Ref. Ares(2025)6572330 - 12/08/2025

DATA SPACE 4 MOBILITY MODELS INTEGRATION

Project Acronym:	**23-ES-TG-DS4MOBMODELS**
Project ID :	**101176007**

Deliverable number:	**D2.2**
Deliverable name:	**DATA SPACE GOVERNANCE**
Work Package number:	**2. IDENTIFICATION, DEFINITION AND VALIDATION OF MOBILITY AND LOGISTICS USE CASES**
Due date :	**30/08/2024**
Delivery date :	**12/08/2025**

Lead Beneficiary :	**NTT DATA**
Main author :	Javier Tarriño / Araceli Balsalobre

Co-funded by the European Union

DS4MOB MODELS

Document Information

The DS4MOBMODELS project (Grant Agreement nº: 101176007) project is co-funded by the EU. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the EU or the CINEA. Neither the EU nor the CINEA can be held responsible for them.

Revision History

Version	Date	Lead Beneficiary
V 1.0	01/08/2025	NTT

Glossary of Acronyms and Abbreviations

API	Application Programming Interface
ATMV	Metropolitan Transport Authority of Valencia
CCDRC	Central Commission for Regional Coordination and Development
CRTM	Regional Transport Consortium of Madrid
DGT	General Directorate of Traffic
DS4MOBMODELS	Data Space for Mobility Models Integration
EDIM	Integrated Mobility Data Space
EGTC	European Grouping of Territorial Cooperation
EMT	Municipal Transport Company of Madrid
FCD	Floating Car Data
FPD	Floating Phone Data
ICT	Information and Communication Technologies
ITS	Intelligent Transport Systems
KPI	Key Performance Indicator
LEZ	Low Emission Zone
MaaS	Mobility as a Service
MITMS	Ministry of Transport and Sustainable Mobility
NAP	National Access Point
RSD	Remote Sensing Device
SCT	Catalan Traffic Service
SEITT	State Company for Land Transport Infrastructures
SUMI	Sustainable Urban Mobility Indicators
TEN-T	Trans-European Transport Network
TMB	Metropolitan Transport of Barcelona
VMP	Personal Mobility Vehicle

Table of Content

Executive Summary 5
Context 6
Objectives of the deliverable 7
Identification and Selection of Stakeholders 8
Activity Planning 10
Participation Methodology 11
Participation Results 12
Key Performance Indicators (KPIs) 31
Integration of Results into Project Implementation 33
Governance Frameworks 34
Configuration of the data space 38
DS4MOBMODELS Roles 43
DS4MOBMODELS Rulebook 46
Data Governance 49
Conclusions 51
Annex I. Description of Pilots 52
Annex II. Stakeholders involved in each pilot 58
Annex III. DS4MOBMODELS Data Governance 59
Annex IV. References 60

Executive Summary

The involvement of stakeholders plays a key role in the development of the data space. The selection of project stakeholders aims to achieve a comprehensive approach to national mobility, providing essential information for the data space.

Establishing a timeline is essential to engage the maximum number of stakeholders. The usual operational approach within public administrations is based on individual interests, making interviews a first step toward shifting the working approach. Among other aspects, current challenges in data sharing should begin to be addressed during this phase.

This document presents two main lines of work. First, it provides a summary of the key outcomes from each of the individual interviews conducted with stakeholders. The interviews were structured to identify the needs expressed by the respondents regarding mobility issues that the data space could help solve. Additionally, efforts were made to collect as much information as possible about available or required data, tools, and/or models.

Second, it outlines the governance rules for the data space based on the key actors identified and defines the mechanism to ensure effective governance within the data space.

The governance model for the DS4MOBMODELS is planned to be articulated around three conceptual axes: ordering and management of the data space, governance of interoperability, and data governance, inspired by recommendations and best practices from established frameworks like DSSC, EIF, UNE norms, DAMA, and FAIR principles. The fundamental purpose of governance is to ensure alignment with the data space objectives, manage participant relationships, build and maintain trust, and ensure regulatory compliance.

The ordering and management aspect, overseen by the Data Space Governance Authority, involves establishing the formal structure, defining strategic objectives, and creating a foundational governance framework or "rulebook" that outlines general rules, policies, and participant roles and responsibilities.

The governance of interoperability focuses on enabling seamless data exchange within and between data spaces, emphasising automation, security, and privacy. Key components include establishing a data space protocol (DSP) for coordinating data sharing and usage policies, implementing transfer and control planes via technical connectors to ensure data moves securely and according to agreed rules, and performing data validation to assure quality and integrity.

Finally, data governance ensures that the data owner retains maximum sovereignty over their data, primarily through the use of contracts that define usage policies, terms, and conditions, allowing for negotiation and automated enforcement. This axis also encompasses rigorous data quality management, which involves defining characteristics, setting minimum acceptable levels, and implementing metrics and monitoring.

Context

DS4MOBMODELS aims to define and deploy a Mobility Data Space that integrates public and private data sources related to transportation and mobility in Spain, cross-border regions with France and Portugal, and selected metropolitan areas.

The project is structured around a series of pilots that validate specific use cases in real environments. These pilots—national, regional, metropolitan and cross-border—serve as operational frameworks for stakeholder involvement.

Each pilot addresses particular challenges of data interoperability, integration of mobility services, and the optimisation of predictive models, contributing to the development of a federated, secure and standards-based data space.

The pilots are organised as follows:

- **National Pilot (Spain):**
  Integration of traffic, public transport and shared mobility service data at national level, aimed at facilitating multimodal planning and the development of sustainable mobility indicators.
- **Regional pilots in Andalusia, Catalonia and Valencian Community:**
  Implementation of regional data spaces integrating public transport data, Mobility-as-a-Service (MaaS) services and traffic management systems into an interoperable platform.
- **Local pilots in the metropolitan area of Madrid, Barcelona and Valencia:**
  Consolidation of urban data covering public transport, traffic, low-emission zones (LEZs) and micromobility to improve urban planning and enhance information services for end users.
- **Cross-border pilots in Portugal-Spain and France-Spain:**
  Creation of a federated data space to facilitate cross-border mobility data interoperability, optimise logistic corridors, and promote intelligent transport services in the southwest European region.



Figure 1. Geographic location of the DS4MOBMODELS pilots.

A detailed description of each pilot—including specific objectives, types of data, key stakeholders and validation mechanisms—is provided in **Annex I** of this document.

Objectives of the deliverable

Deliverable 2.2. pursues the following main objectives:

1. **To understand the needs identified by stakeholders in relation to transport and mobility, as well as the data and tools currently available to them, based on the outcomes of the individual interviews.**

   Using a systematic questionnaire, the specific challenges faced by each stakeholder, the available datasets, and the modelling tools in use are identified. Additionally, the analysis is structured around 22 use cases, each characterised by thematic area and typology.

2. **Establish active working groups with participants to explore synergies and shared interests.**

   The results of the interviews will reveal common goals and areas of interest among various stakeholders. The planned workshop aims to define the criteria for selecting and specifying the use cases to be developed within each pilot.

3. **Present governance frameworks and potential data space configurations.**

   Ensuring alignment between the foundational principles and the objectives of the data space. The project must be structured from both operational and economic perspectives.

4. **Define the governance frameworks and potential data space configuration.**

   Outlining the rights and responsibilities of the stakeholders involved in the project.

5. **Propose mechanisms for the rulebook and data governance.**

   Establishing the necessary criteria to ensure the proper functioning of the data space.

Identification and Selection of Stakeholders

The stakeholder engagement process for the DS4MOBMODELS project is a critical component of Work Package 2, designed to create a comprehensive mobility data ecosystem through strategic stakeholder identification and integration.

The methodology for stakeholder identification leverages a systematic approach to mapping the mobility data landscape. By analyzing the interdependencies between key mobility actors, we have developed a robust framework for identifying and selecting stakeholders that can provide critical insights and capabilities to the Data Space.

The selection methodology is built on five fundamental principles:

1. **Sectoral Representativeness**: We have carefully curated a diverse ecosystem of actors covering all critical sectors related to mobility, transportation, and data management. This approach ensures a comprehensive view of the mobility landscape, capturing insights from urban transportation, logistics, technological innovation, and user experience.

2. **Geographical Diversity**: The stakeholder network spans national, regional, local, and cross-border levels, directly aligned with the project's pilot structure. This multi-level approach enables a nuanced understanding of mobility challenges and opportunities across different geographical contexts.

3. **Modal Diversity**: Priority has been given to organizations representing various transport modes, ensuring a holistic approach to mobility data integration. This strategy allows for comprehensive insights into different transportation ecosystems.

4. **Data Innovation Potential**: We have prioritized stakeholders with proven involvement in open data, interoperability, and data space initiatives. This criterion ensures that selected participants are at the forefront of technological and methodological innovation.

5. **Value Generation Capacity**: Stakeholders were selected based on their ability to actively contribute to the Data Space through data provision, advanced models, validation processes, and strategic recommendations.

By fostering collaboration across, DS4MOBMODELS aims to create a transformative platform that redefines mobility data integration. The network of organizations is strategically positioned to contribute to the development, validation, and future exploitation of the mobility Data Space.

This approach ensures not just data collection, but the creation of a dynamic, interactive ecosystem that can drive innovation, improve transportation efficiency, and ultimately enhance mobility experiences across different regions and transportation modes.

The full set of actors is listed below. Their proposed relationship with each of the pilots can be found in **Annex II**.

Table 1. Active stakeholders and main function.

