MOBIDATALAB

Labs for prototyping future mobility data sharing solutions in the cloud

D3.3 Market Gap Analysis Report

23/01/2023

Author(s): Apruzzese Michela (ICOOR), Hadjidimitriou Selini (ICOOR)

MobiDataLab is funded by the EU under the H2020 Research and Innovation Programme (grant agreement No 101006879).

Summary sheet

Deliverable Number	D3.3
Deliverable Name	Market Gap Analysis Report
Full Project Title	MobiDataLab, Labs for prototyping future Mobility Data sharing cloud solutions
Responsible Author(s)	Apruzzese Michela (ICOOR), Hadjidimitriou Selini (ICOOR)
Contributing Partner(s)	POLIS, HOVE, HERE
Peer Review	AETHON, AKKA
Contractual Delivery Date	30-11-2021
Actual Delivery Date	26-11-2021
Status	Final
Dissemination level	Public
Version	V1.0
No. of Pages	39
WP/Task related to the deliverable	WP3/T3.3
WP/Task responsible	ICOOR
Document ID	MobiDataLab-D3.3- MarketGapAnalysisReport-v1.0
Abstract	The current gaps of products and services related to transport data have been identified in the framework of the project Use Cases. A vision of the future Transport Cloud that may be facilitated by the MobiDataLab prototype has been defined. Finally, a SWOT analysis for the future Transport Cloud have been addressed.

Legal Disclaimer

MOBIDATALAB (Grant Agreement No 101006879) is a Research and Innovation Actions project funded by the EU Framework Programme for Research and Innovation Horizon 2020. This document contains information on MOBIDATALAB core activities, findings, and outcomes. The content of this publication is the sole responsibility of the MOBIDATALAB consortium and cannot be considered to reflect the views of the European Commission.

Project partners

Organization	Country	Abbreviation
AKKA I&S	France	AKKA
CONSORZIO INTERUNIVERSITARIO PER L'OTTIMIZZAZIONE E LA RICERCA OPERATIVA	Italy	ICOOR
AETHON SYMVOULI MICHANIKI MONOPROSOPI IKE	Greece	AETHON
CONSIGLIO NAZIONALE DELLE RICERCHE	Italy	CNR
HOVE	France	HOVE
HERE GLOBAL B.V.	Netherlands	HERE
KATHOLIEKE UNIVERSITEIT LEUVEN	Belgium	KUL
UNIVERSITAT ROVIRA I VIRGILI	Spain	URV
POLIS - PROMOTION OF OPERATIONAL LINKS WITH INTEGRATED SERVICES	Belgium	POLIS
F6S NETWORK IRELAND LIMITED	Ireland	F6S

Funded by the European Union

Document history

Version	Date	Organization	Main area of changes	Comments
V0.0	01/07/2021	ICOOR	ToC	
V0.1	12/08/2021	ICOOR	Chapter 4 input	Draft 1
V0.2	20/09/2021	ICOOR	Chapter 3 input	Draft 1
V0.3	22/09/2021	ICOOR/HOVE/POLIS	Chapter 4.1	contribution
V0.4	11/10/2021	ICOOR/HOVE/POLIS	Chapter 3 input	Market gaps linked the UCs - draft
V0.5	18/10/2021	ICOOR	Chapter 3 input	Market gaps linked to the UCs - review
V0.6	25/10/2021	ICOOR	Chapter 4.1 and 4.2, Chapter 5	Review and contribution, chapter 5 initial contribution
V0.7	29/10/2021	AETHON, HOVE, POLIS	Chapter 3, 4	Contribution
V0.8	04/11/2021	ICOOR	Chapter 1, 2, 3, 4, 5	Revision
V0.9	12/11/2021	ICOOR	Chapter 6 & formatting	
V0.10	15/11/2021	ICOOR	Final version	Finalization
V0.11	25-26/11/2021	AKKA	Final version	Quality Check
V1.0	26/11/2021	AKKA	Final version	Submission

Executive Summary

This document provides a report of the studies performed in the MobiDataLab project task T3.3 «Gap Analysis». The report clarifies the main gaps and issues in the current market of transport data such as heterogeneity of data sources leading to difficult data aggregation and comparability; mobility data availability and accessibility; lack of standardization models and data anonymization tools; low understanding of the business value that data sharing would favour. Moreover, the report provides a vision for the future Transport Cloud, i.e. the tool that is expected to be developed thanks to the MobiDataLab prototype; such vision allows understanding who the stakeholders to be addressed are (data consumers, data providers, service providers, innovators, and researchers) and the needs

that justify its development (need to deal with interoperability, reliability, quality, governance, security, privacy, monetization, and accessibility issues). Accordingly, the future Transport Cloud shall be designed as a lean and strong structure able to identify new variables, requirements, and standards necessary for a successful setting up data usage and sharing mechanisms in the transport sector. It shall allow for a marketplace to match data demand and data supply, where data coming from different platforms and sensors can be aggregated, combined, consolidated, and accessed. The SWOT analysis suggests that strengths and opportunities are mainly related to the favourable and collaborative environment while weaknesses and threats are mainly related to current technical data management complexities, stakeholders' acceptance and related commitment. Therefore, it is recommended to clearly define the governance and business models in parallel to the technical implementation of the future Transport Cloud system.

Funded by the European Union

Table of contents

Funded by the European Union

List of tables

Funded by the European Union

Abbreviations and acronyms

Abbreviation	Meaning
API	Application Programming Interface
DoA	Description of Action
ETA	Estimated Time of Arrival
LL	Living Lab
MaaS	Mobility as a Service
PTA	Public Transport Authorities
PTO	Public Transport Operator
SWOT	Strengths, Weaknesses, Opportunities, Threats
UC	Use Case

Funded by the European Union

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.

1.2. Purpose of the deliverable

The goal of this deliverable is to identify the gaps between the demand and supply of data sharing services and to define a common understanding of new products and services to be included in the future Transport Cloud in order to satisfy users' needs and create a business impact.

1.3. Intended audience

D3.3 is a public deliverable addressed to the MobiDataLab project partners and to the actors of the mobility sectors that aim to contribute to an improved data sharing culture and to the digitalization of the transport sector.

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

This deliverable is structured as follows:

- Chapter 2 provides the methodological approach
- Chapter 3 defines the market gaps in the context of the Use Cases
- Chapter 4 describes the vision of the future Transport Cloud
- Chapter 5 provides the SWOT analysis of the future Transport Cloud
- Chapter 6 summarizes the main conclusions and recommendations for future works

The deliverable takes input from: D2.4, D2.6, D2.9, D3.1, and D3.2. The deliverable provides output to: D3.4, D3.5, WP4 and D5.2.

Funded by the European Union

2. Methodology

2.1. Overall goals

The objective of this deliverable is reporting the main gaps between demand and supply and to identify the potential of digitalization and data sharing. The transport flows defined by the MobiDataLab use cases have been taken as input to assess where inefficiencies occur if there is a lack or ineffectiveness of digitalization and data sharing practices. The identification of the gaps allowed understanding which existing and new products and services should be included in the future Transport Cloud to satisfy users' needs and have a business impact. In addition, a SWOT Analysis for the future Transport Cloud has been performed to clarify the opportunities facilitated by digitalization and data sharing practices. Therefore, the overarching goals of the study performed by task T3.3 are:

- To identify the gaps between demand and supply in the current market of transport data related products and services
- To define a common vision of the future Transport Cloud that may be established beyond the project duration using the prototype created in MobiDataLab (WP4) as a starting point
- To understand strengths, weaknesses, opportunities and threats of the above-mentioned future Transport Cloud

2.2. Methodology and approach

In line with the goals of the study, the approach is led by three main phases, each linked to the other:

- Phase 1: identification of the gaps in the market, in the context of the MobiDataLab Use Cases
- Phase 2: creation of a common vision for the future Transport Cloud
- Phase 3: Analysis of Strengths, Weaknesses, Opportunities and Threats of digitalization and data sharing

Phase 1 and phase 2 run in parallel due to the fact that their goal is to clearly understand the improvement areas that the future Transport Cloud shall achieve to satisfy users' needs and bring innovation in the market. Therefore, while use cases are analysed from a market gap analysis perspective, the main features of the future Transport Cloud are designed. Thanks to this, the SWOT analysis is performed by taking into accounts the characteristics defined in previous phases.

