Highlights
    - Real-time demand in public and private transport: TSPs are incentivized to share real-time demand data in order to allow third parties to consume that data and provide value to the travelling public. Navigation service providers and Trip Planning Services need access to data to produce valuable information to their customers. All other actors - with the exception of regions/cities/municipalities- need to both share and access data in order to be able to integrate their solution in the surrounding ecosystem of transport solutions. Micromobility Operators will access the data and improve service to areas with high demand. For regions and cities data sharing can be important for understanding the

consumer behaviour and needs which can stimulate innovation in terms of new products and services.

- Demand analysis through mobility habits: The demand for different means of transport should be shared in the case of public actors in order to improve their service, manage disruptions (e.g., optimized number and routing of replacement services), close service gaps, make targeted investments and improve processes and/or business.
- Geolocation data on parking availability: For Navigation Service Providers and Trip Planning Services, parking is part of the traveling experience, and a good navigator should consider that in the plan to propose. Transport Service Providers will get access to commuting patterns which can be used to create ad hoc services, such as extra bus runs. Micromobility Operators need this type of data in order to provide stronger guarantees for availability for commuting patterns. For regions and cities data sharing can be important for understanding the consumer behaviour and needs which can stimulate innovation in terms of new products and services.
- Real-time schedule updates in public transport: This type of data helps transport operators understand the traffic patterns in order to be able to adjust their own operations and activities with low disruptions. For the end user – travelling public- it is very important to stay satisfied through continuous feed of information about schedule updates as this can only lead to increased use of local public transport. Therefore, TSPs should share data in order to offer real time services to citizens. TSPs and navigation service providers will also share the data in order to improve demand forecasting, improve operating efficiency and reliability. Ride sharing operators, traffic management centres, and micromobility operators are also the main source of this information and should share it in order to let other mobility services adapt, especially for planning.
- Delays and disruptions in public transport: Delays on transport could be used for private companies to increment their fleet of mobility solutions. While public entities can use that information to improve the offer of traffic management solutions. Transport Service Providers are the main source of this information and should share it in order to let other mobility services contribute to mitigate the negative effects. As for Regions, Cities, Municipalities, a clear view of PT issues can help identifying structural problems and improve future planning of services / infrastructures.
- Traffic Data: Traffic data can be used by Transport Providers to gain insights from traffic patterns, habits and behaviour which can lead to improved operations and efficient service.

- Involved Actors

The list below contains all the actors that were identified as relevant for the UCM through the Delphi, but there was not necessarily any collaboration scenario for all. Therefore, while we list all of them, in Table 7: *UCM5 Real-time data sharing across modes for better operations*, we see only a few of them, for which we found collaboration scenarios.

- Travelling Public
- Transport Service Providers
- Trip Planning Services
- Navigation services providers
- Mobile phone operators

- Satellite Operators
- Weather Data Providers
- Transport authorities
- Micromobility operators
- Car manufacturers
- Regions/Cities/Municipalities
- Research centres/ Universities
- Transport Analytics Providers
- Planning Consultants/Agencies

In Table 7 below, we describe the cooperation framework which shows the relationships among the actors. In the "Actor" column, we describe the actor that is interested in acquiring data. In the next column, "Actors' Needs" we describe the data set need. In the Third column we describe which actor can provide the specific data set and in the last column the purpose of the data exchange.

Table 7: *UCM5 Real-time data sharing across modes for better operations*

Actor	Actor Needs	Provided by Actor	Purpose
Authorities	Cell phone data	Information Service Provider	Improvement of public transportation systems using telco data and timetable schedule of the public operator
	Delays and disruptions in public transport	Transport Service Providers	Updated information communicated to travelling public
	Demand Analysis	Government Transportation Agencies	Supply covers demand
	Geolocation data on parking availability	Information Service Providers	Parking planner for integration with available rail and metro hubs
Transport Service Providers	Traffic Data	Government Transportation Agencies	Correct information communicated to travelling public
	Demand analysis for transport services	Travelling Public Information Service Providers	Demand forecasting
	Delays and disruptions in public transport	Transport Service Providers	Updated and accurate information to reduce the uncertainty and waiting time perception
	Weather Data	Contextual Data Providers	Demand forecasting
	Cell phone data	Information Service Provider	Improvement of public transportation systems using telco data and timetable schedule of the public operator

Trip Planners	Weather Data	Contextual Data Providers	Demand forecasting
	Demand analysis for transport services	Travelling Public Information Service Providers	Integrate multiple means of transport for business trips
	Delays and disruptions in public transport	Transport Service Providers	Updated and accurate information to reduce the uncertainty and waiting time perception
	Geolocation data on parking availability	Information Service Providers	Parking planner for integration with available rail and metro hubs
	Air travel timetables	Transport Service Providers	Updated timetable alignment
	Traffic Data	Government Transportation Agencies	Correct information communicated to travelling public
Information service providers	Demand analysis for transport services	Travelling Public	Innovation for new features to include ridership information
	Demand analysis for transport services	Transport Service Providers	Real time alignment between transport system, trains and regional buses
Travelling Public	Real-time timetables and schedules	Transport Service Providers	Updated and accurate information to reduce the uncertainty and waiting time perception
	Geolocation data on parking availability	Information Service Providers	Updated and accurate information
	Delays and disruptions in public transport	Transport Service Providers	Updated and accurate information to reduce the uncertainty and waiting time perception
Research	Demand analysis for transport services	Transport Service Providers	Real time alignment between transport system, trains and regional buses
Government Transportation Agencies	Ticket Sale from one time-events	Contextual Data Providers	Updated and accurate information of demand
	Demand analysis for transport services	Transport Service Providers	Real time alignment between transport system, trains and regional buses
Emergency Services	Traffic Data	Government Transportation Agencies	Efficient operation in emergency cases

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3.3.4.2. Scenario 2: Decision support through data sharing

- Context

This scenario will involve data sharing where the focus will be on Authorities' needs. Following the EU transport policy for sustainability, this UCM will focus on the improvement of cities through supported decisions. In this scenario multiple stakeholders will be involved to address transportation challenges, but also environmental issues and matters that will upgrade the quality of life of the citizens. Interestingly, in this UCM other stakeholders outside the mobility industry mentioned in previous section could be attracted to participate.