Stakeholder	Main Function
DGT - General Directorate of Traffic	Traffic management and road safety
SEITT - The State Company for Land Transport Infrastructures	Design and promotion of transport infrastructures
Basque Government	Mobility and logistics policies in Basque Country
SCT - Catalan Traffic Service	Road safety policies in Catalonia
Ministry of Transport and Sustainable Mobility	National transport and infrastructure policy
ATMB - The Metropolitan Transport Authority of the Barcelona Area	Metropolitan transport coordination in Barcelona
ATMV - The Metropolitan Transport Authority of Valencia	Metropolitan transport management in Valencia
JUNTA DE ANDALUCIA - The Ministry of Public Works and Housing	Mobility management in Andalusia
JUNTA DE EXTREMADURA - Ministry of Infrastructure, Transport and Housing	Mobility and transport direction in Extremadura
Valencia City Council	Urban mobility management in Valencia
CRTM - The Regional Transport Consortium of Madrid	Transport coordination in Madrid region
CCDRC - The Central Commission for Regional Coordination and Development	Urban development and regional coordination of the Centro Region in Portugal
The EGTC Euroregion Nouvelle Aquitaine	Cross-border economic and social development in the Nouevelle Aquitaine Region
Navarra Government	Mobility and logistics policies in Navarra

Activity Planning

The implementation of the Stakeholder Engagement Plan spans a six-month period. The timeline is structured into distinct, dynamically sequenced phases that are adaptable to stakeholders' availability, while ensuring the logical progression of activities and the effective integration of outcomes.

Activity Calendar

- **1st April 2025 – Approval of the Participation Plan:**

  This document will be approved and validated as the official basis for the deployment of stakeholder engagement activities.

- **Phase 1: 1st April – 1st May 2025 – Update of Stakeholder Contact:**

  Contact will be updated with the previously identified stakeholders, providing them with updated information about the project, confirming their interest in participating, and defining their potential role in the process.

- **Phase 2: 1st May – 30th July 2025 – Conducting Individual Interviews:**

  Structured interviews will be held with key stakeholders to collect detailed information on their capacities, needs, expectations, and potential contributions.

- **Phase 3: September 2025 – Direct or online group meetings:**

  Group sessions will be organised, structured either by entity type or by pilot geography, to collectively contrast requirements, validate service priorities, and identify collaboration opportunities according to the outcomes obtained from the previous phase. The final aim is to define the use case/s for each pilot.

- **Phase 4: 15th October 2025 – Analysis of Results and Participation Report:**

  The contributions collected will be systematised, analysed and synthesised for integration into the final definition of pilots and the design of the Data Space platform. Integrated results will be validated, collaboration commitments will be consolidated, and use cases and technical requirements will be adjusted if necessary

Participation Methodology

The participation process follows a progressive sequence where each activity feeds into the next:



Figure 2. Participation methodology.

This planning ensures a structured collection of contributions, their effective integration into the technical and operational development of the project, and the consolidation of an engaged and active stakeholder ecosystem.

Stakeholder participation in DS4MOBMODELS is structured through a methodology specifically adapted to the characteristics of the project. Following the update of stakeholder contact (**Phase 1**) — which serves to consolidate the relationship between key actors and the project — their active involvement must be aligned with the specific needs of the project's implementation phase.

Phase 2 (conducting individual interviews) required the completion of two preparatory tasks. First, a predefined set of use cases, categorized by thematic areas, was developed to guide stakeholders in identifying potential contributions within the framework of the project. Second, a standardized interview was designed to ensure consistent data collection across all participants, including information specifically related to the predefined use cases.

Each session will have an estimated duration of two hours. The objective is to validate or adjust a set of use cases to more accurately reflect real operational needs, priorities, and conditions; to identify additional functional and operational requirements; to establish the necessary data sources; to define key performance indicators (KPIs); and to identify potential technical, operational, legal, or social acceptance barriers to the Data Space, along with the proposal of concrete mitigation measures. The interview may be conducted in multiple sessions and different days, in coordination with the stakeholders, allowing both parties to work in parallel based on the outcomes of the preceding meeting.

The outcomes obtained from the individual interviews will be the basis for the **Phase 3** activity. In this stage, a joint workshop will be conducted with all involved stakeholders, during which several working groups will be established based on shared thematic areas and relevant use cases. This phase will facilitate the collection of relevant information to refine and enhance the pilot's use cases, the platform's functional requirements, and the project's key performance indicators (KPIs).

The final phase of the participation methodology focuses on identifying synergies between stakeholders' objectives and the available information. In this way, the **Phase 4** task will enable the definition of pilots, the adjustment of technical requirements, and the functional design of the Data Space platform.

Participation Results

Phase 1: Updating Contact and Sending Contextualised Information

The initial phase of stakeholder engagement for the DS4MOBMODELS project focuses on reestablishing and strengthening communication channels with key mobility ecosystem actors. The approach involves a comprehensive strategy to update project context, reconfirm participation, and prepare for in-depth interviews.

A total of 14 relevant organizations had been identified at national, regional, and local levels, representing the diverse mobility landscape in Spain. These stakeholders range from traffic management authorities to metropolitan transport consortiums, each bringing unique perspectives and expertise to the project.

The communication process will involve personalized outreach, providing each stakeholder with a detailed project summary that highlights the objectives of creating an integrated mobility data ecosystem. The goal is not just to inform, but to actively engage these organizations as collaborative partners in developing innovative data-driven mobility solutions.

Interviews are designed to be a collaborative dialogue, exploring the potential of our mobility data space and understanding the specific needs and capabilities of each stakeholder. Meetings have been both virtual and in-person.

The schedule conducted for stakeholder participation in Phase 2 is presented below.

Table 2. Participation schedule.

Stakeholders Interview Date	May				June				July			
	5-11	12-18	19-25	26-1	2-8	9-15	16-22	23-29	30-6	7-13	14-20	21-27
DGT					X			X				
SEITT						X						
BASQUE GOV.					X							
SCT							X					
MITMS												
ATMB							X					
ATMV								X				
J.ANDALUCIA		X						X		X		
J. EXTREMADURA					X			X				
VALENCIA C.C.								X				
CRTM			X									
CCDRC												
EGCT				X								
NAVARRA GOV.					X				X			X

Phase 2: Conducting individual interviews

Predefined use cases

The DS4MOBMODELS project predefines 22 use cases across four key thematic areas**: Public Transport** (6 use cases), **Freight Transport** (4 use cases), **Traffic** (5 use cases), and **Sustainability** (7 use cases). Likewise, these use cases are classified by typology into planning and operation categories.

Planning is the strategic process through which policies, infrastructures or services, and measures are analyzed, designed, and formulated to meet the current and future mobility needs of a population or territory. It is characterized by a long-term, strategic focus. The use of data is usually associated with predictive analysis and transport modelling.

Operation refers to the real-time management and control of transport services, traffic, infrastructures, or systems, with the objective of ensuring their efficient, safe, and reliable functioning. It is characterized by a short-term, tactical focus. The data available requires a continuous monitoring, control, and dynamic adjustment.

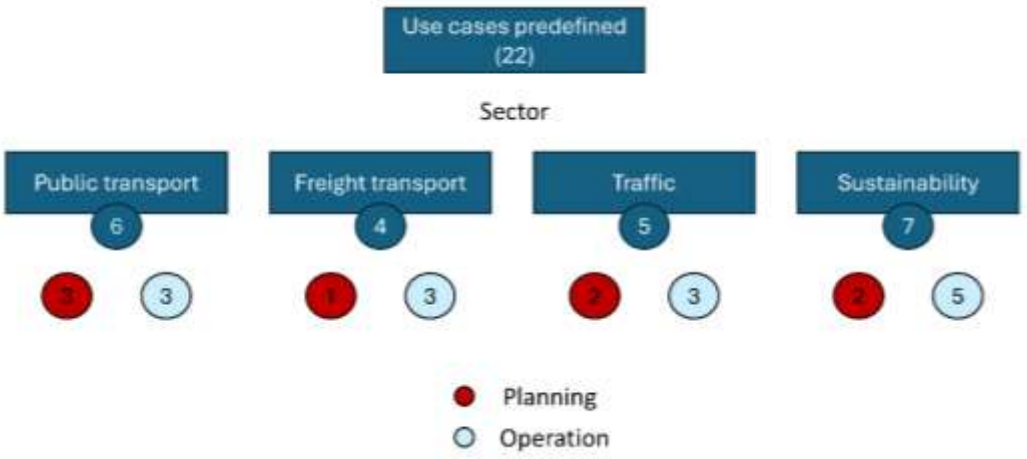


Figure 3. Characteristics of predefined use cases.

This comprehensive framework provides a flexible, multi-dimensional approach to mobility data integration, supporting strategic analysis across different transport modes, operational contexts, and study areas. The predefined use cases classified by thematic area and typology are listed below:

Table 3. Description of predefined use cases.

SECTOR	Use Case		Tipology
Public transport 	1	Optimization of bus routes and frequencies	Planning
	2	Bus fleet route analysis and optimization	Operation
	3	Intermodal node demand analysis	Planning
	4	Real-time public transport user information:	Operation
	5	Cross-border passenger transit analysis	Operation
	6	Urban transport eak demand analysis	Planning
Freight transport 	7	Port-based freight flow analysis	Operation
	8	Airport-origin freight flow analysis	Operation
	9	Logistics platform location in corridors	Planning
	10	Cross-border freight transit nalysis	Operation
Traffic 	11	Main road segment capacity analysis	Planning
	12	Predictive bottleneck resolution	Operation
	13	Highway and main road congestion monitoring	Operation
	14	Special operations congestion prediction	Planning
	15	Real-time network traffic mapping	Operation
Sustainability 	16	Transport emissions evaluation	Planning
	17	Informed shared mobility	Operation
	18	Freight emissions analysis	Planning
	19	Electric vehicle charging infrastructure	Operation
	20	Urban mobility tracking by mode and distance	Operation
	21	Low Emission Zone monitoring	Operation
	22	Active mobility monitoring	Operation

The description of each use case and the objectives defined for its development are as follows:

Public Transport:

1. *Optimization of bus routes and frequencies*: Analysis and improvement of bus routes to optimize public transport efficiency, adjusting frequencies according to passenger flows in national, regional, and urban networks.
   ➡ Reduce waiting times, improve coverage, optimize resources.
2. *Bus fleet route analysis and optimization*: Analysis of bus routes to optimize fleet management, identifying efficiency opportunities in national, regional, and urban transportation networks.
   ➡ Improve fleet utilization, reduce operational costs, enhance service quality.
3. *Intermodal node demand analysis*: Analyze passenger demand at interconnection points between train, tram, and bus services to optimize transportation network efficiency and user experience across national, regional, and urban environments.
   ➡ Improve intermodal connectivity, streamline passenger flow, enhance transfer experiences.
4. *Real-time public transport user information*: Provide instant, accurate travel information for passengers across multiple transport modes (airplane, train, tram, bus) at national, regional, and urban levels.