Funded by the European Union

2.2.1. Phase 1: identification of the gaps, in the context of the MobiDataLab Use Cases

To identify the gaps between demand and supply of data sharing services, the Use Cases have been analysed in detail as explained in table 1.

Table 1 Use Cases based Gap Analysis approach

Use Case Name **Use Case Objective**	As defined in deliverable D2.9
Current Status of the Market	The definition of the current status of the market is partially based on the findings of deliverable D3.2 which was entirely dedicated to discovering the products existing in the market and related to the MobiDataLab use cases. Considerations from deliverable D2.6, which has analysed past and current projects, have been also taken into account. Moreover, other desk research has been done.
Actors' needs	The relevant actors' needs in terms of data and services that have been identified in D3.1 with a survey approach in this project phase have been linked to each Use Case.
Gap	In this study, a gap in the market is defined as which product or services the users would like to have but that currently is not offered or is only partially available in the market.
How the future transport Cloud may fill the gap	Innovations that could be brought by the future Transport Cloud to fill the gaps have been suggested.
Evaluation of the innovations' acceptance and/or impact	The way to measure the evaluation of the suggested innovation and/or of its wider impact has been proposed and it will be used as an input for task T3.5.

2.2.2. Phase 2: creation of a common vision for the future Transport Cloud

While the phase 1 defines the market gaps and suggests improvement areas to cover them, phase 2 defines a framework to determine a common vision for the design of the future Transport Cloud. To build such vision, it is relevant to understand the reasons for its introduction, its potential users, how it could be designed and its innovation and business potential; table 2 defines the approach used to get these answers. Therefore, the vision of the future Transport Cloud is described in terms of recommendations for its future deployment.

The vision is enriched with a description of the innovation elements to be addressed, i.e. the elements that the future Transport Cloud may introduce to fill the gaps and the other novelties that may bring. The value proposition is defined by explaining the value delivered to stakeholders to satisfy their needs.

Table 2 Approach to describe the vision for the future Transport Cloud

Item to be summarized	Approach to describe the vision for the future Transport Cloud
Why do we need the Transport Cloud?	Described in general terms. The answer to this question is valid both if we refer to the MobiDataLab Transport Cloud prototype and to the Future Transport Cloud. The answer to this question is inspired by the MG-4.7-2020 Call text, the MobiDataLab Description of Activities, the deliverable D3.1, the deliverable D3.2, the actors' needs identified in the gap analysis.
Who will use the Transport Cloud?	If we refer to the MobiDataLab project, Living Labs actors will be the primary users of the prototype. Beyond MobiDataLab, referring to the future Transport Cloud, the deliverable D3.1 provides an overview of the general stakeholders of mobility data sharing and we assume they may be those who will be interested to use the Future Transport Cloud. However, key actors and key customers are also part of the Business Model defined in T3.4. Thus, target users identified in this document have been defined in accordance to T3.4.
How may the Transport Cloud look like?	The features of the MobiDataLab Transport Cloud prototype are described in the MobiDataLab Description of Activities and in deliverable D2.6. Later in the project, WP4 will actually deploy the prototype and detailed descriptions of the architecture and functionalities will be provided. To define how the future transport Cloud may look like, we take the same assumptions valid for the prototypes and defined in deliverable D2.6. Furthermore, we consider recommendation provided in deliverable D3.2. The main goal of this document is to recommend allowing for the accommodation of the innovation elements and features identified in T3.3.
Innovation and Business Potential	Because our goal is digitalization and data sharing beyond the project domain, the focus has been put in the future Transport Cloud. Input from the gap analysis has been fundamental to define the innovation elements. Collaboration with T3.4 to provide the preliminary value proposition has been established.

2.2.3. Phase 3: Analysis of Strengths, Weaknesses, Opportunities and Threats of digitalization and data sharing

The future Transport Cloud represents the object to be analysed in the SWOT analysis: the "strengths" are those attributes representing the potential competitive advantage of the future Transport Cloud; the "Weaknesses" are the areas in which it could need improvements; the "Opportunities" are the external factors providing an advantage and are defined both in the context of the project Use Cases and in a wider sense; the "Threats" are external factors that may harm the

Funded by the European Union

future transport Cloud uptake. Table 3 clarifies the main elements considered in listing the items presented in the SWOT Analysis.

Table 3 SWOT analysis approach

Internal Factors			
Strengths	Positive attributes of the future Transport Cloud that allow operating efficiently, generate revenue and achieve goals. This includes tangible aspects, and intangible aspects.	Aspects of the future Transport Cloud that hurt its perceived and actual value or prevent from outperforming the competition. Weaknesses can also be assets, resources or attributes that the future Transport Cloud is missing.	Weaknesses
Opportunities	Factors on which the future Transport Cloud can leverage to gain an advantage over competitors.	Anything that could negatively impact the ability to implement the future Transport Cloud uptake strategy. These are the elements that are out of control.	Threats
External factors			

3. Market Gap Analysis

Taking as input the studies reported in previous MobiDataLab project activities and by collecting further baseline information through desk research, this chapter aims to assess where inefficiencies occur in the transport data sharing domain, investigating if there is a lack or ineffectiveness of digitalization and data sharing practices and how the future Transport Cloud could fill such gaps. The analysis has been done in the context of the MobiDataLab Use Cases defined in deliverable D2.9 and introduced in the following sections.

3.1. Market Gaps related to UC1 “Optimization of Transport flow and ETA

Table 4 UC1 - linked gaps

Use Case Name	UC1: Optimization of Transport flow and ETA
Use Case Objective	The objective of this use case is to consider different types of data that can be deployed to calculate the ETA.

Funded by the European Union

Current Status of the Market	Currently, the market is led by big players who provide maps and real time navigation. TomTom, for instance, provides traffic and travel time information but it does not share data. Google Maps provides information on the ETA for several transport modes (car, public transport, airplane, bicycle or walking) depending on the data availability and geographical location. Data are available through an API at different prices. Similarly, HERE platform provides routing services and the ETA through an API with different price schemes.
Actors' needs	• The traveling public is interested in knowing the ETA to better plan their trips and being more reliable. If the ETA is known, more people would use public transport. • Mobility service providers need to know the ETA to better plan the transports. More specifically, transport service providers need information about delays and disruptions in public transport and traffic data. Furthermore, multimodality is possible when the ETA estimates are accurate. • Private transportation franchisees need to know the ETA to better plan their fleets and to optimize transportation. • Information service providers need to know ETA to provide this information to the travellers.
Gap	• Overall, traffic information is provided thought different platforms with different pricing schemes (e.g. TOMTOM, HERE, and Google). The research community can hardly take advantage of these dataset. A subset of the information on traffic information should be provided for free for research purposes. • Lack of innovative approaches to combine different data sources and different dataset, to aggregate different data formats and to obtain more accurate and realistic ETAs.
How the future Transport Cloud may fill the gap	• The Transport Cloud should allow aggregating and consolidating different platforms by ensuring that each of them can maintain its business model. The aggregation of different dataset allows obtaining more accurate ETA. More specifically, the Transport Cloud allows sharing data resources from different applications deployed by a multiplicity of consumers. • Another service that the Transport Cloud could provide is related to the provision of data for research purposes. The existing platforms usually provide data through an API with different pricing schemes. The Transport Cloud could foresee a section in which a subset of data obtained from different platforms is provided for free and only for research purposes.
Evaluation of the innovations' acceptance and/or impact	• Level of integration among different traffic data platforms • Level of accuracy of ETA • Number of new real time travel planners.