- Scenario Highlights
    - Real-time demand in public and private transport: TSPs are incentivized to share real-time demand data with Government Transportation Agencies in order to improve decision making regarding supply and demand of services. For regions and cities data sharing can be important for understanding the consumer behaviour and needs which can stimulate innovation in terms of new products and services.
    - Demand analysis through mobility habits: All actors need to have a good understanding about the mobility habits of their end users, whether the service provided is a transport service, or a navigation service. Authorities need to have access to this information to better plan for infrastructure and transport services.
    - Traffic Data: Traffic data can be transformed to usable information about traffic patterns, habits and behaviour. Each of them could be shared and accessed the data in order to provide better throughput through the network, and that could result in cooperation among them.
    - Geolocation data on parking availability: Authorities and Government Transportation Agencies need this type of data for strategic decision making, after understanding the consumer behaviour and needs. Micromobility Operators need this type of data in order to provide stronger guarantees for availability for commuting patterns. Data sharing can lead to more efficient processes for Transport Providers, Trip planning services and Navigation service providers.
    - Real-time schedule updates in public transport: This type of data helps the operators understand traffic situation in order to be able to adjust their own operations and activities with low disruptions. Therefore, TSPs should share data in order to offer real time services to citizens. TSP and navigation service providers will also share the data in order to improve demand forecasting, improve operating efficiency and reliability. Ride sharing operators, traffic management centres, and micromobility operators are also the main source of this information and should share it in order to let other mobility services adapt, especially for planning.
    - Delays and disruptions in public transport: Delays and disruptions data are similar to schedule updates. These types of data can be used by organisations to reduce costs and avoid large number of dissatisfied passengers. Delays on transport could be used for private companies to increment their fleet of mobility solutions; While public entities can use that information to improve the offer of traffic management solutions. Transport Service Providers are the main source of this information and should share it in order to

let other mobility services contribute to mitigate the negative effects. As for Regions, Cities, Municipalities, a clear view of PT issues can help identifying structural problems and improve future planning of services / infrastructures.

- Involved Actors

The list below contains all the actors that were identified as relevant for the UCM through the Delphi, but there was not necessarily any collaboration scenario for all. Therefore, while we list all of them, in Table 8: *UCM 6 Decision support through data sharing*, we see only a few of them, for which we found collaboration scenarios

- Transport Service Providers
- Trip Planning Services
- Micromobility operators
- Logistic Operators
- Navigation service providers
- Emergency services
- Mobile phone operators
- Infrastructure Managers
- Airports
- Transport Analytics Providers
- Planning Consultants/Agencies
- Traffic management centres
- Tourism offices/Hoteliers
- Road operators
- Regions/Cities/Municipalities
- Transport authorities
- Climate change NGOs
- Research centres/ Universities

In Table 8: UCM 6 Decision support through data sharing below, we describe the cooperation framework which shows the relationships among the actors. In the Actor column, we describe the actor that is interested in acquiring data. In the next column, Actors' Needs we describe the data set need. In the Third column we describe which actor can provide the specific data set and in the last column the purpose of the data exchange.

Table 8: *UCM 6 Decision support through data sharing*

Actor	Actor Needs	Provided by Actor	Purpose
Authorities	Data from cars (positions)	Travelling Public	Traffic Management
	Cell phone data	Information Service Provider	Improvement of public transportation systems using telco data and timetable schedule of the public operator
	Emission Data	Government Transportation Agencies	Sustainability/Decision Making

	Traffic Data	Government Transportation Agencies	Traffic Management
	Delays and disruptions in public transport	Transport Providers	Traffic Management/ Improved public Transport
	Ticket Sale from one time-events	Contextual Data Providers	Updated and accurate information of demand
Trip Planners	Demand analysis for transport services	Transport Service Providers	Real time alignment between transport system, trains and regional buses
	Demand analysis for transport services	Travelling Public Information Service Providers	Integrate multiple means of transport for business trips
	Parking Spots	Information Service Providers	Parking planner for integration with available rail and metro hubs
	Delays and disruptions in public transport	Transport Service Providers	Updated timetable alignment
Contextual Data Providers	Demand analysis for transport services	Information service providers	Improvement of public transportation systems using telco data and timetable schedule of the public operator
Information service providers	Demand analysis for transport services Data from cars (positions)	Travelling Public Information Service Providers	Traffic Management
Travelling Public	Real time timetables and schedules, Delays and disruptions in public transport	Transport Service Providers	Updated and accurate information to reduce the uncertainty and waiting time perception
	Traffic Data	Information Service Provider	Improvement of public transportation systems using telco data and timetable schedule of the public operator
Research	Air travel timetables	Transport Service Providers	Mobility service providers' integration into multi-modal trip planning solution
	Joined up city data assets (e.g., parking data / CCTV / environmental data)	Government Transportation Agencies	Predictive modelling that can have positive benefits on service provision to city stakeholders.
Government Transportation Agencies	Demand analysis for transport services	Travelling Public Information Service Providers	Integrate multiple means of transport for business trips
	Parking Spots	Information Service Providers	Planning and management of big, long-term interventions to the mobility infrastructures: assessing and predicting

			their impact on local mobility
Transport Service Providers	Planned Works	Authorities	Updated transport schedule with change of routes
	Traffic Data	Government Transportation Agencies	Correct information communicated to travelling public
	Demand analysis for transport services	Travelling Public Information Service Providers	Demand forecasting
	Delays and disruptions in public transport	Transport Service Providers	Updated and accurate information to reduce the uncertainty and waiting time perception
	Weather Data	Contextual Data Providers	Demand forecasting
	Ticket Sale from one time-events	Contextual Data Providers	Updated and accurate information of demand
	Parking Spots	Information Service Providers	Planning and management of operations for micromobility operators

3.3.4.3. Scenario 3. Real-time data sharing across modes for better operations

- Context

In this UCM, the power of real-time data will be leveraged in order for Transport Service Providers and Trip Planners in the private and public sector to improve their offerings and consequently to deliver better service to the travelling public.

- Scenario Highlights
    - Real-time demand in public and private transport: TSPs are incentivized to share real-time demand data in order to allow third parties to consume that data and provide value to the travelling public. Navigation service providers and Trip Planning Services need access to data to produce valuable information to their customers. All other actors - with the exception of regions/cities/municipalities- need to both share and access data in order to be able to integrate their solution in the surrounding ecosystem of transport solutions. For all of them, access or sharing of data will improve operational performances and provide better load factor of the vehicles. Traffic Management Centres: mobility demand should be considered as a basic form of potential traffic information, useful for forecasting. Micromobility Operators will access the data and improve service to areas with high demand. For regions and cities data sharing can be important for understanding the

consumer behaviour and needs which can stimulate innovation in terms of new products and services.