➡ Enhance user experience, improve transportation accessibility, reduce uncertainty in travel planning.

5. *Cross-border passenger transit analysis*: Analyze passenger movements and transit patterns across borders using bus, car, and motorcycle transportation.
   ➡ Optimize cross-border mobility, understand transit dynamics, improve transportation flow between regions.
6. *Urban transport peak demand analysis*: Analyze passenger demand peaks in urban transportation systems, focusing on train, tram, and bus services across regional, metropolitan, and urban environments.
   ➡ Optimize service frequency, manage passenger flow, improve urban mobility efficiency during high-demand periods.

Freight Transport:

1. *Port-based freight flow analysis*: Analyze freight transportation flows originating from ports, focusing on train and truck logistics at the national level.
   ➡ Optimize port-based freight movement, improve transportation efficiency, enhance national logistics infrastructure.
2. *Airport-origin freight flow analysis*: Analyze goods transportation flows originating from airports, focusing on air and truck logistics at the national level.
   ➡ Optimize airport-based freight movement, enhance air-ground transportation efficiency, improve national logistics networks.
3. *Logistics platform location in corridors*: Identify optimal locations for logistics platforms along transportation corridors, focusing on train and truck logistics at the national level.
   ➡ Optimize freight infrastructure placement, improve logistics network efficiency, enhance transportation corridor connectivity.
4. *Cross-border freight transit analysis*: Analyze goods transportation movements across borders, focusing on train and truck logistics in cross-border regions.
   ➡ Optimize cross-border freight flows, improve international logistics efficiency, reduce transit barriers.

Traffic:

1. *Main road segment capacity analysis*: Comprehensive analysis of traffic capacity and flow dynamics on primary road segments, examining interactions between cars, buses, trucks, and motorcycles at the national infrastructure level.
   ➡ Optimize road infrastructure utilization, identify potential congestion points, improve traffic management strategies.
2. *Predictive bottleneck resolution*: Identify and address traffic bottlenecks using predictive information for cars, trucks, and motorcycles at the national level.
   ➡ Anticipate and mitigate traffic congestion, optimize road network performance, improve travel efficiency.

3. *Highway and main road congestion monitoring*: Monitor traffic congestion on highways and primary roads for cars, buses, trucks, and motorcycles at the national level.
   ➡ Real-time traffic analysis, identify congestion patterns, support dynamic traffic management strategies.
4. *Special operations congestion prediction*: Predict traffic congestion during special events or operations for cars and trucks at the regional level.
   ➡ Anticipate traffic impacts, develop proactive management strategies, minimize disruption during special circumstances.
5. *Real-time network traffic mapping*: Create a dynamic, real-time traffic map of the regional transportation network.
   ➡ Provide instant traffic visualization, support dynamic routing, enhance transportation decision-making and user information.

Sustainability:

1. *Transport emissions evaluation*: Assess emissions generated by cars, buses, trucks, and motorcycles at the national level
   ➡ Quantify transportation-related environmental impact, support sustainable mobility strategies, inform policy-making for emissions reduction.
2. *Informed shared mobility*: Analyze and optimize car-sharing practices and mobility patterns at the national level.
   ➡ Promote sustainable transportation, reduce individual vehicle usage, enhance urban mobility efficiency.
3. *Freight emissions analysis*: Evaluate emissions generated by air, train, and truck transportation, with specific focus on truck logistics at the national level.
   ➡ Quantify freight transportation environmental impact, support sustainable logistics strategies, inform emission reduction policies.
4. *Electric vehicle charging infrastructure*: Analyze and optimize electric vehicle charging network for cars at national level.
   ➡ Support electric vehicle adoption, improve charging infrastructure and accelerate sustainable transportation transition
5. *Urban mobility tracking by mode and distance*: Monitor urban mobility patterns for tram, bus, car, motorcycle, bicycle, and pedestrian transportation in metropolitan and urban areas.
   ➡ Analyze urban transportation diversity, understand mobility behaviors, support sustainable urban planning strategies.
6. *Low Emission Zone monitoring*: Track and analyze transportation in Low Emission Zones, including tram, bus, car, motorcycle, bicycle, pedestrian, and truck movements in metropolitan and urban areas.
   ➡ Evaluate low emission zone effectiveness, support sustainable urban mobility strategies, reduce environmental impact.
7. *Active mobility tracking*: Monitor and analyze bicycle and pedestrian mobility patterns in metropolitan and urban environments.
   ➡ Support sustainable urban transportation, promote non-motorized mobility, improve urban infrastructure planning for active transportation modes.

Standardized interviews

The interviews are structured on the basis of a questionnaire designed for the comprehensive identification and development of use cases. It follows a strategic approach designed to progressively refine and validate potential mobility data scenarios through a structured questioning process.



Figure 4. Structure of individual interviews.

- **Initial Sector and Approach Exploration.** The initial phase focuses on identifying and prioritizing strategic areas of interest. This involves an evaluation process where stakeholders systematically:
  - ✓ Assess multiple potential sectors
  - ✓ Rank sectors by strategic importance
  - ✓ Select primary areas of focus
  - ✓ Determine whether the approach will be oriented towards planning or operational improvements

- **Use Case Selection Methodology.** The selection process is designed to be both flexible and rigorous. When predefined use cases do not fully meet project requirements, the methodology includes:
  - ✓ Comprehensive use case mapping
  - ✓ Iterative refinement of potential scenarios
  - ✓ Mechanisms to capture innovative or previously unconsidered requirements
  - ✓ A contingency approach for defining novel use cases

- **Detailed Use Case Analysis Framework.** Each identified use case undergoes an exhaustive examination through a questioning strategy. This approach ensures:
  - ✓ Comprehensive understanding of potential implementation
  - ✓ Clear definition of key performance indicators
  - ✓ Identification of data requirements and stakeholder needs
  - ✓ Assessment of technical and operational constraints
  - ✓ Evaluation of scalability and future development potential

Initial exploration (Questions 1-4)

Question	Objective	Methodology	Expect Outcome
In the four areas we are initially considering, which do you consider to have the most interest? (If there is more than one, order by priority)			
1: Sector of Interest	Identify and prioritize strategic sectors for mobility data integration	Comprehensive evaluation of potential sectors	Hierarchical ranking of sectors
If a single sector is chosen, which use case is the most relevant? Similarly, order use cases if multiples are selected			
2: Most Relevant Use Case	Select most critical use case within chosen sector	Multi-criteria assessment	Identification of primary use case
If none of the predefined use cases is selected, orientation towards planning or operation			
3: Planning or operation approach of interest	Determine approach focus (planning or operations)	Detailed strategic intent analysis	Definition of use case tipology of interest
If none of the predefined use cases satisfy the needs, ask about the specific need as a wish-list			
4: Unmet Needs Identification	Capture innovative requirements	Creative exploration of potential gaps	New use case proposed

Definition of Cases Uses (for each use case selected) (Questions 5-17)

Question	Objective	Methodology	Expect Outcome
Now that we have one or several use cases (predefined or newly created), for each of them, what do we want from the model? (KPIs, graphic information, specific numerical results)			
5: KPIs and metrics definition	Establish measurable performance indicators	Comprehensive metrics development	Quantifiable success criteria
What specific objective do we want to achieve? What specific questions do we want to answer? What information do we want to obtain?			
6: Specific Objectives	Define precise project goals	Detailed objective mapping	Clear project scope and expectations
What data do we have? Owner? Format?			
7: Data Availability	Assess current data landscape	Comprehensive data inventory	Clear understanding of data resources
If data is not currently available, in what timeframe could they be available? Need assistance to obtain them or define them?			
8: Data Acquisition	Identify data acquisition strategy	Gap analysis and resource mapping	Data acquisition roadmap
Is there any current tool (models, algorithms, Power BI, etc.) that they currently use for this calculation?			
9: Existing Tools	Identify existing technological resources	Technology and tool assessment	Understanding current technological landscape
Can you identify the users of the system? Understanding their roles, those who can have data, share them, need or use the results			

Question	Objective	Methodology	Expect Outcome
10: User Identification	Define user ecosystem and roles	Comprehensive user mapping	Clear user profile and interaction model
What functions can be established for users?			
11: Functional Requirements	Define user interaction and system capabilities	Functional requirements analysis	Detailed user interaction framework
Where will the model be developed?			
12: Development Origin	Determine development environment	Organizational capability assessment	Clear development strategy
Is there a specific area where we can develop the model? Either by specific need or data availability			
13: Pilot Testing	Identify pilot implementation zone	Geographical and technological mapping	Pilot implementation strategy
Is there a specific time horizon that is most interesting to carry out the model or analyze results?			
14: Temporal Horizon	Define temporal scope	Temporal requirement analysis	Clear time frame definition
Is it replicable in another context?			
15: Scalability Potential	Assess model's scalability and replication potential	Scalability impact analysis	Understand expansion and replication capabilities
What should be the next steps to define this model? (meetings, contacts, visibility, technical connection, consultations, intermediate steps)			
16: Next Development Steps	Define concrete action plan for model development	Strategic roadmap creation	Comprehensive implementation strategy
What intermediate steps do you consider relevant?			
17: Internal and External Intermediary Steps	Identify critical milestones and transition points	Milestone and transition mapping	Detailed project progression framework