Funded by the European Union

3.2. Market Gaps related to UC2 “Emission Reporting”

Table 5 UC2 - linked gaps

Use Case Name	UC2: Emission Reporting
Use Case Objective	The objective of this use case is to consider the challenges related to the emission reporting. Emissions reporting is both used to understand where there is greatest potential for reducing emissions as well as during the planning for comparing different planning choices.
Current Status of the Market	According to the MobiDataLab market analysis performed in deliverable D3.1, 16 out of 37 services analysed are relevant for this Use Case: this use case is amongst the least covered by the services on the market (it ranks #5 out of 8 use cases taken into consideration when it comes to market coverage). The main market leaders are mapping and routing companies (e.g. ESRI, HERE, TomTom, Waze, Moovit) and major analytics service providers (e.g. Geotab, Inrix, Populus, PTV). Only a few of them aggregate data from different transport modes (public transport, micro-mobility, private vehicles) but private cars emission data is often available. Some companies provide reporting only on their proprietary devices (e.g. Geotab), whereas most companies aggregate several data sources. Information on emission reporting is priced by the companies either on an API call basis or a subscription scheme.
Actors’ needs	• Manufacturers, policy makers and the whole society need estimating both direct (linked to the transport operation) and indirect emissions (caused by the production of assets needed for the transportation, such as manufacturing the vehicle) of a particular transport asset, such as a truck, a ship, an airplane etc. • Trips, especially for goods, involve several journey legs sharing transport assets. Companies need to understand the share of emissions due to the whole trip, not for a single leg.
Gap	• Platforms have developed their emissions modelling calculations independently, hence we can anticipate differences of how emissions are calculated, making their integration and comparison difficult without adjustments. • The availability of emission reporting of personal cars seems well covered by the market but the information for other transport modes is less easily available, making the comparison between modes difficult. • As all the platforms provide reporting through regular market offers, the availability of emission reporting for free in the context of academic research is not possible yet.
How the future Transport Cloud may fill the gap	• As indirect emissions are influenced by a huge number of parameters, often unavailable, the future Transport Cloud could: integrate data from different platforms, create emission related datasets and provide a catalogue of models for emission modelling. • The future Transport Cloud could develop micro services for emissions calculation. For instance, in addition to compute a travel plan, the services could also compute estimated emission. This can be predicted emissions (e.g. routing) or emission that have already taken place (e.g. tracking, route matching).
Evaluation of the innovations’	• Number of companies planning trips based on emission-reduction objectives before the Transport Cloud introduction VS with the Transport Cloud introduction.

Funded by the European Union

acceptance and/or impact	• Percentage of respondents willing to uptake travel scheduling practices based on lower-emissions choices

3.3. Market Gaps related to UC3 “Analytics & Learning”

Table 6 UC3 - linked gaps

Use Case Name	UC3: Analytics & Learning
Use Case Objective	The objective of this use case is to allow different actors to access data, to analyse them and learning from historical information. The actors should be able to access different types of data such as the geographical data or mobility data.
Current Status of the Market	There are a few products that allow data pre-processing and analysis. Akka datahub, for instance, allows to collect heterogeneous data and to integrate machine learning tools. Another example is ArcGIS or QGIS that allow performing spatial data analysis. Similarly, Carto allows performing spatial analysis. The market offers tools that can be easily deployed by users that have not a deep knowledge of machine learning algorithms (i.e. Knime). However, these tools do not include the provision of dataset for the analysis. In terms of data, there are several competitors, such as Kaggle, that provide data to be deployed for analytics and learning purposes. However, these competitors usually have the objective to solve specific problems of the companies or institutions that have provided the data and offer a monetary prize to the winner.
Actors’ needs	• Considering that the market offers already valuable tools for analytics and learning, the needs of the actors are mainly related to the availability of data from different sources. • Data availability is conditioned by the need to anonymize them or by need of companies to keep them private or available for sale. • On the other hand, municipalities, transport planners or other institutions that works on the interest of the public need innovative approaches that allow offering new services and products for reducing the environmental impact of transport.
Gap	• The main issue related to the availability of product and services that allow performing analytics and learning are related to the availability of large dataset and to the users’ knowledges and tools availability. • Another issue is linked to the marketability of data: the main business of companies is data, and they are not willing to share it for free. • Besides the availability of data from different sources, there is the need and lack of standardization.
How the future transport Cloud may fill the gap	• To develop innovative approaches, the research community and developers should benefit from the possibility of using large and meaningful dataset. • If large sample of dataset would be available for free by also complying with company requirements, the digital service providers could be able to integrate different and new functionalities into their tools.

Funded by the European Union

	• The Future Transport Cloud could offer innovative services for data standardization and anonymization.
Evaluation of the innovations' acceptance and/or impact	• Percentage of respondents/ number of potential users willing to use the future Transport Cloud for data analytics purpose • Percentage of respondents/ number of companies willing to share large dataset for free through the future Transport Cloud

3.4. Market Gaps related to UC4 "Re-use of transport data for journey planners / digital services"

Table 7 UC4 - linked gaps

Use Case Name	UC4: Re-use of transport data for journey planners / digital services
Use Case Objective	The objective of this use case is to foster the use of transport data for journey planning, through a service layer (unified API, common user experience) that simplifies the usage and allows the use of transport data also for non-domain experts.
Current Status of the Market	The market seems to be focused mainly on mobility data management and sharing (chouette, Mobi-iti, oneTRANSPORT), mapping (Mapbox, Mapkit, Openstreet Map), and transport planning. Most of the transport planning apps are targeted at cities and transport operators (CARTO, Populus, UrbanSDK) to plan their services and not so much dedicated to non-domain experts. Although services focused on data sharing have multiplied in the last decade, most of them are still very domain focused and not accessible to non-domain users. A strong business ecosystem has developed around connected car data with some players specializing on this data source to develop digital services or analytics solutions. For the clients of these organizations, the possibility to aggregate other vehicles data is limited. A similar trend can be observed in the context of public transport data (e.g., Navitia). Organizations aggregating multiple types of vehicles (cars and public transport, for example) are of two types: mapping services which provide journey planning with data they own, access, or buy (e.g., Google Maps, Moovit) and software which do not provide data but allow users to aggregate their data and build customized data services (e.g., Opendatasoft, AKKA data hub, Vianova). Vehicle location data, cartographic data and static infrastructure data are the most commonly available data. On the contrary, payment, ticketing, environment, and dynamic infrastructure data are less easily available.

Funded by the European Union

Actors' needs	• According to the results from the survey elaborated in MobiDataLab (reported in deliverable D3.1), respondents identified the use case "better journey planning through third party data integration" as one of the most significant in terms of data-sharing. • Besides transport, survey respondents identified several industries that could be interested in the data produced from transport operations, namely: health care, tourism and real estate. • Public authorities could be important actors in the transport innovation process, however there is a lack of ownership rights of data among them, preventing real change and improvement.
Gap	• Existing data sharing and management platform and services are mainly focused on serving the transport sector, which seems to be preventing other innovators from accessing them. Data interoperability gaps and the related APIs are claimed by innovators. • There is no promotion of innovative business models that offer incentives for all organizations and show operational business cases that reflect the value of data sharing and prove the degree to which organizations can reduce risk through informed decisions.
How the future transport Cloud may fill the gap	• Open-source tools could be created to validate datasets and guide producers on how to improve them and grading schemes to assess the quality of data beyond automatized validation. • The future transport data could offer specific "on-demand" mobility information, addressed to specific actors, including those that do not belong to the transport sectors, such as real estate companies, health care and tourism companies. • The future Transport Cloud should foster the use of transport data through a common service layer (i.e. unified API) based on the Transmodel concepts and data structure. Navitia (www.navitia.io/) or Open Trip Planner (OTP, www.opentripplanner.org/) could be a starting point for defining this API.
Evaluation of the innovations' acceptance and/or impact	• Percentage of small players / innovators re-using datasets provided by the Transport Cloud VS % of small players / innovators re-using datasets provided by currently available products/services/platforms. • Percentage of non-mobility actors (on the total amount of users) of transport datasets without VS with the Transport Cloud

3.5. Market Gaps related to UC5 "Mobility as a Service"

Table 8 UC5 - linked gaps

Use Case Name	UC5: Mobility as a Service
Use Case Objective	To provide MaaS operators with raw data or with journey planning services to allow MaaS operator to provide data to the Transport Cloud with information on MaaS users and journeys that can be later analyzed.