- Demand analysis through mobility habits: This type of data should be shared in the case of a public actors in order to Improve service, manage disruptions (e.g., optimized number and routing of replacement services), close service gaps.
- Geolocation data on parking availability: For Navigation Service Providers parking data should be part of their offering in order to enhance the traveling experience. Transport Service Providers: commuting patterns might be used to create ad hoc services, such as extra bus runs. Micromobility Operators need this type of data in order to provide stronger guarantees for availability for commuting patterns.
- Real-time schedule updates in public transport: This type of data helps the operators understand traffic situation in order to be able to adjust their own operations and activities with low disruptions. For the end user it is very important to stay satisfied through continuous feed of information about schedule updates as this can only lead to increased use of local public transport. Therefore, TSPs should share data in order to offer real-time services to citizens. TSPs and navigation service providers will also share the data in order to improve operating efficiency and reliability.
- Delays and disruptions in public transport: Delays and disruptions data are similar to schedule updates. These types of data can be used avoid large number of dissatisfied passengers. Delays on transport could be used for private companies to increment their fleet of mobility solutions; While public entities can use that information to improve the offer of traffic management solutions.
- Traffic Data: Traffic data is crucial for the travelling public in order to enhance their journey, therefore actors that generate this type of data are motivated to share it to third parties. Traffic data can be transformed to usable information about traffic patterns, habits and behaviour.

- Involved Actors

The list below contains all the actors that were identified as relevant for the UCM through the Delphi, but there was not necessarily any collaboration scenario for all. Therefore, while we list all of them, in Table 9: *UCM 10 Real-time data sharing across modes for better operations*, we see only a few of them, for which we found collaboration scenarios

- Transport Service Providers
- Trip Planning Services
- Traffic Management Centre
- Micromobility operators
- Logistic Operators
- Navigation services providers
- Emergency services (ambulances, police, delivery of critical goods)
- Mobile phone operators
- Infrastructure Managers
- Airlines
- Airports
- Transport Analytics Providers
- Parking Operators

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- Ride sharing operators
- Road operators
- Regions/Cities/Municipalities
- Transport authorities
- Planning Consultants/Agencies
- Research centres/ Universities
- Weather Data Providers
- MaaS integrators

In operations we describe the cooperation framework which shows the relationships among the actors. In the Actor column, we describe the actor that is interested in acquiring data. In the next column, Actors' Needs we describe the data set need. In the Third column we describe which actor can provide the specific data set and in the last column the purpose of the data exchange.

Table 9: *UCM 10 Real-time data sharing across modes for better operations*

Actor	Actor Needs	Provided by Actor	Purpose
Authorities	Daily move patterns of individuals Mobility service providers' integration into multi-modal trip planning solution	Information service providers	Real time alignment between transport systems
	Daily move patterns of individuals	Information service providers	Demand forecasting
	Traffic Data	Government Transportation Agencies	Real time alignment between transport systems
Trip Planners	Delays and disruptions in public transport	Transport Service Providers	Traffic Management
	Weather Data	Contextual Data Providers	Delay predictions
	Micromobility options hubs	Transport Service Providers	Improvement of last-mile trip
Information service providers	Weather data	Transport Service Providers	Delay predictions
	Micromobility options hubs	Transport Service Providers	Real time alignment between transport system
Travelling Public	Charging station finder	Trip Planner Information Service Providers	Efficient Trip Planning
	Dynamic road congestion pricing	Trip Planner Information Service Providers	Efficient Trip Planning/ Traffic Management
	Parking spots	Trip Planner Information Service Providers	Traffic Management
	Weather Data	Contextual Data Providers	Prediction of delays based on meteorological data

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Transport Service Providers	Planned Works	Authorities	Updated transport schedule with change of routes
	Traffic Data	Government Transportation Agencies	Correct information communicated to travelling public
	Demand analysis for transport services	Travelling Public Information Service Providers	Demand forecasting
	Delays and disruptions in public transport	Transport Service Providers	Updated and accurate information to reduce the uncertainty and waiting time perception
	Weather Data	Contextual Data Providers	Demand forecasting

Apart from the proposed cooperation framework, we can also see the entire ecosystem of actors and their relationships based on their data needs in Table 12 in the Annex.

4. Lessons Learned

4.1. Recommendations for future application of the Delphi Survey process in MobiDataLab and beyond

The Delphi Survey is a very fruitful technique that can produce a significant breadth of views. However, there were some pain points that need to be taken into consideration. The selection of the panellists needs to be very thorough from the beginning in order to avoid bias selection, which however cannot be easily achieved as the Delphi usually needs commitment for more than 2 rounds, and therefore is seems natural to seek respondents by leveraging personal networks.

Regarding the implementation of the survey, the framing and tense of the questions could be improved. The second and third round could have been merged in order to have more participants in the end. Also, in the last round we received very little open-ended feedback and the dropdown answers were not extremely insightful.

Alternative questionnaire formats may have advantages for researchers. Analysing a Word document, transferring the results into table format for analysis, and preparing the second round personalized for 50 panellists can be very time-consuming and prone to errors. As an alternative questionnaire format, we would recommend considering the real-time Delphi (RTD) for immediate feedback, which was avoided in our case so as not to create bias in the process.

Conducting a Delphi study is a slow process. Receiving feedback and returns may take several weeks, so a long period for data gathering must be considered in planning projects. Hence, we advise researchers to plan a suitable back-up period in case returns are slower than expected.

4.2. Recommendations for the implementation of the MobiDataLab Virtual Lab

An overreaching challenge is the lack of willingness of key decision makers to embrace data sharing, especially at the research stage where innovation and experimentation is required. Usually, these actors need motivation through tangible benefits and KPIs that could benefit their specific line of work and address real-world challenges. The collaboration is necessary for successful innovation in data sharing have their own overhead, burdens and challenges/risks without always a clear path to clear-cut benefits for involved parties.