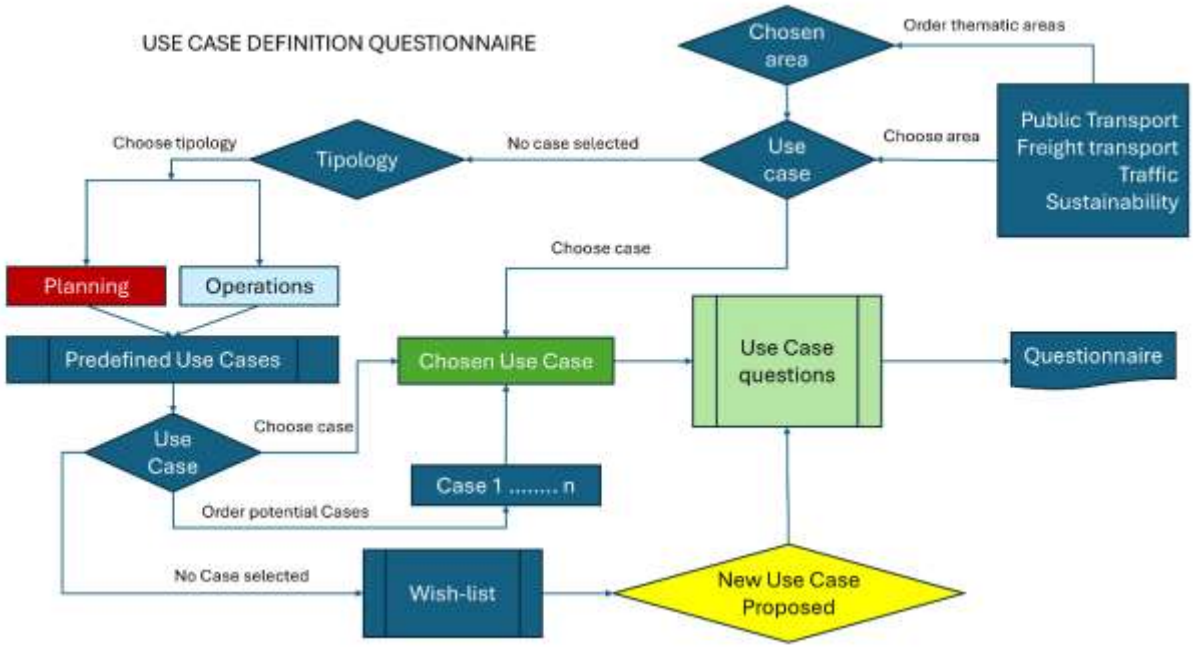


Figure 5. Questionnaire structure.

Summary of interviews

- **DGT**

Context

Two interviews have been conducted with the Directorate-General for Traffic (DGT), focused on the provision of nationwide data they can offer and the needs that can be addressed through the project.

Strategic objectives:

- Continuously improve traffic management on roads under their jurisdiction.
- Actively contribute to road safety.

According to the information gathered during the interviews, the DGT operates various types of equipment on Spanish roads. This includes, among others: real-time data from traffic cameras, variable message signs, speed control radars, connected traffic cones, slow vehicle positioning, roadwork zones, and weather-related information. This data is useful for detecting incidents that may impact traffic flow in real time.

This type of information is publicly available through a traffic map developed by the DGT. In addition, the DGT manages the National Access Point, another relevant data repository.

The DGT is primarily interested in the thematic area of traffic. Specifically, they see value in a nationwide road network map (Use Case 15) that includes areas beyond their administrative

jurisdiction, as well as in working on the joint planning and operation of emergency parking areas for heavy vehicles in response to snow-related emergencies.

Nº	Use Case	Typology
15	Real-time network traffic mapping	Operation
***	Winter service management: emergency parking for heavy vehicles	Operation

- **SEITT**

The interview focused on identifying strategies for transforming transport infrastructure management, examining how real-time data could optimize urban and interurban mobility.

Strategic Objective:

- Management of the toll road network as an efficient alternative
- Real-time traffic state monitoring
- Incentivize the use of less congested routes
- Reduce emissions through dynamic pricing
- Optimize public transport fleet operations

Through the interview, SEITT revealed its strategic focus on positioning the toll road network as an efficient transportation alternative. The organization seeks to leverage real-time data for monitoring traffic states, incentivizing less congested routes, and reducing emissions through dynamic pricing strategies.

The stakeholders are particularly interested in collecting data from diverse sources such as traffic cameras, road infrastructure characteristics, and Floating Car Data. Their goal is to create a comprehensive view of mobility that goes beyond traditional monitoring, enabling proactive management of transportation networks.

By integrating information from the Traffic General Directorate, road concessionaires, and various technological systems, SEITT aims to develop a model that not only tracks current conditions but also provides strategic insights for optimizing public transport fleet operations and infrastructure efficiency.

Nº	Use Case	Typology
2	Bus fleet route analysis and optimization	Operation
13	Highway and main road congestion monitoring	Operation
15	Real-time network traffic mapping	Operation
16	Transport emision evaluation	Planning

- **Basque Government**

Context

Interview with Basque Government focused on digital mobility twin development and advanced transportation management strategies.

Strategic Objectives

- Develop a comprehensive digital mobility ecosystem
- Generate specific use cases for transport planning and traffic management
- Enhance predictive capabilities in urban and interurban mobility

Based on the interview, the Basque Government seeks to develop a digital mobility ecosystem that goes beyond traditional data collection. The project aims to integrate diverse information sources, from road infrastructure data to mobility simulation models, to gain a comprehensive understanding of transportation dynamics.

Floating Car Data, GTFS, and meteorological information will provide real-time mobility insights. By capturing vehicle movements, traffic patterns, and transportation events, the digital mobility twin can offer a more nuanced view of urban and interurban mobility.

The sources include organizations such as the Basque Government Transport and Traffic Departments, EJIE (public IT services entity), and various mobility data providers. This diversity could enable the creation of analytical models that go beyond simple data collection, potentially transforming into a strategic tool to optimize transportation infrastructure, improve traffic management, and support sustainable mobility.

The project addresses key transportation challenges through multiple strategic use cases prioritizing public transport optimization, traffic monitoring, and emission evaluation. The Basque Government demonstrates a clear interest in developing data-driven mobility solutions.

Nº	Use Case	Typology
1	Optimization of bus routes and frequencies	Planning
2	Bus fleet route analysis and optimization	Operation
3	Intermodal node demand analysis	Planning
4	Real-time public transport user information	Operation
5	Cross-border Passenger transit analysis	Operation
6	Urban transport peak demand analysis	Planning
11	Main road segment capacity analysis	Planning
12	Predictive bottleneck resolution	Operation
13	Highway and main road congestion monitoring	Operation
14	Special operations congestion prediction	Planning
15	Real-time network traffic mapping	Operation
16	Transport emissions evaluation	Planning

- **SCT**

Context

Interview with the Catalan Traffic Service, focusing on real-time traffic management and urban-interurban mobility interactions.

Strategic Objectives

- Enhance the Current Real-Time Traffic Management Model
- Analyze and Monitor Mobility Interactions Between Urban and Interurban Environments

The Catalan Traffic Service is working to improve real-time traffic management through two existing models aligned with Data Space use cases. Currently, they employ a machine learning approach to predict the number of vehicles during incoming and returning special operations, supporting police surveillance planning. In addition, they maintain a real-time network traffic map that aids in daily operational decisions by tracking network status and suggesting alternative routes and restrictions.

Their main need focuses on understanding the interactions between urban and interurban areas. The exposed use case aims to manage traffic on connecting roads, which rely on complex mobility dynamics between urban, peri-urban and rural environments. By analyzing these interconnected movements, it is intended to facilitate integrated transportation planning.

The specific objective is to analyze and monitor mobility interactions between urban and interurban contexts, breaking down movements by mode of transport and distance. This approach will help characterize mobility patterns and identify changes in modal shift preferences that could affect their road networks.

Nº	Use Case	Typology
20	Urban mobility tracking by mode and distance	Operation
22	Active mobility monitoring	Operation

- **ATMB**

Context

Interview with the Metropolitan Transport Authority (ATM) of Barcelona, focusing on digital validation processes and mobile application usage in public transportation.

Strategic Objectives

- Identify user behavior patterns in mobile ticket validation
- Analyze the relationship between transportation supply and demand
- Understand digital interaction in public transport

In the current landscape of increasing digital transportation, understanding user interaction with mobile validation tools becomes crucial for optimizing public transport efficiency. This use case presented by ATM focuses on analyzing validation processes through the mobile app, aiming to identify

precise behavioral patterns of how, when, and where users validate their travel tickets. By examining these digital interactions, ATM seeks to develop a comprehensive understanding of the relationship between transportation supply and demand, ultimately enabling more strategic and user-centric service planning.

This use case represents a new approach not initially contemplated in the primary use case list, focusing on mobile application validation analysis.

Nº	Use Case	Typology
***	Demand prediction by user profile based on mobile app. validation	Planning

- **ATMV and Valencia City Council**

Context

Interview with metropolitan transport management and urban mobility management in Valencia focused on coordinating both stakeholders and identifying potential synergies between them.

Strategic Objectives

- Improve accessibility to public transport
- Optimize the intermodal infrastructure network
- Efficient management of Low Emission Zone

Both stakeholders are primarily interested in the thematic area of public transport, with a particular focus on use cases 1 through 6. Additionally, in the area of sustainability, they have expressed interest in the use case related to Low-Emission Zones (use case 21).

Nº	Use Case	Typology
1	Optimization of bus routes and frequencies	Planning
2	Bus fleet route analysis and optimization	Operation
3	Intermodal node demand analysis	Planning
4	Real-time public transport user information	Operation
5	Cross-border passenger transit analysis	Operation
6	Urban transport peak demand analysis	Planning
21	Low Emission Zone monitoring	Operation

- **Junta de Andalucia**

Context

Interview with Andalusia Regional Government focusing on public transport, freight transport, and sustainability challenges.

Strategic Objectives

- Analyze mobility demand patterns between origin-destination pairs, focusing on the performance of the public transport system in Andalusia.
- Identify optimal locations for new intermodal transport nodes, based on existing network configuration and observed mobility flows.
- Obtain detailed emissions data by transport type, mode, and distance traveled.
- Determine the proportion of emissions attributable to transport modes under the Junta's responsibility.
- Estimate the impact of mobility policies on the evolution of transport-related emissions at the regional level.
- Differentiate emissions and vehicle profiles between light-duty vehicles, heavy-duty vehicles, and public transport fleets.