Current Status of the Market	There are currently a few organizations that focus on dynamic data exchange, some of them including data provision with data catalogues. One of them is Convex, a global commercial data exchange facility that aims to facilitate innovation and includes an open data catalogue. oneTRANSPORT is a cloud-based platform that allows for dynamic data-sharing and it is used by both the public and the private sector. Both of them do not provide their own data. Services focused on data exchange and data provision do not include journey planning services, while some of them do include visualization and analytics functionalities (AKKA dataclub or HERE platform). On the other side, services dedicated to journey planning do not seem to work with data exchange (google maps). Static infrastructure data and vehicle location data sharing is well established. Organizations aggregating multiple types of vehicles (cars and public transport, for example) are of two types: mapping services which provide journey planning with data they own, access, or buy (e.g., Google Maps, Moovit) and software which do not provide data but allow users to aggregate their data and build customized data services (e.g., Opendatasoft, AKKA data hub, Vianova).
Actors' needs	• MaaS operators need data on all types of transport modes to provide different types of services such as the multimodal journey planning and the possibility to buy the ticket. • For actors to get trust and MaaS to thrive, focus should be given to the management of proper definition of role, rules and processes for data governance.
Gap	• Scarce ownership, offering and provision of ticketing data, meaning that very little ticketing data sharing is happening today. • The main problem is the availability of data that are often provided with different formats. There should be a standard based on which all types of data are provided. • Gaps linked to interoperability and management of data from different sources.
How the future transport Cloud may fill the gap	• The future Transport Cloud could be the interface between the MaaS operator and the different organization that provide data with different formats. It can also serve to exchange data coming from the MaaS operator to the organization, as well as already provide analytics and other valuable services. • The governance body of the future Transport Cloud federation can establish, define, and enforce the strategies for identification and access to data, as well as ensuring that services are compliant with the existing regulatory environment. • The future Transport Cloud can provide open-source tools to validate datasets and guide producers on how to improve them, for instance with the creation of grading schemes to assess the quality of data beyond automatized validation.
Evaluation of the innovations' acceptance and/or impact	• Number of MaaS operators willing to join the future Transport Cloud.

Funded by the European Union

3.6. Market Gaps related to UC6 “Geodata sharing applied to Transport, OpenStreetMap for inclusive transport”

Table 9 UC6 - linked gaps

Use Case Name	UC6: Geodata sharing applied to Transport, OpenStreetMap for inclusive Transport
Use Case Objective	This use case deals with the possibility to easily obtain the accessibility data such as places which can be reached with wheelchairs, etc. Openstreetmap data are often enriched by associations which use Openstreetmap data and contribute to add spatial information. For this purpose, the use case will consider the collaboration with municipalities to enrich Openstreetmap data with information on accessibility by people with reduced mobility.
Current Status of the Market	There are associations (e.g. Wheelmap) or transport authorities (e.g. Baden Wurttemberg) that contribute to the OpenStreetMap project.
Actors’ needs	• People with limited spending power may not afford the cost of a private car, have tendency to be keen on cycling and other alternatives to car transport and, for those living in remote areas or who need to travel to work at unsocial hours when public transport is limited or non-existent, there is a strong need to access reliable transport information on alternative transport modes and low-cost transport solution. • Elderly population may have increasing physical problems and cognitive impairments that imply the need for secure transport options and easy access to information (timetables and destinations). • For people with physical impairment it is very important to know whether they can access a place or not (i.e. with a wheelchair). • Women and gender related aspects: accessibility of transport options is a key factor when carrying small children. Need to have information on safety and need to avoid harassment when travelling. • For people living in remote areas, due to poor infrequent public transport services, mobility is mostly satisfied by cars and consequent need to have access to traffic information.
Gap	• Limited integration of alternative transport options (such as car sharing) with public transport information • Limited information on accessibility of the different transport option and poor update of such information. • Difficult understanding of transport information for some users’ categories, due to physical problems (visual impairment) or due to language barriers. • Lack of information on safety plans to ensure safe trips.
How the future transport Cloud may fill the gap	• The future Transport Cloud could help to easily access different types of data such as the Openstreetmap data but also spatial information that are added to Openstreetmap but available in other websites. More specifically, the Transport Cloud can help to discover the datasets, to combine them and to perform data analysis.

Funded by the European Union

	• The future Transport Cloud service offering could provide users the possibility to rate travel options according to their inclusivity, accessibility, safety, etc. so that companies can include this information in their dashboards.
Evaluation of the innovations' acceptance and/or impact	• (scale) Satisfaction of vulnerable users of the information provided by platforms federated to the future Transport Cloud.

3.7. Market Gaps related to UC7 "Geodata sharing applied to Transport, environmental data for sustainable transport"

Table 10 UC7 - linked gaps

Use Case Name	UC7: Geodata sharing applied to Transport, environmental data for sustainable transport
Use Case Objective	This use case aims to combine the data provided by public transport authorities with the static and dynamic environmental data provided by the local authorities. The final objective is to assess the impact of transport on the environment.
Current Status of the Market	The availability of real time data is possible thanks to the increased use of sensors: innovative applications are data driven. There are a variety of sensors produced by different companies that are installed in the European urban areas, different indicators calculated at different levels of aggregations (World Air quality Index, European Air Quality Index by EEA, etc.). Plume Labs (plumelabs.com), for instance, provides technologies to collect data and develop new solutions to reduce the impact on the environment. The European Environmental Agency provides information on the air quality in real-time although the information provided are static and at an aggregate level or dynamic but with incomplete geographical coverage.
Actors' needs	• Local authorities need static and real time data to monitor air pollutant emissions and noise data. • Most importantly, historical data are needed to monitor the trend and develop new mobility plans aimed at reducing the impact on the environment. • Transport authorities need environmental data to be more competitive with other transport means.
Gap	• The accessibility of air quality and environmental data is the main gap because of the heterogeneity of the available solutions, products and services.
How the future transport Cloud may fill the gap	• The future Transport Cloud should facilitate the integration of environmental and air quality data into travel planners and traffic controls. • The future Transport Cloud could help to aggregate all the information from different sensors and to understand which type of data are provided by the different entities, with which level of coverage and aggregation.

Funded by the European Union

Evaluation of the innovations' acceptance and/or impact	• Number of accesses to the dataset provided through the Transport Cloud combining environmental data with transport data.

3.8. Market Gaps related to UC8 "Transport data sharing within the Linked Open Data Cloud"

Table 11 UC8 - linked gaps

Use Case Name	UC8: Transport data sharing within the Linked Open Data Cloud
Use Case Objective	This use case is mainly addressed to tourists. It aims to provide them information on points of interests or places to visit by tracking them. Tourists' trajectories are tracked and described based on the Segmented Trajectory Ontology (STO) and each segment is enriched with a variety of information such as the transport mode used by a person. Thanks to Linked Data Meshup (LDM) heterogeneous data are combined and merged to enrich the segments.
Current Status of the Market	In certain member states such as in France it is now possible to combine transport and tourism data. There is the French National Access Points for mobility data (transport.data.gouv.fr) and the DataTourisme platform (https://www.datatourisme.gouv.fr/) that aims to collect, disseminate, and process tourism open data. There are some applications that provide information to tourists such as NEXT STOP PARIS. Furthermore, the Wikidata project[1] is a semantic database. Similarly, Wikitravel is an open world travel guide written by travellers.
Actors' needs	• Tourists and travellers need accurate information to be able to reach different types of destination: there are a variety of information that tourists need such as the availability and location of accommodation and restaurants, information about the local culture, museums and other points of interest, the availability of trails, information on transportation, accessibility for reduced mobility, etc. • On the other hand, local authorities and service providers need to be able to communicate with tourists and make available to them information which are easily accessible by locals.
Gap	• A mix of transport and tourism data application requires several heterogeneous data so that it is difficult to offer services of reasonable quality.