It is important to position the Virtual Lab as an inextricable part of innovation of the cities of tomorrow. This is necessary so as to attract the right expertise from the local community to help put the open data portal on the municipal map as a strategic decision to make and support and for citizens to participate too. Sharing of data by the public sector will allow private companies to emerge and have a chance to make use of that knowledge and carry it forward. Data exchange by the private sector will enable the public transportation sector to foresee the needs of citizens and identify gaps in the planning and operation of existing transport systems. The public-private sector should be obliged to keep their data open and accessible, to promote transparency and allow taxpayers to have a clear view of what it is that is being produced by that partnership.

Data are crucial for scientific research and progress. Access to accurate and detailed data is essential for researchers who provide a scientific explanation of observed phenomena in transport. The analysis of wide sets of data can help to create a big picture of the effects of transport on society and the environment. This is very important for further transport development and for the evolution of regulations and policies.

For the long-term sustainability of the Virtual Lab, large data sets will be needed. Acquiring data from different sources can improve the quality of the data that are used to describe the mobility pattern in an urban context. Therefore, this will enable the development of more impacting decision support systems for better policies. Data should be shared at all levels, through open mechanisms and a cross-sectorial approach should be promoted in order to drive innovation. In a Virtual Lab environment, each actor can function both as a Data Producer and as a Data Consumer that guarantees multi-partner collaboration.

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5. Conclusions

The aim of MobiDataLab is to present actors in the mobility industry with recommendations on how to improve the quality, accessibility, and usability of their data, encourage the reuse of these data and foster users' trust in the data. MobiDataLab contributes to the development and promotion of open tools to the community of innovators and bring together mobility stakeholders (both data providers and data consumers) to find innovative solutions to concrete problems, using open data as a tool.

MobiDataLab aims to be the technological middleman (connector/matchmaker) between Innovators (entrepreneurs, start-ups and SMEs) and Data Providers, creating and managing a favourable and sustainable environment for collaboration on data exchange between the two groups that will lead into new opportunities for SMEs and new business for data owners.

Given the complex nature of the research, the insights that need to be gathered should focus on the identification of actors and the needs that arise in a context of data exchange. Along these lines, the existing landscape of initiatives for data sharing and platforms on data sharing will be explored. This has been tackled by the T3.1 and the objective of the work was to identify, classify and describe all the actors and stakeholders that may interact within a data sharing context and may use its services. To this aim, a methodology was adopted based on the following steps:

- Literature review and market analysis to define a list of actors involved in the transportation and mobility domain (based on market analysis, related previous projects and questionnaires' analysis).
- Create and execute surveys (Delphi survey and Innovators' questionnaire) that explore actors' needs and insights.
- Analyse the Delphi survey and Innovators' questionnaire results to group the identified actors in broad categories, based on common objectives and/or features, to define the relationships among actors by means of a relationship matrix and to identify data-sharing scenarios according to their needs.

As a result, research of D3.1 outlined the actors involved in the mobility sector, explored their needs across various categories and described possible data sharing scenarios among them. We propose the use of UCMs as made of 3 pillars which will be used to provide context in the MobiDataLab Virtual Lab in T5.1 "Creation of the Virtual Lab – Extension of cloud's UI". Real-time data was the most discussed data set across all cases (TSPs, users, vehicles). The rise of the technology and the latest crises (e.g., COVID-19) show the demand for always updated and accurate information, so that the end users can stay informed.

Effective and public principle-based governance frameworks are needed to ensure benefits from MaaS for all stakeholders, private, public and public-private. The need for collaborative projects with various use cases and more clear and attractive frameworks for different actors to join any data sharing scheme was apparent throughout the literature review and the results of the questionnaires.

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As survey's answers show, a first step towards this direction is the creation of incentives and the realisation of the importance of data sharing by all stakeholders. It is very important to address the transportation challenges holistically. It is concluded that the demand to facilitate cooperation between stakeholders with society, associations, NGOs, small firms, universities through open source/open knowledge, open science, open data, open hardware) is imperative in order to drive innovation and create sustainable mobility frameworks. Therefore, a Living Lab approach in a virtual environment could be the ideal solution to implement the above.

Regarding the needs of the actors, the most prominent one is the availability of data exchange environments. All organisations need access to a European or even worldwide standardization system with different grades; the Virtual Cloud needs to be able to take information autonomously and to manage disruptions effectively.

The findings of this deliverable are truly insightful about the actors, their needs and their relationships, as it showcases the complexity of them but also the value that derives from their cooperation. Yet, the actors' landscape needs further exploration for the purpose of the Virtual Lab. As the stakeholders are many, their needs should be listed exhaustively after the technical requirements of the Virtual Lab are established. Yet, it is important to note that the basis for a collaborative approach exists as the results of the Delphi survey showed and the use cases can work as pillars for the Virtual Lab.

The deliverable is the basis for the future work in MobiDataLab and has to be meant as the initial phase of a continuous breakdown of actors and actor's needs until the development of the MobiDataLab Virtual Lab which will begin their cooperation framework and will uncover even more needs.

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7. Annex A – Delphi Survey

7.1. Delphi Survey - Questionnaire of the1st round

The questionnaire of the 1st round of the Delphi survey had 3 different sections and 13 answers in total. The detailed questions are presented below.

Section A – Personal Information

- 1) [Checkboxes] Please select the industry you work in:
  - Data Service Provider
  - Transport Service Provider
  - Consulting Company
  - Engineering Company
  - Policy Making Organization
  - Cities/Municipalities
  - Mobility Association
  - Research Association
  - Other (please state)
- 2) [Free text] Please state specific services or products that your organization provides.
- 3) [Free text] Which is your area of expertise in the organization?
- 4) [Checkboxes] How many years of experience you have?
  - Less than 8
  - 8-15
  - 16-25
  - 26-35
  - 35+
- 5) [Free text] Please state the country that your organization is active in.
- 6) [Checkboxes] *Gender*
  - Male
  - Female
  - Other
  - Would rather not say
- 7) [Free text] Email

Section B – Use cases

Questions

- 1) [Rank] Below you will find 10 generic use cases that are relevant to the data sharing context of our project. Please rank the use cases from 1 to 5 (where 5 is most interesting based on your experience as an expert).
    - A. Transport Planning Activities for multimodal systems
    - B. Daily commuting congestion and low emission zones management
    - C. Real-time environmental data monitoring for Green Cities and Green Logistics
    - D. Machine Learning and Artificial Intelligence for better operations
    - E. Better journey planning through 3rd-party data integration
    - F. Decision support through data sharing
    - G. Transport planning activities to improve area accessibility
    - H. Facilitating connections for critical infrastructure and emergency vehicles
    - I. Georeferenced and geo-represented (better maps) data to support planning and operational activities
    - J. Real-time data sharing across modes for better operations
- 2) [Free text] Can you identify any specific use case that you have encountered (that might fit into the above generic use cases or not) and describe how it could have been addressed through data sharing?
- 3) [Free text] From the use cases in question (1), choose 3 and list as many private and public actors (organisation types or names) relevant to the use case as possible. Separate each answer by comma.