While defining the strategic framework for the project, the Junta carefully evaluated and selected specific use cases aligned with their objectives in public transport, freight transport, and sustainability. Two primary use cases were identified: 'Demand Analysis at Intermodal Nodes' and 'Transport Emissions Assessment', which directly address the organization's key competencies and planning challenges.

Conversely, two predefined use cases were excluded from the project scope. Use Case 9, related to intermodal logistics platforms, was ruled out due to an existing regional Logistics Strategy that already includes a comprehensive modeling process for platform locations. Similarly, Use Case 22, involving certain governance and regulatory competencies, was excluded due to data limitations and jurisdictional constraints. As an alternative approach to Use Case 9, the Junta proposed developing a tool to assist municipalities in planning Urban Freight Distribution Centers. Additionally, the electric vehicle charging infrastructure use case was set aside due to insufficient data availability at this stage.

Nº	Use Case	Typology
3	Intermodal node demand analysis	Planning
16	Assessment of Transport-Related Emissions	Planning

- **Junta de Extremadura**

Context

Interview with Extremadura Regional Government focused on improving public transportation systems and cross-border mobility solutions.

Strategic Objectives

- Improve regional public transportation systems
- Enhance cross-border connections with Portugal for passengers and goods

Through the interview, it was identified that the stakeholder requires a project that integrates a complex data ecosystem focused on regional and cross-border transportation management. The information comes from diverse sources, ranging from public transport supply to mobility flow data, allowing a comprehensive analysis of transportation challenges in Extremadura.

Mobile telephone data and transportation network information provide a comprehensive view of mobility, capturing passenger and goods movements, cross-border interactions, and critical transportation patterns. The public transport optimization and emissions analysis models complete this panorama, offering details about transportation demand, fleet management, and environmental impact.

The sources include organizations such as the Extremadura Regional Government, transport service providers, mobile telephone data from MITMS, and cross-border mobility agencies. This diversity allows the creation of analytical models that go beyond simple data collection, transforming itself into a strategic tool to understand regional transportation systems, enhance cross-border connectivity, and analyze transportation emissions management

Nº	Use Case	Typology
1	Optimization of bus routes and frequencies	Planning
2	Bus fleet route and optimization	Operation
3	Intermodal node demand analysis	Planning
5	Cross-border Passenger transit analysis	Operation
10	Cross-border freight transit analysis	Operation

- **CRTM**

Context

Interview with the Madrid Regional Transport Consortium (CRTM) focused on urban mobility planning and optimization of transportation infrastructure.

Strategic Objectives

- Identify optimal locations for new intermodal nodes
- Optimize the network of transportation ticket sales and recharge points

According to the information obtained, a complex data ecosystem is desired to support urban mobility planning and transportation infrastructure optimization. The envisioned information would come from diverse sources, ranging from public transport ticketing data to urban planning information, potentially allowing a comprehensive analysis of transportation challenges in the Madrid region.

Mobility data, ticketing information, and urban transit data could provide a real-time view of daily movements, capturing commuter patterns, transportation events, and critical mobility interactions.

The proposed analytical models and simulation tools would complete this panorama, offering insights about intermodal nodes, accessibility of sales points, and resource optimization.

The sources would include organizations such as the CRTM, municipal governments, public transport operators, and various transportation authorities. This diversity could enable the creation of analytical models that go beyond simple data collection, potentially transforming into a strategic tool to optimize transportation infrastructure, improve public transport accessibility and enhance urban mobility planning.

The project addresses key transportation challenges through multiple strategic use cases prioritizing intermodal node analysis and optimization of ticket sales point distribution.

Nº	Use Case	Typology
3	Intermodal node demand analysis	Planning
**	Distribution of public transport ticket sales point	Planning

- **The EGTC Euroregion Nouvelle Aquitaine Euskadi Navarra**

Context

Interview with Basque and Nouvelle-Aquitaine regional governments focused on cross-border mobility data space and interoperability strategies.

Strategic Objectives

- Reinforce cross-border mobility integration
- Develop a shared mobility data space
- Enable coordinated transportation planning and decision-making

According to the interview, a complex data ecosystem is desired to support cross-border mobility management. The envisioned information would come from diverse sources, ranging from public transport schedules to cross-border mobility data, potentially allowing a comprehensive analysis of transboundary transportation challenges.

Mobility data, GTFS, and cross-border transportation information could provide a real-time view of daily movements, capturing worker and student commutes, transportation events, and critical cross-border interactions. The digital mobility models and simulation tools would complete this panorama, offering insights about intermodal services, sustainable transport, and resource optimization.

The sources would include organizations such as the Basque Government, Nouvelle-Aquitaine Region, Navarre Government, and various transportation authorities. This diversity could enable the creation of analytical models that go beyond simple data collection, potentially transforming into a strategic tool to optimize cross-border infrastructure, support ecological transition, and enhance regional mobility cooperation.

The project addresses key transportation challenges through multiple strategic use cases prioritizing cross-border passenger and freight transit and, electric vehicle infrastructure.

Nº	Use Case	Typology
5	Cross-border passenger transit analysis	Operation
10	Cross-border freight transit analysis	Operation
19	Electric vehicle charging infraestructure	Operation

The regional governments demonstrate a clear interest in developing data-driven mobility solutions, strategically balancing technological innovation and institutional cooperation.

- **Navarra Government**

Context

The interview focused on operational aspects of road management, specifically prioritizing two key use cases related to traffic management and winter road services.

Strategic Objectives:

- Assist in real-time traffic management with limited resources
- Manage heavy vehicle parking areas during winter road conditions
- Manage traffic incidents on the Pamplona Ring Road

During the interview with Navarra Government, a unique approach to winter road service management emerged. The focus is on developing a robust system to handle challenging road conditions through intelligent data integration.

The project leverages diverse information sources, from road infrastructure details to real-time meteorological data, enabling a comprehensive understanding of mobility challenges during winter events. Floating Car Data and incident reports provide crucial insights into vehicle movements and potential road disruptions.

Unlike traditional traffic management systems, this approach aims to create a dynamic tool that not only monitors winter road conditions but also supports proactive decision-making. By combining data from government agencies, transit services, and meteorological experts, Navarra seeks to transform winter road safety from reactive monitoring to strategic intervention

Nº	Use Case	Typology
***	Winter service management: emergency parking for heavy vehicles	Operation/Planning
11	Main road segment capacity analysis	Planning

Uses cases

The quantitative assessment of 22 primary use cases reveals a strategic distribution: Public Transport (40%), Traffic Management (35%), Sustainability (19%), and Freight Transport (6%).

The matrix below provides an overview of stakeholder interest in the proposed use cases, organised by thematic area. A colour code is applied to indicate the level of relevance: orange represents moderate interest, while green reflects a high degree of interest. This visual representation facilitates the identification of common priorities and areas of alignment across stakeholders.

It is worth noting that, as a result of the individual interviews, three additional use cases were proposed and subsequently integrated into the analysis: Distribution of public transport ticket sales point; Demand forecasting by user profile based on mobile app validations; Winter service management: emergency parking for heavy vehicles.

SECTOR		Use Case	Tipology	DGT	SEITT	BASQUE GOV.	SCT	MITMS	ATMB	ATMV	J.ANDALUSIA	J.EXTREMADURA Transfronterizo	J.EXTREMADURA Regional	VALENCIA C.C.	CRTM	CCDRC	EGCT	NAVARRA GOV.
Public Transport	1	Optimization of bus routes and frequencies	Planning															
	2	Bus fleet route analysis and optimization	Operation															
	3	Intermodal node demand analysis	Planning															
	4	Real-time public transport user information:	Operation															
	5	Cross-border passenger transit analysis	Operation															
	6	Urban transport peak demand analysis	Planning															
	*	Distribution of public transport ticket sales points	Planning															
	**	Demand forecasting by user profile based on mobile app validations	Planning															
Freight Transport	7	Port-based freight flow analysis	Operation															
	8	Airport-origin freight flow analysis	Operation															
	9	Logistics platform location in corridors	Planning															
	10	Cross-border freight transit nalysis	Operation															
Traffic	11	Main road segment capacity analysis	Planning															
	12	Predictive bottleneck resolution	Operation															
	13	Highway and main road congestion monitoring	Operation															
	14	Special operations congestion prediction	Planning															
	15	Real-time network traffic mapping	Operation															
	***	Winter service management: emergency parking for heavy vehicles	Operation															
Sustainability	16	Transport emissions evaluation	Planning															
	17	Informed shared mobility	Operation															
	18	Freight emissions analysis	Planning															
	19	Electric vehicle charging infrastructure	Operation															
	20	Urban mobility tracking by mode and distance	Operation															
	21	Low Emission Zone monitoring	Operation															
	22	Active mobility monitoring	Operation															

Figure 6. Stakeholders' interest matrix.

Phase 3: Direct or online group meeting

A workshop involving all relevant stakeholders is scheduled to take place during the month of September. The first objective is to present the work carried out during Phase 2, particularly the interview process and the identification of synergies among stakeholders with shared interests.

The second objective is to define the use cases associated with each pilot. Four working groups will be established, each aligned with the thematic areas of the presented use cases, with the aim of identifying active collaboration opportunities among stakeholders. A thorough analysis of the interviews with each stakeholder will enable the establishment of these groups based on strategic relevance, technological contribution capacity, and sectoral representativeness.