[1] https://www.wikidata.org/wiki/Wikidata:WikiProjects

Funded by the European Union

	• There could be language barriers that do not allow communicating with tourists.
How the future transport Cloud may fill the gap	• The Transport Cloud could aggregate, combine and merge heterogeneous data to enrich the trajectories' segments. • Moreover, the Transport Cloud could also provide an automated translation of the information provided through applications or other communication means. In this way, local information could be more easily accessed by tourism service providers. With the recent development of more advanced deep learning models (i.e. transformers[2]), the quality of automatic text translation has been improved enormously (see DeepL[3]). This offers new opportunities to reach a broader public such as the temporary users of the urban services.
Evaluation of the innovations' acceptance and/or impact	• (scale) Tourists' satisfaction of the information provided by platforms federated to the future Transport Cloud.

4. A vision for the future Transport Cloud

The MobiDataLab project will design and deploy a prototype that may be developed after the end of the project in order to become the future Transport Cloud, described in this chapter. In contrast to deliverable D3.4 that will provide the business and financial model to identify the resources for such future evolution; this chapter aims to describe the future Transport Cloud vision by MobiDataLab and to identify the main innovations and business value generated by its future deployment. The MobiDataLab project refers to future Transport Cloud as the federation of Transport Clouds that the prototype developed within the project will facilitate.

4.1. Who will use the future Transport Cloud?

The Transport Cloud prototype will be validated and used by the actors engaged in the MobiDataLab Living Labs. The Reference Group will provide real life problems and relevant data sets (i.e. data providers) and the Living Labs participants (i.e., data users) will aim to create solutions for the specific challenges. The data users will be entrepreneurs, hackers, developers, researchers, start-

[2] https://en.wikipedia.org/wiki/Transformer_(machine_learning_model)

[3] https://www.deepl.com/translator

Field Code Changed

Funded by the European Union

ups and SMEs that have the knowledge and skills to propose concepts that overcome the living lab challenges provided by the MobiDataLab Reference Group. The MobiDataLab Transport Cloud prototype will be available by the end of the project and it will be available for test by the Living Labs actors engaged during the project in Europe. The future Transport Cloud is expected to have a wider scope and uptake, and the project exploitation plan will provide details on the expected timing and coverage.

The future Transport Cloud is expected to be used by a wider audience: Public Administrators, Public Transport Operators, Mobility Service Providers, Government Transportation Providers, Information Service Providers and Public Transport Authorities will be interested. Furthermore, stakeholders from other sectors such as health care, energy, tourism, insurance, advertising, real estate, urban planning, and telecommunications will get value from the existence of the future Transport Cloud. The future Transport Cloud will be addressed to a wide range of potential users that will be the main target for the value proposition. Main stakeholders' categories for the future Transport Cloud are expected to be:

- data consumers: Public Administrators, Public Transport Authorities, Public Transport Operators
- data providers: Public Transport Operators, Government Transportation Providers
- service providers: Information Service Providers, analytics service providers
- innovators: entrepreneurs, start-ups and SMEs
- researchers

4.2. Why do we need the Transport Cloud?

The future Transport Cloud stakeholders need a favourable and sustainable environment for collaboration on data exchange: that may also lead to new opportunities for SMEs and new business for data owners. Task T3.1 has analysed the needs of mobility stakeholders by deploying a set of questionnaires to collect stakeholders' concerns and needs in terms of data, cooperation incentives, business goals, standardization and interoperability. Chapter 3 has identified several stakeholders' needs linked to the MobiDataLab project Use Cases. The market analysis of mobility data-sharing platforms and products as reported in deliverable D3.2 identified the main business trends occurring in the market. Data generators use several distribution channels to share their data and trading data is for them an additional revenue source. They compete to be a proxy for mobility data. At the same time, mobility data sharing market has a direct influence on the mobility market itself and the way data is shared (or not) has an influence on the usage of the various mobility services aggregated in a data-sharing platform.

Consequently, both data generators and aggregators are reluctant to share publicly precise information on their commercial agreements and some data generators aggregate others' data to limit the competition from aggregators within both the mobility data-sharing market and the mobility market. The actors' needs analysis, the market trends analysis and the gap analysis suggest that the main reasons to introduce the future Transport Cloud are:

- Ensuring that the several actors can properly access and take advantage of the data produced for the improvement of their operations and services.

Funded by the European Union

- Allowing smooth interoperability and connectivity across the various components of the multimodal transport system,
- Enabling innovation and emergence of new business models.

Table 12 provides an aggregated overview of the stakeholders' issues and the related stakeholders' needs that the future Transport Cloud should address.

Table 12 Stakeholders' issues and needs

Stakeholder Issue	Stakeholder Need	Linked MDL UC
Data Interoperability issues linked to technical problems in inter-platform data handling.	• Need to use data management support tools. • Need to use data from difference sources.	UC2, UC4, UC5, UC7, UC8
Data reliability and quality issues depending on data quality and maturity. Lack of real-time data and the accuracy and update frequency of historical data.	• Need to introduce effective tools and processes to grade the data and to keep trace of their provenance. • Need to have an aggregated access to information. • Need to standardize data formats	UC1, UC3, UC5, UC6, UC7
Data governance issues related to concerns on data security and protection by external attacks, and low trust in the data encryption processes. Information asymmetry inside organizations and consequent lack of operational awareness.	• Need to create open-source tools to validate datasets and guide producers on how to improve them to create of grading schemes to assess the quality of data beyond automatized validation	UC5
Data exchange issues related to users' data privacy reasons. Public bodies concentrate information on users' mobility data that cannot be disclosed to private companies due to policy. The phenomenon of private companies buying data from data brokers lead to higher acquisition costs.	• Need to influence new policies on data sharing. • Need to push for a policy to allow data sharing for research purposes for free. • Need to anonymize data	UC3
Data exploitation issues linked to the lack of cooperation culture among private organizations, lack of understanding about the value of real/live data, mistrust among the organizations about data ownership, risk of monopoly.	• Need to facilitate the introduction of innovative business models that offer incentives for all organizations and show concrete use cases that reflect the value of data sharing, and the degree to which organizations can reduce risk through informed decisions. • Need for companies to develop successful business models in which data has different types of marketability strategies.	UC3, UC4, UC6, UC8

Funded by the European Union

	• Need of non-transport companies to make use of transport data	
Data access issues for SMEs and start-ups and for research purposes.	• Need to have access to open-source data and complete information, also for free.	UC1

4.3. What does the future Transport Cloud may look like?

Today a wide range of product and services for sharing and exploiting transport-related data and information exist, however, the market framework is very fragmented. The future Transport Cloud will be built based on this acknowledgement and will identify new variables, requirements, and standards necessary for a successful setting up data usage and sharing mechanisms in the transport sector (both passenger and freight). MobiDataLab envisions the usage of an open federated cloud architecture where complex and often contrasting requirements coming from FAIR (Findability, Accessibility, Interoperability, and Reusability) and privacy principles can be enforced easily and practically. The main requirements for the design of the MobiDataLab Transport Cloud prototype must be considered as pillars for the future Transport Cloud.

The future Transport Cloud will promote the concept of data as “public goods” while preventing unfair practices and enforcing contractual terms. To ensure a smooth follow up of regulatory changes, the future Transport Cloud shall promote a lean structure, both in terms of infrastructure and for governance models. The future Transport Cloud will provide robust and full authentication services to ensure identity and trust are properly ensured. For the granularity level, it might include both dataset and record level. It will be conceived a Software as a Service, considering Platform as a Service features for the data processors. The future Transport Cloud will provide compliance with standards, and we must ensure that the identified technical solutions in MobiDataLab will support such compliance. The data management will have to consider different aspects and criteria: privacy and security, FAIR principles, flexible data access policies, clear API access features, ability to support real time data.

In terms of business consideration, the future Transport Cloud shall be designed to support data types and value-chain component defined by the D3.2’s recommendations: the nine data types with highest potential impact on the creation of innovative digital services are vehicle location, environment, maps, payment, vehicle usage, static infrastructure, dynamic infrastructure, ticketing, user generated data; the four main components of the mobility data sharing value chain: generation, collection, analysis, and exchange. Furthermore, the future Transport Cloud shall be designed to accommodate the innovation elements described in section 4.4.1.