Section C – Challenges and benefits of data sharing

- In this part you will be asked to provide answers relating to challenges and benefits of data sharing.
- 1) [Free text] In the context of data sharing, many challenges like users' privacy protection and lack of real-time data have been identified. Can you think of at least 3 more challenges in terms of a data-sharing culture?
- 2) [Free text] From your experience, can you describe how the lack of data sharing impacts your organization? You can list specific challenges your organization faces and/or even specific examples of data sets.
- 3) [Free text] Based on your response above, can you describe how data sharing could be employed to address the challenges you stated in terms of technology, policy or organisational practices?

End of the questionnaire

7.2. Delphi Survey – Questionnaire of the 2nd round

The questionnaire of the 2nd round of the Delphi survey had 3 different sections and 13 answers in total. The detailed questions are presented below.

Section A – Personal Information

- 1) [Free text] Email

Section B – Actors

In the first round of the Delphi Survey, the group was presented with 10 generic use cases that are relevant to the data sharing context of the MobiDataLab project. The answers of the group showed that the most interesting cases were:

- a) Decision support through data sharing. This use case concerns the generation of insights that will be used as evidence for decision making to enhance the predictability and consistency of transport, both in terms of services and infrastructure.
- b) Real-time data sharing across modes for better operations. This use case concerns the exchange of real-time multimodal data in order to improve reliability and efficiency of transport services provided by both the private and the public sectors.
- c) Better journey planning through 3rd-party data integration. This use case concerns the importance of accurate data from various sources in order to improve the usability and accessibility of transport services by accommodating the users' needs.

In this part you will be asked to identify the importance of actors in terms of data sharing within the context of the above use cases.

Questions

- 1) [Checkboxes] Below you will find a list of actors proposed by the group that are relevant to the use case of "Decision support through data sharing". Can you choose the ones that are most important in terms of data sharing, either as data producer or as data consumer? You can choose up to 10.
    - Transport Service Providers
    - Trip Planning Services

- Micromobility operators
- Logistic Operators
- Navigation services providers (maps, traffic)
- Emergency services (ambulances, police, delivery of critical goods)
- Mobile phone operators
- Infrastructure Managers
- Airlines
- Airports
- Information Service Providers
- Planning Consultants/Agencies
- Traffic management centres
- Tourism offices/Hoteliers
- Road operators
- Regions/Cities/Municipalities
- Transport authorities
- Trade Associations
- Climate change NGOs
- Research centres/ Universities

- 2) [Checkboxes] Below you will find a list of actors proposed by the group that are relevant to the use case of "Real-time data sharing across modes for better operations". Can you choose the ones that are most important in terms of data sharing, either as data producer or as data consumer? You can choose up to 10.
  - Transport Service Providers
  - Trip Planning Services
  - Transport Authorities
  - Traffic Management Centre
  - Ride-sharing Operators
  - Micromobility Operators
  - Logistic Operators
  - Navigation Services Providers (maps, traffic)
  - Emergency Services (ambulances, police, delivery of critical goods)
  - Infrastructure Managers
  - Airlines
  - Airports
  - Information Service Providers
  - Parking Operators
  - Road operators
  - Regions/Cities/Municipalities
  - Planning Consultants/Agencies
  - Research centres/ Universities
  - Weather Data Provider
  - Mobile Phone Operators
  - MaaS Integrators

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- 3) [Checkboxes] Below you will find a list of actors proposed by the group that are relevant to the use case of "Better journey planning through 3rd-party data integration". Can you choose the ones that are most important in terms of data sharing, either as data producer or as data consumer? You can choose up to 10.
    - Transport Authorities
    - Transport Service Providers
    - Trip Planning Services
    - Ride-sharing Operators
    - Micromobility operators
    - Navigation services providers (maps, traffic)
    - Satellite Operators
    - Weather Data Providers
    - Tourism offices/Hoteliers
    - Car manufacturers
    - Mobile Phone Operators
    - Regions/Cities/Municipalities
    - Research centres/ Universities
    - Information Service Providers
    - Planning Consultants/Agencies
- 4) [Likert] Which of the following data are important in the context of "Decision support through data sharing"?:
    - Real-time demand in public and private transport
    - Demand analysis through mobility habits
    - Real-time schedule updates in public transport
    - Delays and disruptions in public transport
    - Traffic Data
    - Accident rate analysis
    - Daily move patterns of individuals (e.g., through mobile phones)
    - Travel cards and ticket usage data
    - User profiles
    - Tourist flow data (e.g., through payments in points of interest, one-time events like ticket sales for concerts)
    - Data on maintenance and predictive maintenance in vehicles
    - Data from vehicles - GPS, V2V, V2I
    - Emission data
    - Geolocation data on available parking spaces
    - Travel Regulations - database for international travel restrictions and requirements such as visitor's visas, foreign entry, vaccination requirements
    - Dynamic road congestion pricing fed into journey planning applications
    - Loading zones for ride-hail
    - Urban freight vehicle flows
    - Geolocation data on available micromobility options

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- 5) [Likert] Which of the following data are important in the context of "Real-time data sharing across modes for better operations"?
    - Real-time demand in public and private transport
    - Demand analysis through mobility habits
    - Real-time schedule updates in public transport
    - Delays and disruptions in public transport
    - Traffic Data
    - Accident rate analysis
    - Daily move patterns of individuals (e.g., through mobile phones)
    - Travel cards and ticket usage data
    - Data from vehicles - GPS, V2V, V2I
    - Geolocation data on available parking spaces
    - Dynamic road congestion pricing fed into journey planning applications
    - Loading zones for ride-hail
    - Urban freight vehicle flows
    - Geolocation data on available micromobility options
- 6) [Likert] Which of the following data are important in the context of "Better journey planning through 3rd-party data integration"?
    - Real-time demand in public and private transport
    - Demand analysis through mobility habits
    - Real-time schedule updates in public transport
    - Delays and disruptions in public transport
    - Traffic Data
    - Daily move patterns of individuals (e.g., through mobile phones)
    - Travel cards and ticket usage data
    - Geolocation data on available parking spaces
    - Dynamic road congestion pricing fed into journey planning applications
    - Loading zones for ride-hail
    - Geolocation data on available micromobility options
    - Travel Regulations - database for international travel restrictions and requirements such as visitor's visas, foreign entry, vaccination requirements
    - Air travel and connection with airports
- 7) [Free text] In the previous round, an interesting point was raised that concerned the sharing of data produced from transport operations that affect other industries. For example, to valuate real estate prices using public transport travel time and accessibility in general. This is a very creative use of transport data that enhances stakeholders' value of data and sits precisely within the realm of MobiDataLab. In the context of the use cases in the previous questions, can you hypothesise how data produced can be utilised by other industries?