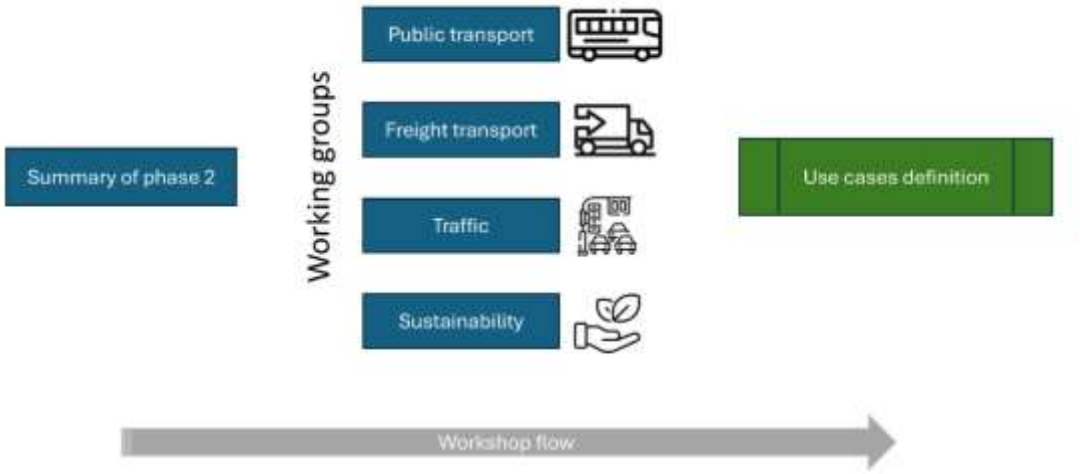


Figure 7. Worskhop structure.

Within these working groups, use cases of common interest to the participating stakeholders will be proposed. Once the strategic objective of the use case has been explored, each stakeholder will be responsible for identifying the datasets, tools, and models that could support its development. Similarly, current technical limitations and the specific challenges the use case poses for each stakeholder will be documented.

This collaborative exchange should lead to joint work on defining the functional requirements and governance policies of the use case. Subsequently, efforts should focus on the expected outcomes of the model and the associated KPIs, the development of the pilot test, and the scalability of the model.

This process will provide the necessary information from which the use cases to be developed in each of the project's pilot phases will be defined:

1. *Specific objectives*
2. *Datasets, tools and models available*
3. *Functional requirements*
4. *Governance policies and roles*
5. *Outcomes and KPIs*
6. *Pilot area (test)*
7. *Scalability plan*

Key Performance Indicators (KPIs)

To assess the degree of achievement and progress toward the objectives defined in this deliverable, a set of Key Performance Indicators (KPIs) has been established. These KPIs are intended to quantitatively measure critical aspects such as stakeholder engagement, the quality and completeness of the information gathered, the identification of synergies among actors, and the relevance of the defined use cases.

Table 4. Key Performance Indicators for Project Monitoring.

KPI	Description and threshold	Value
Stakeholders Participation	Number of stakeholders who have been interviewed relative to the total number of stakeholders (0-15)	13
Data Availability	Number of interviewed stakeholders identifying data relevant to the Data Space and predefined use cases (0-15)	11
Tools and Models Availability	Number of interviewed stakeholders contributing tools or models relevant to the Data Space and predefined use cases (0-15)	1
Use Case Identification Rate	Number of stakeholders who, in the course of the interview, showed interest in a predefined use case or suggested a new one (0-15)	11
Use Cases of Multiple Interest	Use cases of interest to different stakeholders (0-22)	16

Risk Assessment and Mitigation Strategies

Risks identified during meetings with stakeholders and the use case definition process are presented below. Each risk is classified according to its impact and accompanied by proposed mitigation measures, aiming to anticipate potential obstacles and ensure proper alignment between the stakeholders and project objectives.

Table 5. Identification, Impact and Mitigation Measures.

Identified Risk	Impact	Mitigation Measures
Lack of engagement from stakeholders holding essential data for use case implementation	High	Seek alternative data sources; change use case proposed
Current data availability insufficient to support use case development	High	Identify and acquire new data sources; replace the use case proposed
Requirement for external data from non-participating stakeholders in the project	Medium	Explore integration of external stakeholders into the Data Space
Requirement for acquisition of paid data sources	Medium	Procure the required dataset or explore alternative open data sources
Stakeholder is unable to identify a relevant predefined use case during the interview process	Low	Enable the design of new use cases or involve the stakeholder in sector-relevant workshops to foster alignment
Insufficient participation of stakeholderss in project workshops	High	Schedule multiple workshop sessions at different times and offer remote participation options to maximize engagement
Need for development of unavailable technical tools	Low	Allocate resources to design and implement required tools within the project timeline
Collaboration breakdown among stakeholders caused by data governance issues	High	Hold targeted meetings involving concerned stakeholders and project coordination representatives

Integration of Results into Project Implementation

The results obtained through individual interviews and working groups will be systematised, analysed, and structurally integrated into the implementation of the DS4MOBMODELS project.

This integration will take place at several levels:

Adjustment and Validation of Use Case

Stakeholder contributions will allow the validation of the initially defined use cases and, where necessary, adjustments to align them with the real needs of end users, operators, and involved administrations. Priorities, application scenarios, and specific requirements will be redefined as appropriate.

Adaptation of the Functional and Operational Architecture of the Data Space

The information gathered will be used to adapt the functional components of the Data Space platform, including interoperability services, data provision mechanisms, metadata management, access control, and usage control, based on the requirements and expectations expressed by stakeholders.

Definition and Expansion of Data Services

Based on identified needs, new data services, analytical tools, or visualisation services will be proposed to enrich the functional offering of the Data Space and meet the specific demands of end users.

Prioritisation of Key Performance Indicators (KPIs) and Data Sources

The set of KPIs envisaged for the evaluation of the pilots will be adjusted, prioritising those indicators considered most relevant by stakeholders. New data sources will be incorporated if they are identified as strategic during the participation process.

Incorporation of Stakeholders in the Pilot Validation Phase

Stakeholders who express interest and whose contribution is deemed pertinent will be invited to actively participate in the pilot validation phase, either as data providers, test users, or external validators of the achieved results.

The effective integration of participation results will ensure that the Data Space and the pilots of DS4MOBMODELS reflect the real needs of the mobility ecosystem, thereby increasing their practical applicability, acceptance by end users, and potential for future replication.

Governance Frameworks

The Data Space for Mobility (DS4MOBMODELS) [1]defines and creates an advanced Mobility Data Space that integrates transport, traffic, and travel data across various regions in Portugal and Spain. To establish a functional platform capable of aggregating data and supporting efficient, safe, and sustainable mobility management, a robust governance framework is essential.

This section outlines the foundational principles, rules, policies, standards, and decision-making processes that regulate a data space's operation, participant interactions, and the maintenance of sovereignty and legality. Its fundamental purpose is to ensure alignment with data space objectives, manage participant relationships, build and maintain trust, and guarantee regulatory compliance. The DS4MOBMODELS governance models are typically inspired by recognised reference frameworks. In the following points, we will address different initiatives and frameworks related to data space governance.

DSSC

The Data Space Support Centre (DSSC) [2]is a European consortium that plays a leading role in defining and developing data spaces, offering support to the European Commission. The main governance requirements and digital capabilities proposed for data spaces are derived from DSSC's suggestions (Figure 8).

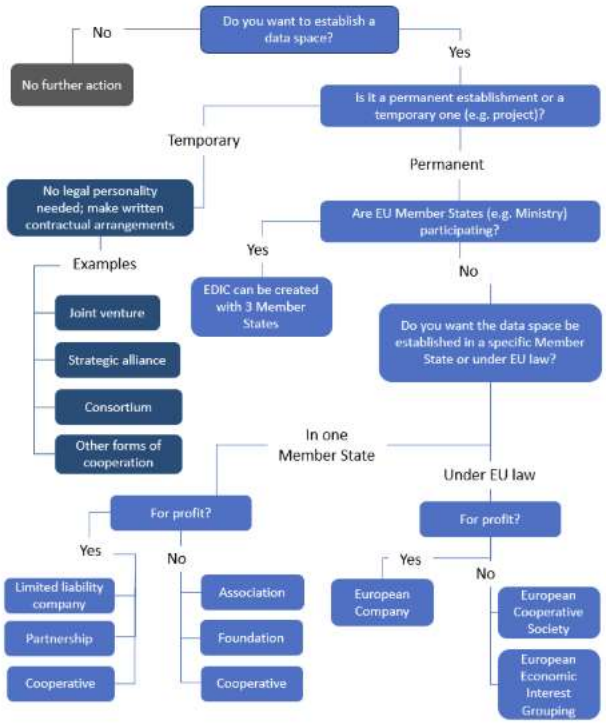


Figure 8. DSSC's decision tree for data spaces organisational form.

[1] DS4MOBMODELS: https://www.ds4mobmodels.eu/
[2] DSSC: https://dssc.eu/

IDSA

The International Data Spaces Association (IDSA) [3]is a significant reference for data space interoperability. Its Dataspace Protocol (DSP) [4]is being developed as a candidate standard for enabling interoperability both within and between data spaces. Technical connectors, such as those derived from the Eclipse EDC[5], implement the IDSA protocol for critical functions such as contract negotiation and transfer control.

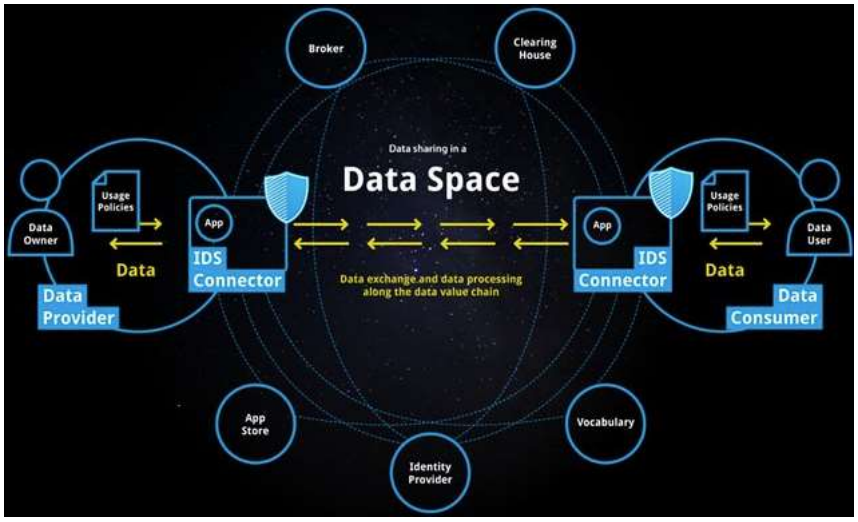


Figure 9. IDS Data Space Model and architecture.