4.4. Innovation and Business Potential

4.4.1. Innovation elements

The future Transport Cloud shall be designed to include innovation elements that will facilitate filling the market gaps, satisfying users' needs and where a marketplace to match the demand and supply of data will be possible. The future Transport Cloud will allow the establishment of a data sharing framework where the knowledge from the transport sector may facilitate business opportunities, economic growth and efficient and sustainable transport planning. The main innovation element that the future Transport Cloud will bring is the ability to aggregate, combine, consolidate and access data coming from different platforms by ensuring that each of them can maintain or improve its business model. Data coming from different types of sensors shall be included in the offered datasets, allowing the identification of the entities providing data, with which level of coverage and aggregation they have. The future Transport Cloud may provide open-source tools to validate datasets and guide datasets producers on how to improve them, for instance with the creation of grading schemes to assess the quality of data beyond automatized validation. It will help to easily access different types of data, especially to discover the datasets, to combine them and to perform data analysis. The governance body of the future Transport Cloud shall establish, define, and enforce the strategies for identification and access to data, as well as ensuring that services are compliant with the existing regulatory environment. It shall consider having a pricing scheme in which data for research purposes is free of charge.

Based on the gap's analysis presented in Chapter 3, specific innovation elements may be addressed in the service offering of the future Transport Cloud, with the aim of filling the gaps identified in the context of the MobiDataLab Use Cases.

Table 13 Innovation elements linked to UCs

UC	General description of the Gap	Innovation element
UC1	Traffic information is provided through different platforms with different pricing schemes and data sharing settings.	• Functionalities allowing aggregating consolidate data from different platforms and to share real time data from different applications used by several users and calculate a more accurate ETA. Availability of data provided for free for research purposes.
UC2	Emissions are influenced by a huge number of parameters and many of which are not readily available; emission data is not comparable.	• Provision of a catalogue of models for emission modelling and other micro services for emissions calculation. For instance, a routing service could also compute estimated emission (predicted emissions or emission that has already taken place).
UC3	Scarce offering of services for data standardization and anonymization impeding the	• Facilitation in sharing large sample dataset by complying with companies' business requirements.

Funded by the European Union

	possibility to use large and meaningful data.	• Provision of services to make the data anonymous and make them standardized
UC4	Lack of operational business cases and common service layers that reflect the value of data sharing in the transport sector and beyond.	• Offering of "on-demand" mobility information, addressed to several types of actors, including those that do not belong to the transport sectors, such as real estate companies, health care and tourism companies. A marketplace may facilitate such demand/supply of "on-demand" mobility information. • Open-source tools to validate datasets and guide producers on how to improve them and grading schemes to assess the quality of data beyond automatized validation
UC5	Low data availability and quality in MaaS data exchange experiences, especially for ticketing data.	• Acting as an interface between the MaaS operator and the different organization that provide data with different formats. • Facilitate the exchange data coming from the MaaS operator to the organizations, as well as provide analytics and other valuable services. • The governance structure to manage the future Transport Cloud operations includes a data quality verification mechanism.
UC6	Limited accessibility to information, especially for vulnerable transport users	• Introduction of a catalogue of mobility services where a "grading" system allows ranking services based on their inclusiveness (e.g. accessibility of the transport service, readability of the transport information, safety of the transport service provided, etc.). The grades may be validated by vulnerable groups' representatives (e.g. associations).
UC7	Difficult accessibility to air quality and environmental data due to heterogeneity of solutions	• Functionalities for facilitating the integration of air and environmental data into transport services: any mobility service user will be provided with travel information and air quality data allowing choosing the more sustainable travel options (for service users) and include air quality as a main parameter (for service providers).
UC8	Heterogeneous data sources and language barriers	• Aggregate, combine and merge non-transport data with transport data. • Automated translation of the information provided through applications or other communication means, or more advanced deep learning models.

4.4.2. Value proposition

The future Transport Cloud, allowing several companies to get federated and share data, will be an innovation in the market since it could represent the first opportunity to gather services and information from different transport domains. The future Transport Cloud will be conceived and designed to satisfy a variety of purposes, including research, development and innovation.

The potential business model will allow for costs savings for several actors, since it will facilitate the opportunity to access shared data in a secure environment, closing the gap provided by current asymmetric information situations. It will facilitate business collaboration between stakeholders, by creating a framework where public and private actors, small and big players, can network and take advantage of the collaborative environment and the opportunities that a federation would allow. The future Transport Cloud will provide value for all main stakeholders of the data sharing culture, specifically:

- Data consumers will be facilitated in the decision-making process related to resources-allocation thanks to the access to reliable, traceable, real-time and historical mobility data and to the connection to a reliable pool of experts to whom they can ask specific services
- Data providers, such as Public Transport Operators and Mobility Service Providers, will get benefit by having a better exposure and distribution of their services
- Services providers, specifically analytics services providers, will have an easier identification of new business opportunities
- Innovators will be able to improve their operations and expand their business
- Researchers will benefit from the access to a secure and reliable data source for knowledge development.

5. SWOT analysis of the future Transport Cloud

In this chapter a SWOT analysis is performed based on the characteristics of the future Transport Cloud described in the previous chapter. This analysis provides an assessment linked to the potential uptake by the market of the future Transport Cloud and defines the internal and external factors determining the success or failure of the solution. Table 14 provides a summary of the main items addressed by the SWOT analysis, while details are provided in the following sections.

Table 14 SWOT analysis summary

Internal Factors			
Strengths	• Open Tool • Data availability from different sources • Improves stakeholders' collaboration • Data reuse thanks to standardization • Trusted data sharing environment • Inclusive, unbiased and ethical data sharing • Cost savings in the long term	• Unstructured information from several sources • Significant initial resource investment • Complex implementation and deployment • Complex governance and difficult maintenance • Stakeholders' acceptance of standardization difficulties	Weaknesses

Funded by the European Union

Opportunities		Threats
	• Specific opportunities linked to the UCs • Synergies and collaborations with other sectors' data sharing initiatives • Showcase opportunity for SMEs and start-up initiatives • Generation of new business ideas and research approaches • Better organization of the operations connected to transport and mobility	• Risk of data misuse or misinterpretation • Shortage of technical expertise • Trust issues and cyber security risks • Privacy issues and sharing issues • Responsibility issues related to data integrity	
External factors			

5.1.1. Strengths

- The intrinsic factors of the future Transport Cloud that make it unique and competitive are the following:It is an open tool with the potentiality of being widely spread: the future Transport Cloud is expected to be open to any stakeholder that wishes to join it as a data provider and to any stakeholder willing to make use of the available data. The future Transport Cloud governance model will define the requirements in order to ensure that high-quality data sharing occurs.
- It ensures data availability and provides easy connection between different data sources: being open, it will allow several data providers to give access to datasets. The future Transport Cloud will emphasize the availability of different data sources being typical of the transport and mobility domain; however, it aims at integrating data also from different sectors allowing the possibility to get engaged in innovative cross-sectorial data analysis. The possibility to collect and analyse data from various internal and external sources is a key factor and it may be useful to industries and organizations that own a huge amount of digital information they are not able to exploit.
- It improves collaboration between stakeholders: data-driven decision making and operations give more objectivity and transparency in communication between different actors and helps to increase cooperation between stakeholders when mobility related decisions have to be taken.
- It allows data reuse thanks to standardization: stakeholders can reuse information provided by the future Transport Cloud instead of entering it all the time and easily process data since it is converted into common formats, enabling collaborative research, large-scale analytics, and sharing of sophisticated tools and methodologies. Moreover, standardization enables easy data exchange between different countries and companies.
- It enables trust in data sharing because it is in line with security and privacy legislations: the future Transport Cloud will be designed and continuously updated in order to be compliant with global security and privacy regulations. The heterogeneous regulatory environment across jurisdictions to which the future Transport Cloud stakeholders will be located further requires different approaches: customized privacy approaches will be deserved for the different types of data and data-sharing models will account for differences between different geographies. The overarching rule will be transparent in the way data will be stored and shared. Security, specifically cyber security, will be monitored with recurrent controls to the integrity of the systems.
- The data sharing framework of the future Transport Cloud is inclusive, ethical, and unbiased by design: data sharing models and protocols are going to be transparent and aligned with community expectations about right and proper use as it includes a dataset auditing mechanism. This will ensure the verification of the impartiality of data provided and the extent to which the information shared is able to lead to inclusive analysis and services.
- The future Transport Cloud will facilitate the stakeholders' understanding of the perceived competitive advantage of owning data with the value that could be unlocked through its sharing and aggregation. Cost

savings in the long term will be obtained by the future Transport Cloud stakeholders, due to the fact that the enhanced data sharing in a multi-actor framework will allow for increased customers satisfaction, improved urban mobility performance, operational excellence and new business opportunities.