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Section C – Actors' needs

In the first round of the Delphi Survey, the group was presented with 10 generic use cases that are relevant to the data sharing context of the MobiDataLab project. The answers of the group showed that the most interesting cases were:

- a) Decision support through data sharing. This use case concerns the generation of insights that will be used as evidence for decision to enhance the predictability and consistency of transport, both in terms of services and infrastructure.
- b) Real-time data sharing across modes for better operations. This use case concerns the exchange of real-time multimodal data in order to improve reliability and efficiency of transport services provided by both the private and the public sectors.
- c) Better journey planning through 3rd-party data integration. This use case concerns the importance of accurate data from various sources in order to improve the usability and accessibility of transport services by accommodating the users' needs.

In this part you will be asked to provide answers relating to actors 'needs in terms of data sharing within the context of the above use cases.

Questions

- 1) [Likert] In the previous round, the group identified cases relating to willingness to cooperate in terms of data sharing among the actors. Can you state if you agree with the following statements:
    - There are not clear business models in order to participate in data sharing platforms
    - There is lack of understanding about the value of real/live data in the public sector
    - Data sharing for research purposes should be free
    - By opening data, there is the risk of competition creating better solutions
    - Passengers are unwilling to share their data
    - Effective and public principle-based governance frameworks are needed to ensure benefits from MaaS for all stakeholders, private and public
    - Data cannot be applicable across countries
    - Maintaining data sharing over time is difficult
    - Cultural constraints impede understanding of potential value of data
    - Risk of monopoly from large companies

End of the Questionnaire

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7.3. Delphi Survey – Questionnaire of the 3rd round

The questionnaire of the 3rd round of the Delphi survey had 3 different sections and 13 answers in total. The detailed questions are presented below.

Section A – Personal Information

- 1) [Free text] Email

Section B – Data Sharing Scenarios

In the second round of the Delphi Survey, the group's answers showed that the most important actors for all the use cases that were presented are:

- Transport Service Providers
- Regions/ Cities/Municipalities
- Navigation Services Provider
- Ride Sharing Operators
- Transport Authorities
- Trip Planning Services
- Micromobility Operators
- Traffic Management Centres

And the most important types of data in the context of all use cases are:

- Real-time demand in public and private transport
- Demand through mobility habits analysis
- Real-time schedule updates in public transport
- Delays and disruptions in public transport
- Traffic Data
- Geolocation data on available parking spaces

In this part you will be asked to identify which actors can collaborate by sharing or accessing specific types of data and the motivation behind it.

Example

Type of data: Delays and disruptions in public transport

Actors to share or access data: Public Transport Providers (share), Micromobility operators (access)

Motivation: Public Transport Providers will share the data in order to improve services for the citizens. Micromobility operators will access the data in order to improve operations in areas with regular delays.

Questions

- [Checkboxes, Free text] Can you choose which actors would be interested to share or access data of "Real-time demand in public and private transport"?
  After choosing all the actors that could be interested, you will be asked to state each actor's motivation for accessing and/or sharing data.
- [Checkboxes, Free text] Can you choose which actors would be interested to share or access "Demand analysis through mobility habits" data and the motivation behind it? After choosing all the actors that could be interested, you will be asked to state each actor's motivation for accessing and/or sharing data.
- [Checkboxes, Free text] Can you choose which actors would be interested to share or access "Real-time schedule updates in public transport" data and the motivation behind it? After choosing all the actors that could be interested, you will be asked to state each actor's motivation for accessing and/or sharing data.
- [Checkboxes, Free text] Can you choose which actors would be interested to share or access "Delays and disruptions in public transport" data and the motivation behind it? After choosing all the actors that could be interested, you will be asked to state each actor's motivation for accessing and/or sharing data.
- [Checkboxes, Free text] Can you choose which actors would be interested to share or access "Traffic Data" data and the motivation behind it? After choosing all the actors that could be interested, you will be asked to state each actor's motivation for accessing and/or sharing data.
- [Checkboxes, Free text] Can you choose which actors would be interested to share or access "Geolocation data on available parking spaces" data and the motivation behind it? After choosing all the actors that could be interested, you will be asked to state each actor's motivation for accessing and/or sharing data.

End of the questionnaire

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In the Table 10 the demographic characteristics of the survey participants are presented

Table 10: *Demographics of Delphi Survey Participants*

Gender		
Female	**12**	**24%**
Male	37	74%
Would Rather Not Say	1	2%
Years of Experience		
Less than 8	**11**	**22.00%**
8-15	16	32.00%
16-25	13	26.00%
26-35	6	12.00%
35+	4	8.00%
Industry		
Engineering Company	**5**	**10.00%**
Transport Service Provider	7	14.00%
City/Municipality	5	10.00%
Consulting Company	6	12.00%
Research Association	9	18.00%
Policy Making Organization	3	6.00%
Data Service Provider	5	10.00%
Mobility Association	2	4.00%
Other (please specify)	8	16.00%
Organization active in		
Greece	**6**	**12.00%**
France	7	14.00%
Italy	15	30.00%
Spain	5	10.00%
Germany	2	4.00%
Serbia	2	4.00%
Rest of Europe	13	26.00%

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8. Annex B – Innovators' Questionnaire

During the T3.1 a questionnaire dedicated to innovators, start-ups and SMEs was conducted in order to gather their views in the data sharing environment. In this chapter the questionnaire format and questions are presented.

Section A –Actors and Needs

In this part, you will be asked first, to evaluate how the lack of a data sharing culture affects the transport industry and your organisation and second, to identify your needs in terms of data sharing.