Related regulations

Data spaces must adhere to a comprehensive set of European and national regulatory texts that directly impact their development and operation. These regulations can be generic, sector-specific, or tied to particular use cases. Key European regulations that strongly influence data spaces include the Data Governance Act (DGA)[6], the Data Act (DA)[7], and the General Data Protection Regulation (GDPR)[8].

DGA

The Data Governance Act (DGA), applicable since September 2023, establishes conditions for the reuse of public sector data, provides a framework for data intermediation services, and promotes data sharing for altruistic purposes. It defines data intermediation services as those facilitating commercial data exchange between an undetermined number of data holders/subjects and data users, involving technical, legal, or other means. Data intermediaries are characterised by assisting data sharing, not modifying/enriching data without consent, having a commercial nature, serving multiple parties,

[3] IDSA: https://internationaldataspaces.org/
[4] The IDSA Dataspace Protocol solution has been migrated to Eclipse: https://eclipse-dataspace-protocol-base.github.io/DataspaceProtocol/2025-1-RC1/; a previous version of the IDSA specification can be accessible through their website: https://docs.internationaldataspaces.org/ids-knowledgebase/dataspace-protocol.
[5] Eclipse EDC Connector: https://github.com/eclipse-edc/Connector
[6] DGA: https://eur-lex.europa.eu/eli/reg/2022/868/oj/eng
[7] DA: https://eur-lex.europa.eu/eli/reg/2023/2854/oj/eng
[8] GDPR: https://eur-lex.europa.eu/eli/reg/2016/679/oj/eng

actively facilitating exchange, having autonomy over clients, and not facilitating intellectual property-protected material exchange.

GDPR

The General Data Protection Regulation (GDPR) is crucial for data spaces, especially when personal data is involved. It governs principles of lawfulness, data minimisation, purpose limitation, legal basis for processing, privacy by design, data lifecycle management, and defines roles and responsibilities. The determination of whether an entity acts as a Data Controller (decides on means and purposes of processing) or a Data Processor (processes data on behalf of a controller) depends on its decision-making authority over the data. For the operational aspects of a data space, the Data Space Authority and the Data Space Operator (see section 3., DS4MOBMODELS Roles) typically function as Data Controllers, while providers and consumers (cf. section DS4MOBMODELS Roles) manage their internal data processing.

Interoperable Europe Act

The Interoperable Europe Act (IEA)[9] aims to foster cross-border interoperability of trans-European digital public services by establishing common standards and a governance framework. The broader governance model for data spaces is also inspired by the European Interoperability Framework (EIF)[10].

Ecosystem and convergence

This section implies the importance of aligning various components and stakeholders within the data space ecosystem. While documents such as the 'Data Spaces Business Alliance Technical Convergence Discussion Document' [11]are referenced in the table of contents, their content is not explicitly developed in the current version, the sources primarily highlight the Data Space Protocol (DSP) as a key element for technical convergence and interoperability. The overall aim is to ensure systems, participants, and the Governance Authority align their behaviour within the chosen architectural model.

Data Spaces Business Alliance Technical Convergence Discussion Document

This document serves as a foundational reference for aligning technical standards and architectural models across various data space initiatives. It outlines the principles and mechanisms for achieving convergence in data exchange protocols, interoperability frameworks, and governance structures. The discussion emphasizes the importance of harmonising efforts among stakeholders to ensure scalable, secure, and compliant data sharing environments. Its recommendations are particularly relevant for the implementation of the Data Space Protocol and the integration of federated services.

[9] IEA: https://eur-lex.europa.eu/eli/reg/2024/903/oj/eng
[10] EIF: https://ec.europa.eu/isa2/eif_en/; a new version of EIF will be released as part of the IEA.
[11] DS Business Alliance Technical Convergence Discussion Document: https://data-spaces-business-alliance.eu/wp-content/uploads/dlm_uploads/Data-Spaces-Business-Alliance-Technical-Convergence-V2.pdf

DSP (Dataspace Protocol 2025-1-RC1)

The Dataspace Protocol 2025-1-RC1 is a proposed technical standard developed to facilitate interoperability within and across data spaces. It defines the specifications for data product publication, contract negotiation, access control, and secure data transfer. The protocol enables machine-readable policies that ensure consistent access control, supports federated identity and trust management, and facilitates automated contract negotiation and enforcement.

From a governance perspective, the DSP is not merely a technical standard but a foundational element that enables and enforces the rules, policies, and trusted interactions necessary for effective data space operation. It defines the specifications and guidelines for publishing data product and service offers, negotiating agreements and contracts, and ultimately accessing data. From a governance standpoint, it acts as the orchestrator, coordinating the sharing and use of data based on the data space's defined policies and contractual agreements between participants. This ensures that data transactions align with the overarching objectives and principles of the data space.

It is the Technical Expert Role (integrated in the Governance Authority of the data space) who focuses on developing infrastructure and ensuring alignment for communication with other data spaces, which relies on common protocols like the DSP.

Configuration of the data space

This section covers the essential steps and decisions involved in establishing and structuring the DS4MOBMODELS, from its formal constitution to defining its operational and economic frameworks, supported by a clear rulebook to define responsibilities and operational principles.

Constitution of the DS4MOBMODELS

Mapping the foundational elements of the DS4MOBMODELSOBMODELS is essential to establishing an effective governance framework.

Founders, initialiser of the DS4MOBMODELS

The constitution involves formalising the Governance Authority, defining its members and support mechanisms, and making organisational decisions that set the common aspects, participant roles, and activities of the data space.

Business models and niche market

Defining sustainable business models and identifying specific market niches are critical for the long-term viability of data spaces. These economic structures must support operational maintenance, encourage innovation, foster active participation, and facilitate shared value creation.

In the context of data spaces, defining sustainable business models and identifying specific market niches are key to ensuring long-term viability. These spaces are collaborative environments for the secure, ethical, and controlled exchange of data among multiple stakeholders. They require economic structures that not only support operational maintenance but also encourage innovation, active participation, and the creation of shared value.

Data space strategy decisions and business processes

These involve defining the objectives of the data space, its naming, and its governance structure, including the functions of its members and their relationships with participants and other data spaces. These decisions should be made before the data space becomes operational.

Identification of actors within the Governance Authority

The Governance Authority can be structured with one or more "bodies" composed of data space participants, potentially including the promoter, and may leverage external organisations for specific tasks. The authority must formally constitute itself and document its structure. Specific roles within the Governance Authority are listed in section 5. (section about DS4MOBMODELS Roles).

Data transactions

Data transactions involve the interactions between different actors (e.g., data consumers, providers, operators) for the exchange and use of data products[12]. These transactions are governed by the data space's policies and contracts.

Data sovereignty and trust

Data sovereignty is the ultimate goal of any data space, granting maximum control over data to its rightful owner. It combines authority (independence to regulate and decide) and control (resources to trace, audit, and correct). Sovereignty applies to participants, data assets, and technical resources (code and infrastructure). Neglecting code and infrastructure sovereignty can directly impact data sovereignty and business continuity.

Trust in a data space is a continuous process built through technical, organisational, and legal mechanisms that ensure reliability, operational integrity, regulatory compliance, and rights preservation. Key mechanisms include robust identity management, certification schemes, defined trust frameworks, secure communication, and transparent governance. A strong trust model fosters collaboration, ensures compliance, and reduces operational costs.

Data quality

Governing data quality requires identifying and defining minimum quality characteristics (e.g., accuracy, credibility, timeliness, traceability), establishing acceptable quality levels, implementing metrics and monitoring mechanisms, tracking compliance, and providing solutions for improvement. Data quality information should be included in the data product's metadata, ideally for automated verification, and can be used for promotion and value generation in data marketplaces. Reference frameworks for data quality include the FAIR principles[13] and the DAMA dimensions[14].

- The FAIR principles: findability, accessibility, interoperability, and reusability.
- The DAMA dimensions: completeness, uniqueness, timeliness, validity, accuracy, and consistency.

Governing data quality involves identifying and defining the minimum quality characteristics that must be ensured, establishing the minimum acceptable levels for each of these characteristics, implementing metrics and monitoring mechanisms based on these metrics, tracking compliance with quality thresholds, and providing or recommending solutions to improve data quality.

Data value creation

The core activity for value creation in a data space is data reuse, benefiting both those who repurpose the data and the end-users and society. Value is generated through data sharing and exploitation,

[12] According to the DSSC, data products are “data sharing units, packaging data and metadata, and any associated license terms”: https://dssc.eu/space/BVE2/1071252161/Alphabetical+List+of+All+Defined+Terms+in+Blueprint+v2.0
[13] FAIR: https://www.go-fair.org/fair-principles/
[14] DAMA-UK: https://www.dama-uk.org/

which can drive technological innovation, new services, operational efficiency, economic growth, and social benefits. A mature data space must support viable and sustainable business models that facilitate this value creation through various mechanisms like use cases and data catalogues.

The core activity that generates value is data reuse. This reuse benefits those who repurpose the data, society, and end users. Value is created through data sharing and exploitation, which can lead to technological innovation, new services, operational efficiency, economic growth, and social benefits. A mature data space must support viable and sustainable business models.

Value creation is enabled through diverse key mechanisms: business models, use cases, data catalogues, data acquisition methods, enabling services, and the configuration of the data space itself.

Configuration of the DS4MOBMODELS

This section provides insights into the composition and organisation of the DS4MOBMODELS, highlighting the importance of clearly defining the roles, rules, and data assets required to support coordinated data sharing.

Business model of DS4MOBMODELS and participants

The business model defines how value is created and sustained, involving use cases, the roles of various participants (including data providers, consumers, intermediaries, and operators), and the economic structures that support the data exchange.

Legal form

The decision to formalise the data space's existence as a legal entity (e.g., legal person) has implications for its internal organisation, governance, and the definition and application of rules, including its evolution and continuity. This also involves ensuring compliance with sector-specific regulations and establishing a robust contractual framework (i.e., sector-specific regulatory compliance, legal status of technical building blocks, contractual framework, contract template).