5.1.2. Weaknesses

Factors of the future Transport Cloud that may impede its performance at the optimum level are:

- Difficulty in classifying unstructured information from several sources: one of the main added value of the future Transport Cloud will be the ability of data processing with data coming from several heterogeneous sources. The current lack of standards makes the building of the data structures and models complicated, due to the fact that every stakeholder designs its own procedures and structures that are hard to be related to the ones of other players.
- A significant resource investment may be needed to develop the future Transport Cloud federation services and tools. There is a lack of suitable devices that makes it hard to store and process a large amount of incoming data and provide proper real-time information. The collection of large and complex datasets for which special tools are needed. Also, advanced data-processing techniques are required in order to effectively analyse and use the information; special technologies or methods, such as algorithms and models to handle high data volumes are needed.
- Complex implementation and deployment due to the multitude of organizations that shall be involved in data sharing: the setup of the data sharing framework of the future Transport Cloud is intrinsically complex, involving both data science skills and knowledge about the transport and mobility market and operations. One of the key points is that collected and stored data should be integrated together and a mix with new data sources and historical data is highly needed to draft typical analytics and reports; to do it, data should be normalized and standardized before combining different versions of similar datasets.
- Complex governance and difficult maintenance of the overall system: governing the functioning of a federation of data platforms such as the future Transport Cloud implies a complex structure made of different members (the data providers) and different data types. At the same time complexity relies in the maintenance of the overall system, including both technical and business-related aspects.
- Hard to obtain standardization acceptance by data providers: standardization involves by-definition more actors; in most cases, it is particularly difficult to obtain the consensus of standard and later usage of standard between different stakeholders.

5.1.2.1. Weaknesses mitigation strategy

Some suggested strategies to address weaknesses are shown in table 15:

Table 15 Weaknesses mitigation strategies

Funded by the European Union

Weaknesses	Mitigation strategy
Unstructured information from several sources	It is recommended to design an overall data model to help to identify classes, structures, and connections between data sources and involving in this process the MobiDataLab stakeholders that will test the prototype in order to come to shared definitions about the potential standards to be adopted in the future Transport Cloud.
Significant initial resource investment	A precise estimation of needed investment in technologies and human resources to implement the future Transport Cloud can be hard to do since a precise quantification is not available yet. The MobiDataLab project will make a significant effort in determining the cost and revenue structure in task T3.4 business models. The prototype developed in the project is the first step for the future development of the future Transport Cloud and it is funded with EU funds.
Complex implementation and deployment	Before implementing the systems, it is recommended to define a detailed assessment of available data sources owned by each actor. An inventory of datasets can be highly useful in mapping relationships between actors and for identifying priorities.
Complex governance and difficult maintenance	In parallel with the technical development of the future Transport Cloud, it is recommended to define its governance model, the expected operational model and the related roles to be established. Before the actual uptake of the future Transport Cloud, responsibilities among the managing partners have to be clarified. The MobiDataLab project provides a good opportunity to test a prototype in a controlled environment, thus allowing to highlight good and bad practices.
Stakeholders' acceptance of standardization difficulties	The acceptance and implementation of standards by many parties may be a long-time process, so it is recommended to carefully plan the steps to be taken and the implementation times, involving all actors from the beginning. For instance, by establishing as an entrance requirement to the federation the acceptance of at least a minimum level of standardization and the achievement of a higher level of standardization after a certain time frame.

5.1.3. Opportunities

5.1.3.1. Market opportunities enabled by digitalization and data sharing (in the context of each UC)

Factors of the future Transport Cloud that may give a competitive advantage in the context of MobiDataLab UCs are represented in table 16:

Table 16 Market opportunities in the context of UCs

Funded by the European Union

UC	Market opportunity
UC1	The dataset aggregation of the future Transport Cloud allows for a more accurate ETA calculation, providing the opportunities: • For transport managers to have a better monitoring of real time traffic and a more reactive response in case of disruptions • For transport service providers to have an improved planning of timetables, allowing for real time adjustments • For workers of the transport sector (e.g. drivers), to have more favourable working conditions • For users of transport to have an improved transport service. UC1 is also related to the enhanced availability of data for free for research purposes: this allows for the opportunity to explore innovative approaches to combine different data sources and different dataset, to aggregate different data formats and to obtain more accurate and realistic ETAs. This is an opportunity both for researchers and for innovators.
UC2	Understanding emission related data is needed for a more sustainable planning of transports, both for people and freight. Beside the environmental impact that the increased awareness will raise, this UC may lead to business opportunities for stakeholders involved: • Transport and mobility service providers can develop “micro-services” that can be added to the main service they offer • Business stakeholders of the mobility sector can establish partnerships with public authorities • This UC may lead to cross-sectorial collaboration, for instance between transport and energy or transport and health.
UC3	The research community, developers and innovators may benefit from the possibility of using large and meaningful dataset for analytics and learning purposes: • If large sample of dataset is available for free in compliance with company requirements, digital service providers can integrate different and new functionalities into their tools. • Data providers may have the opportunity to advertise the availability of datasets to attract new users, providing the chance to use such data for free for a certain time frame and then allow choosing to continue with a fee-based system. • Data providers can get standardization and anonymization support services needed to join the future Transport Cloud thus increasing the number of possible users of the dataset. • Having the possibility to test analytics and learning techniques on multiple datasets, innovators may have the opportunity to develop new services and new ideas based on data fusion approaches.
UC4	• Re-use of mobility data by opening a window for “on-demand” services offered by the future Transport Cloud experts, allowing for alternative business models. This can be the starting point for a marketplace of demand/supply services, facilitated by the future Transport Cloud. • Data re-use facilitated by the future Transport Cloud may be addressed to several sectors, allowing for cross industry collaboration and for new business opportunities leading to local economic growth.
UC5	The future Transport Cloud will be structured around a solid governance model that ensures that datasets are compliant to laws and that ensures high levels of quality. • Companies willing to join the future Transport Cloud federation as data providers will have the opportunity to get guidance and support in enhancing their datasets in order to comply with entrance requirement, leading to a better service offering to their customers. • Data users will have the opportunity to use high quality data, due to the data validation and grading tools that the future Transport Cloud incorporates

Funded by the European Union

UC6	The future Transport Cloud may include transport information linked to the inclusiveness of the transport services and the transport services may be rated according to their usability, accessibility and inclusiveness. • This allows the opportunity for transport providers to know the perceived inclusiveness of their services thus leading to improvements of their offering and create business value. • Users will be endorsed with a more complete information on transport accessibility, allowing for a wider uptake of public transport and consequent social and environmental benefits at the urban level.
UC7	The collaboration between transport authorities and local authorities allows combining environmental data with transport data. • Collaboration opportunities will arise between sensors manufacturers, public authorities, transport companies and service providers, with the potentiality to engage innovators to develop new services and ideas. • A competitive advantage for public transport authorities will be possible because they will be provided with environmental data, needed for the planning of a suitable transport system.
UC8	The future Transport Cloud will allow the combination of datasets coming from different domains: • Transport services providers will offer a mobility information system addressed to a wide audience of actors with different interests (e.g. cultural information, weather information, recreational information, etc.) thus enlarging the range of users of the offered services. • The combination of data from different sectors allows for the opportunity to establish partnerships between local businesses to develop joint services and have economies of scale.