Questions

- 1) [Checkboxes] Does your organisation consume open data?
  - Yes
  - No
  - I am not aware
- 2) [Checkboxes] Does your organisation produce open data?
  - Yes
  - No
  - I am not aware
- 3) [Checkboxes] Does your organisation pay another agency/company to acquire the data it needs?
  - Yes
  - No
  - I am not aware
- 4) [Likert question] - From your experience, can you describe how the lack of data sharing impacts your organisation?
  - a. Lack of insights for tactical business decisions
  - b. Current work depends on outdated data
  - c. Increased costs for data acquisition
  - d. Limited resources for innovation
  - e. Duplication of efforts due to lack of common standards in terms of licenses, data models, formats, and software protocols
  - f. Other please specify
- 5) [Checkboxes] - Based on the source of data, which ones would be most useful for your organisation? Choose up to 2.
  - Data sourced directly from users

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- Data from urban administrative divisions (e.g, municipalities)
- Data from government departments (e.g., ministries)
- Data from public-interest organisations (e.g. Transport Service Providers)
- Data from private entities

- 6) [Rank] – Which indicators would be considered by your organisation if it wanted to join a data-sharing solution? Rank the following indicators according to their importance (the first being the most important and the last the least important).
  - Trust/Reliability
  - Security
  - Cost
  - Data Governance
  - Data Privacy
  - Ease of Usability
  - Minimum level of expertise needed
  - Integration with existing infrastructure
  - Customization
- 7) [Likert scale]- Based on your experience, what would be the most important characteristics of a data-sharing solution for your organisation?
  - Data Analytics and Visualization
  - User Access Control
  - Clear and Consistent Documentation
  - Data Interoperability with 3rd parties
  - Data Scalability
  - Maintenance and Support
  - Data Accessibility and Availability (eg. APIs)
- 8) [Rank] - Please rank the impact of current modern data exchange practices on data sharing based on your experience from the industry you work in.
  - a. Open innovation networks
  - b. Data-sharing platforms
  - c. Conferences
  - d. Data brokers
  - e. Forums
  - f. Open data portals
- 9) [Checkboxes] - If you could join an ecosystem consisting of cities, municipalities, authorities, private companies, citizens, start-ups and research organisations to access open data supported by data access and analytics tools, what would be your main goal? Choose up to 2.
  - To access data that are not widely available
  - To gain ideas on how to optimize your product
  - To expand in other business directions
  - To explore data and partners' network
  - To participate in a city challenge (e.g. participate in a problem-solving datathon to provide solutions for on demand transport for a municipality)

- To pilot your product
- Other (please specify)

Section B –Personal Information

Questions

- 1) [Checkboxes] Please select the industry you work in:
  - Data Service Provider
  - Transport Service Provider
  - Consulting Company
  - Engineering Company
  - Research Association
  - Other (please state)
- 2) [Checkboxes] For which department in your organisation do you work in?
  - Business
  - Product
  - Software/Technology
  - Operations
  - Other (please specify)
- 3) [Checkboxes] How many years of experience you have?
  - 1-5
  - 6-10
  - 11-15
  - 16+
- 4) [Small free text response] Please state the country/countries that your organisation is active in.
- 5) [Checkboxes] *Gender*
  - Male
  - Female
  - Other
  - Rather not say

End of the questionnaire

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In the Table 11 the statistical analysis of the sample is presented.

Table 11: *Innovators' Questionnaire Demographics*

Gender	
Female	17.19%
Male	82.03%
Other	0.78%
I would rather not say	0.00%
Years of Experience	
1-5	25.95%
6-10	21.37%
11-15	21.37%
16+	31.30%
Industry	
Transport Service Provider	3.05%
Engineering Company	25.95%
Consulting Company	22.90%
Research Association	10.69%
Data Service Provider	13.74%
Other (Blockchain, Real Estate, Healthtech, Automotive, Advertising, Deep Tech, Hospitality, Agroindustry)	23.66%
Department	
Business	41.22%
Operations	5.34%
Software	33.59%
Product	3.82%
Other	16.03%

9. Annex C - Actors and their needs

Table 12: *Complete list of Actors and Needs*

Actor	Data	Provider	Purpose
Research centre/ Universities	Joined up city data assets (e.g., parking data / CCTV / environmental data)	Minimalities, Government Transportation Agencies	Enable predictive modelling that can have positive benefits on service provision to city stakeholders.
	Real-time emission data	Authorities	Measure environmental impact
	Mobility habits	Transport Providers/ Information Service Providers	Support municipalities and cities infrastructure planning by analysing mobility habits data e.g. planning of cycling lanes
	Tickets from transport	Transport Providers	Support municipalities and cities infrastructure planning by analysing mobility habits data e.g. planning of cycling lanes
Citizens	Pricing of public transport means	Trip Planners	Accurate information for journey planning
Commuters/Passengers	Ridership in vehicles	Transport Providers	Decision Making
Tourists	Timetable/bus stops/lines and real-time data	Transport Providers	Provide updated information to the end-users, to reduce waiting time
Tourist Agencies	Tickets from transport	Transport Providers	
Hoteliers	Tickets from transport	Transport Providers	
Climate change NGO	Real-time emission data	Authorities	Urge municipalities for sustainable modes of transport
Tourism Associations	Daily move patterns of individuals	Navigation Service Providers	Advertising/Better Service
Points of interest (museums etc)	Daily move patterns of individuals	Contextual Data Providers	
Regional policy makers	Daily move patterns of individuals	Navigation Service Providers/Trip Planners	Planning and management of big, long-term interventions to the mobility infrastructures: assessing and predicting their impact on local mobility is important to avoid critical issues, e.g. systemic traffic jams.