5.1.3.1. Wider business opportunities

Besides the opportunities linked to the project Use Cases, other external factors of the future Transport Cloud that give a competitive advantage are:

- The future Transport Cloud will be open environment for all those that wish to provide and use transport related data. However, the tool will aim at having a more holistic scope and to allow for synergies and collaborations with other sectors' data sharing initiatives to promote concepts such as sustainability, active mobility, sustainable use of resources, etc.
- The future Transport Cloud can be a showcase opportunity for SMEs and start-up initiatives willing to collaborate in the data sharing environment, to promote their innovative ideas and collaborate with potential clients, being the place where demand and supply of data will be met. Moreover, some types of "on demand" services may be requested by users of the Transport Cloud.
- The increased availability of dataset due to the future Transport Cloud will facilitate the generation of new business ideas for innovators and for innovative research approaches.
- A better organization of the operations connected to transport and mobility will be possible, facilitating the resolution of real-life problems based on the available data sets and the stakeholders collaboration within the transport sector and beyond: the future Transport Cloud will improve several transport issues allowing for a better planning of operations, processes and use of resources

Funded by the European Union

5.1.4. Threats

External factors of the future Transport Cloud that may harm its uptake are:

- Risk of data misuse or misinterpretation: the lack of adequate training and knowledge can lead to misuse and misinterpretation of data. The future Transport Cloud can be a valuable tool for enhanced data sharing between different actors, but it requires a clear definition of rules of conduct for data re-use and for an ethical approach to data analysis for potential users.
- Shortage of technical expertise to work for the future Transport Cloud: when providing results of specific data analytics or when maintaining such a complex technical structure, this may require for the future Transport Cloud a high technical knowledge in analytics, statistics, and software modelling, as well as expertise in computer sciences, mathematics, and data sciences.
- Trust issues and cyber security risks, represent the major threats when dealing with data and it provides serious consequences for the trusted environment that the future Transport Cloud shall ensure and that is essential for data sharing: without confidence in the source and use policies, data sharing will be constricted and the integrity of the system will be impacted.
- Privacy issues and sharing issues are often linked to the re-usage of personal data: when these issues arise, it may harm stakeholders' support and create the concerns for the dissemination of sensitive, personal information to parties beyond those who have given consent. Not only this undermines privacy rights, but also heightens the risk of unintended disclosure through data breaches or mishandling.
- Uncertainty or unwillingness of data sharing could be linked to responsibility issues related to data integrity: for instance, it may be unclear the definition of faults in case of data breach or in case something goes wrong. Without a clear mechanism to deal with such risk, data providers may be reluctant to get engaged to the perceived risk of incurring in business and legal problems with other stakeholders.

5.1.4.1. Threats mitigation approaches

Some suggested strategies to address potential threats are explained in table 17.

Table 17 Threats mitigation strategies

Threats	Mitigation strategy
Risk of data misuse or misinterpretation	To avoid the incorrect usage of data provided by the future Transport Cloud, it is recommended to define a clear Code of Conduct that data users must accept to have access to data. Data users shall accept to incur in possible future verifications of data usage after they get the data. In this way, the governance body of the future Transport Cloud may establish periodic verification loops on a sample of data users.
Shortage of technical expertise	The future Transport Cloud shall provide technicians with a specific training to understand all the technical functionalities, models and processes. The training material shall be explanatory in a simple way, so that it can be clear also for entry-level or lower skilled technicians (in that case, they shall be supported by an expert). For specific on demand analytics of special study that the future Transport Cloud will offer, a marketplace approach can be used to engage researchers and skilled innovators in advertising their studies.

Funded by the European Union

Trust issues and cyber security risks	The future Transport Cloud shall be built with a “cybersecurity by design” approach meaning that its architecture embeds security as part of the data lifecycle so that the integrity of data is periodically verified. The system governance shall put special emphasis on security management by establishing appointed managers that take care of these risks.
Privacy issues and sharing issues	Similarly, to the above mentioned strategy to avoid cyber security risks, the future Transport Cloud shall accommodate “privacy by design” into data repositories, access mechanisms and sharing protocols. Data anonymization services could be established and enforced with data sharing approaches such as: simplified and transparent models of consent-based data sharing, provision of “view-and-redact” access to raw and processed data, provision of secure enclaves for providing data services without access to underlying data, etc.
Responsibility issues related to data integrity	The affiliation to the future Transport Cloud shall be subject to the acceptance of rules of conduct and statutes that – amongst others – clarify the internal stakeholders’ relations. Moreover, regulatory structures, standardized data specifications and common reporting requirements may alleviate concerns about responsibility issues for some parties over others.

Funded by the European Union

6. Conclusions

The goal of the study presented in this document is to highlight the main gaps between demand and supply of data services in the context of the project use cases and to define a common understanding of the related improvement areas. Based on these, the study provides a vision of a future Transport Cloud that may be developed beyond the project, based on the MobiDataLab prototype. The vision includes a proposition of new products and services that may satisfy users' needs and create added value; a SWOT analysis defines the business uptake potentialities, risks and mitigation strategies linked to the future Transport Cloud.

The gap analysis provides an assessment of the eight MobiDataLab use cases and defines where inefficiencies occur and if there is a lack or ineffectiveness of digitalization and data sharing practices. General gaps identified in the analysis are related to heterogeneity of data sources leading to difficult data aggregation and comparability; mobility data availability and accessibility; lack of standardization models and data anonymization tools; low understanding of the business value that data sharing would favour. The gap analysis, together with analysis performed in other project activities, has contributed to a better understanding of the vision for the future Transport Cloud that the MobiDataLab project is expected to facilitate.

The study clarifies that the main stakeholders' categories for the future Transport Cloud will be mainly: data consumers, data providers, service providers, innovators, and researchers. The needs of stakeholders justify the reason why a future Transport Cloud shall be developed: interoperability, reliability, quality, governance, security, privacy, monetization, and accessibility. According to this, the future Transport Cloud shall identify new variables, requirements, and standards necessary for a successful setting up data usage and sharing mechanisms in the transport sector. At the same time, it is recommended to develop a lean structure, both in terms of infrastructure and for governance models.

The future Transport Cloud shall be designed to include innovation elements that will facilitate the creation of a marketplace where the matching between the demand and supply of data will be possible. The main innovation element that the future Transport Cloud will bring is the ability to aggregate, combine, consolidate, and access data coming from different platforms and sensors, allowing the identification of the entities providing data, with which level of coverage and aggregation they have. Other innovations that may be introduced could address the validation of datasets and guidance for datasets producers on how to improve them. Being conceived as a federation, a governance body of the future Transport Cloud federation shall be established to define and enforce the strategies for identification and access to data, as well as ensuring that services are compliant with the existing regulatory environment. As such, the main value added of the future Transport Cloud will be facilitating business collaboration between stakeholders, by creating a framework where public and private actors, small and big players, can network and take advantage of the collaborative environment and the opportunities that a federation would allow.

Funded by the European Union

The SWOT analysis concludes that the main strengths and opportunities are related to the favourable and collaborative environment that is provides for data sharing, leading to higher trust in data sharing and better operational efficiency in data usage. The identified weaknesses and threats are mainly related to current technical data management complexities, stakeholders' acceptance and related commitment to accept the rules of conduct.

Also, the resources are seen as a relevant factor to be considered, both in terms of economic investments and in terms of human capital to be trained. To deal with possible weaknesses and threats, it is recommended to create a strong governance model for the future Transport Cloud, that foresees technical, operational and management procedures. Moreover, it is recommended to develop a clear financing and revenue model in parallel to the technical implementation of the future Transport Cloud system.

Funded by the European Union

MobiDataLab consortium

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

@MobiDataLab
#MobiDataLab

https://www.linkedin.com/company/mobidatalab

For further information please visit **www.mobidatalab.eu**

MobiDataLab is co-funded by the EU under the H2020 Research and Innovation Programme (grant agreement No 101006879).