	Geolocation data on parking	Navigation Service Providers	Identifying available (private) parking-sides to "free" urban roads from parking cars to open space for bikes and pedestrians.
	Analysis of tourist flows	Navigation Service Providers	Manage transport options depending on demand
European Policy Makers	Daily move patterns of individuals	Navigation Service Providers/Trip Planners	Planning and management of big, long-term interventions to the mobility infrastructures: assessing and predicting their impact on local mobility is important to avoid critical issues, e.g. systemic traffic jams. Proactive Planning, new signage
	Accident rate analysis	Emergency Services	Planning for safety
	Demand analysis for transport services	Government Transportation Agencies	Planning and management of big, long-term interventions to the mobility infrastructures: assessing and predicting their impact on European mobility
Municipalities	GPS data from cars and buses coupled with travel card information (check ins and check outs)	Navigation Service Providers/Trip Planners	Demand Forecasting
	Accident rate analysis	Police	Planning of new infrastructure / signage
	Integration between public transport system, trains, regional buses	Authorities	Planning of new infrastructure / signage
	Visitor's visas, foreign entry, vaccination requirements	Airlines	Safety
Government / ministries	Real-time emission data	Authorities	Sustainability
	Daily move patterns of individuals regardless of mode	Contextual Data Providers	Passenger tracking for safety reasons like COVID - 19 tracing
	Accident rate analysis	Police	Emergency management/ Planning for safety
	Demand analysis for transport services	Transport Service Provider	Planning for schedules, rolling stock
Public Transport Authority	Daily move patterns of individuals	Contextual Data Providers	Planning for new services
	Ridership in vehicles	Transport Service Provider	A disruption occurs on the transit network and rail service must be replaced with temporary buses. Data sharing is important for understanding how many

			people are typically riding at that time and will require temporary service, as well as their destination to inform the number and route of the replacement buses.
	Real-time emission data	Authorities	Sustainability
	Timetable/ Bus stops / Lines and real-time data provided	Transport Service Providers	Updated information to the end-users, to reduce waiting time at the bus stop, to better optimize the services and the flee
	Accident rate analysis	Police	Emergency management/ Planning for safety
	Traffic Data	Government Transportation Agencies	Better integration between public transport system, trains, regional buses if we could gather all real-time data in one platform.
	Rolling stock	Transport Providers	A disruption occurs on the transit network and rail service must be replaced with temporary buses. Data sharing is important for understanding how many people are typically riding at that time and will require temporary service, as well as their destination to inform the number and route of the replacement buses.
Rail Infrastructure Authorities	Real time data sharing of information coming from vehicles (position, info on vehicle dynamic, etc...)	Transport Providers	Traffic Management
Traffic management centre	Ticket Sales from one - time events	Contextual Data Providers	Plan to accommodate more passengers
	Accident rate analysis	Police	Safety planning
	Data from cars	Travelling Public	Planning for traffic
	Parking spots	Parking Operators/ Navigation Service Providers	Traffic Management
	Planned works on roads generating congestion	Municipalities	Avoid disruptions and alert end users
	Mobile phone data	Contextual Data Providers	Demand forecasting
Trade Association	Planned works on roads generating congestion	Authorities	Avoid disruptions and alert end users
Logistics operators	Planned works on roads generating congestion	Municipalities	Avoid disruptions and alert end users
Public Logistics operator	User Demand	Transport Service Provider	Origin/Destination data will show how to improve the

			availability of transport modes
Ride-sharing companies	Prediction of train delays based on meteorological data	Weather Providers	Demand forecasting
Public Transport Operators	Mobile phone data	Contextual Data Providers	Demand forecasting
	Daily move patterns of individuals	Contextual Data Providers	Planning for new services
	Ridership in vehicles	Transport Service Provider	A disruption occurs on the transit network and rail service must be replaced with temporary buses. Data sharing is important for understanding how many people are typically riding at that time and will require temporary service, as well as their destination to inform the number and route of the replacement buses.
	Real-time emission data	Authorities	Sustainability
	Timetable / Bus stops / Lines and real-time data provided	Transport Service Providers	Updated information to the end-users, to reduce waiting time at the bus stop, to better optimize the services and the flee
	Joined up city data assets (e.g., parking data / CCTV / environmental data)	Minimalities, Government Transportation Agencies	Enable predictive modelling that can work for planning
	Accident rate analysis	Police	Emergency management/ Planning for safety
	Accident rate analysis	Police	Emergency management/ Planning for safety
Micro-mobility operators	Traffic Data	Government Transportation Agencies	Better integration between public transport system, trains, regional buses if we could gather all real-time data in one platform.
Airlines	Weather Data	Weather Providers	Prediction of delays
Transport Agencies	User Demand	Travelling Public	Ease of navigation
Pricing/payment platform	Geolocation information on the available parking space	Parking Operators	Improved Service for end-user
Navigation services providers	Geolocation information indicating the availability of charging stations for private electric vehicles in city networks	Navigation Service Providers	Improved Service for end-user
	Geolocation data	Travelling Public	Better signal/Advertising

Mobile phone operators	Data usage	Trip Planners	Unified information, better monitoring, better service for final users
Cloud Providers	Traffic, parking spots	Navigation Service Providers/ Authorities	Traffic Management
Trip Planners	Geolocation information on the available parking spaces	Service Providers	Realtime indication open space improves air quality, traffic safety and sustainable car use
	Sharing (micro)mobility management across different operators by the city and for the citizens	Transport providers	Unified information, better monitoring, better service for final users
	Air travel and connection with airports	Transport providers	Unified information, better monitoring, better service for final users
	Dynamic road congestion pricing	Authorities	Unified information, better monitoring, better service for final users
	Real-time updates in transport	Transport Operator Providers	Forecasting demand
Software providers	Different types of data	Transport Operator Providers/Trip Planners/Navigation Service Providers	Interoperability
Satellite Operators	Management of public parking spaces	Service Providers	Unified information, better monitoring, better service for final users
Search Engines	Daily move patterns of individuals	Information Service Providers	Personalised suggestions and better service
	Public Transport Demand	Transport Operator Providers	Forecasting sales
Autonomous vehicles manufacturers	Public Transport Demand	Transport Operator Providers	Forecasting sales
Car Manufacturers	Accident rate	Police	Proactive planning
Fire Service	V2V and V2I communication	Car Manufacturers	To activate emergency vehicles on time and prepare their route for quick and effective first aid support (in case of accidents, natural disasters etc.)
Ambulances	V2V and V2I communication	Car Manufacturers	To activate emergency vehicles on time and prepare their route for quick and effective first aid support (in case of accidents, natural disasters etc.)
Police	Geolocation data on parking space	Service Providers	Management of public parking spaces

Government Transportation Agencies	Geolocation data on parking space	Service Providers	Management of public parking spaces

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MobiDataLab consortium

The consortium of MobiDataLab consists of 10 partners with multidisciplinary and complementary competencies. This includes leading universities, networks and industry sector specialists.

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