Organisational form

The organisational form defines how the Governance Authority is internally structured to perform its tasks. This includes processes for the management of participants (onboarding, permanence, and offboarding) and mechanisms for conflict resolution (e.g., mediation or arbitration) between participants or with the Governance Authority.

Contractual conditions of data space

The governance framework acts as a foundational agreement that participants subscribe to, detailing objectives, applicable regulations, terms and conditions of use, and internal rules/policies. It must cover rules and roles. Key contractual agreements include a Framework Agreement (general principles, roles, dispute resolution, adhesion/desvinculation procedures), Data Exchange Agreements (detailed data product descriptions, usage clauses, compliance obligations), and Service Level Agreements (SLAs) (availability, performance, incident responsibilities, maintenance). The negotiation process for

data contracts is typically automated, involving the consumer requesting an offer and the provider accepting or negotiating policies before data transfer.

Assessments, regular reporting and audits

This involves mechanisms to ensure accountability and build trust among participants and authorities. It includes "observability" solutions like tracing, monitoring, and auditing, applicable to both ordering and management activities. These mechanisms provide evidence for compliance, dispute resolution, and continuous improvement.

Project overview and objectives

Regular assessments evaluate the DS4MOBMODELS's status, performance, and achievement of objectives.

Data management

This process involves reviewing metrics and reports related to data quality and technical compliance, ensuring that security measures are effectively implemented.

Compliance and regulatory updates

Periodic evaluations include verifying legal and technical compliance and ensuring alignment with updated regulations and agreements.

Technical infrastructure

Monitoring includes the proper functioning and efficiency of common data space services, and adherence to agreed service levels for the underlying infrastructure.

Stakeholder engagement

While not explicitly detailed as a distinct reporting category, stakeholder involvement (e.g., co-governance with participant representatives) is a key principle of transparency and good governance that should be reflected in assessments.

Risks and risk mitigation

While not explicitly detailed as a distinct reporting category, stakeholder involvement (e.g., co-governance with participant representatives) is a key principle of transparency and good governance that should be reflected in assessments.

Performance metrics

Statistical data on data product usage, services, transactions, and value metrics are essential for control and accountability.

Financial overview

While not directly elaborated, long-term viability and sustainable business models imply a need for financial oversight.

Future plan and roadmap

The future development of the DS4MOBMODELS will follow a phased approach aligned with its governance, technical, and operational foundations:

- Short-term (Initiation Phase)
  - Formal constitution of the Governance Authority
  - Definition of participant roles and onboarding processes
  - Deployment of core services (e.g., identity management, catalogues)
  - Initial use case identification and data product publication
- Medium-term (Expansion Phase)
  - Implementation of automated contract negotiation and data exchange mechanisms
  - Integration of quality assurance, compliance monitoring, and audit tools
  - Development of sustainable business models and service offerings
  - Strengthening stakeholder engagement and trust frameworks
- Long-term (Maturity Phase)
  - Cross-sector interoperability with other European data spaces
  - Continuous improvement of the rulebook and technical standards
  - Strategic alignment with evolving EU regulations (e.g., DGA, DA, IEA)
  - Evaluation of performance metrics and financial sustainability

This roadmap ensures the data space evolves in a structured, compliant, and value-driven manner, supporting innovation and long-term continuity.

DS4MOBMODELS Roles

This section defines the fundamental roles within a data space, outlining the rights and duties of the different actors involved[15]. A participant may adopt more than one role under different circumstances.

DS4MOBMODELS Governance Authority

The Governance Authority is the entity responsible for developing, maintaining, operating, and enforcing the data space's governance system. Its main functions include global supervision, setting policies, defining standards, managing participant admission/exit, and dispute resolution. It also ensures consistency with European regulations and principles of transparency, neutrality, and security.

Among the main responsibilities of the Governance Authority, this role covers the responsibilities associated to the following roles: the legal expert, financial expert, technical expert, rulebook maintainer, use case coordinator, data modelling expert, governance expert and metadata and data management expert.

Legal Expert Role

The Legal Expert is responsible for ensuring that all activities within the data space comply with applicable legal frameworks. This includes providing legal guidance on data governance, drafting and reviewing contracts, supporting use case agreements, monitoring regulatory developments, and advising on the legal form and internal rules of the data space. The role also includes representing the data space in legal working groups and supporting dispute resolution processes.

Financial Expert

The Financial Expert oversees the financial sustainability of the data space. This includes developing financial strategies, managing budgeting and accounting, ensuring compliance with financial regulations, conducting audits, and preparing financial reports. The role also supports fundraising efforts and provides financial advice to use case teams and individual participants.

Technical Expert Role

The Technical Expert is responsible for the design, implementation, and maintenance of the data space's technical infrastructure. This includes deploying federated services, ensuring interoperability, managing the platform's operation, assessing the quality of external services, and providing technical support and training. The role also involves aligning with external data space initiatives to ensure compliance with evolving standards.

[15] Roles have been identified from the DSSC: https://dssc.eu/space/BVE2/1071252161/Alphabetical+List+of+All+Defined+Terms+in+Blueprint+v2.0, and IDSA: https://docs.internationaldataspaces.org/ids-knowledgebase/ids-ram-4/layers-of-the-reference-architecture-model/3-layers-of-the-reference-architecture-model/3-1-business-layer/3_1_1_roles_in_the_ids.

Rulebook Administrators / Maintainer

The Rulebook Administrator maintains and updates the governance framework (the Rulebook) of the data space. This includes integrating legal and technical updates, coordinating with expert roles to revise rules, conducting internal audits, and ensuring that the governance structure remains aligned with evolving needs and regulations. The role ensures clarity, usability, and accessibility of all governance documents.

Use Case Coordinator Role

The Use Case Coordinator facilitates the identification, development, and implementation of use cases within the data space. This role ensures alignment with strategic objectives, supports stakeholder collaboration, identifies common requirements, and monitors progress. It also promotes standardization, organizes community events, and supports cross-data space interoperability.

Data Modelling and Governance Experts

The Data Modelling and Governance Expert is responsible for defining and maintaining metadata vocabularies, data models, and catalogues. This role ensures semantic interoperability, supports data quality assurance, and provides tools and training for data providers and consumers. It also contributes to the design of registries and participates in standardization efforts.

(Meta)Data Management Role

This role focuses on the governance of both metadata and payload data. Responsibilities include defining metadata standards, managing data catalogues, ensuring data quality, and supporting data transformation and validation. The role is essential for enabling consistent, interoperable, and high-quality data exchange across the data space.

Data consumer

The Data Consumer is a participant who uses the data and/or services offered in the data space. A consumer might also become a data producer with control over potential exploitation. Their main functions include accessing data products, processing metadata, and reusing shared data for specific business objectives, analysis, new product development, research, or innovation, in accordance with contractual terms. Responsibilities include respecting terms of use, ensuring security and confidentiality, deleting/returning data upon contract termination, and providing quality feedback to providers.

Data provider

The Data Provider is a participant who offers data and/or services within a data space. If the provider generates the data, they also take on the role of a data producer. If they consume data in their activities, they also adopt the role of a data consumer. Their primary functions include making data/services available while guaranteeing quality and agreed service levels (in accordance with the provisions established by the Governance Authority, or the competent Data Space Operator and Data Space Provider), defining usage conditions and access policies, facilitating connections between consumers and providers, and managing catalogues. Responsibilities include regulatory compliance,

data maintenance and updating, maintaining a reliable data directory, ensuring neutrality, supporting interoperability, and providing information transparency.

Service Provider

This category often refers to entities (a role, as for the Governance Authority) that provide services to the data space itself, rather than just data. This category often refers to entities that provide services to the data space itself, rather than just data.

The set-up of a data space requires the delimitation of tasks performed by the data space operator and the data space provider, clearly distinguishing them from those of a service provider.

Data Space Operator

The Data Space Operator is a legal entity that provides the fundamental capabilities and enabling services of the data space. These functions can be delegated to third parties by the Governance Authority. Their main functions include ensuring the proper functioning of the data space and coordinating its operational and technical aspects, such as supervising infrastructure and ensuring availability and agreed service levels. Contrary to the Service Provider, the Data Space Operator performs tasks covering the infrastructure management (i.e., servers, network, security, APIs), the implementation of access policies, as well as guaranteeing service levels and reporting incidents to the Governance Authority and affected participants.

Data Space Provider

The Data Space Provider is the entity responsible for delivering and maintaining the core infrastructure and services that enable the operation of the data space. This includes hosting federated services such as identity management, catalogues, and connectors, as well as ensuring the availability, performance, and security of the platform. The Data Space Provider may operate internally within the Governance Authority or be contracted externally. Its role is central to guaranteeing technical reliability and supporting the onboarding and participation of stakeholders.

DS4MOBMODELS Rulebook

The Data Space Rulebook is essentially the governance framework documentation that participants must subscribe to. It defines the foundational objectives, agreements, applicable external regulations, terms and conditions of use, internal rules, and policies for operating the DS4MOBMODELS, and other daily governance procedures (e.g., dispute resolution, long-term continuity planning). This document is based on the IDSA Rulebook[16], which is a governance framework designed to clearly describe both mandatory rules and optional guidelines for the development and operation of data spaces. It encompasses functional, technical, operational (organisational), and legal dimensions.

The Rulebook is also expected to incorporate specific content, such as dissemination guidelines from the Marketing and Communication role and "Data Literacy Rules" to foster a common understanding of metadata for data sharing between providers and consumers. The Rulebook Maintainer is expected to collaborate with various roles and the Data Spaces Support Centre (DSSC) to align concerns and solve interoperability challenges. Moreover, the overall governance model should be inspired by recommendations and good practices from known reference frameworks such as the DSSC, EIF, ELAP principles, various UNE Standards, DAMA, and FAIR principles.

Functional Requirements

The rulebook includes rules that guide the performance and functionalities of common services within the DS4MOBMODELS. This also encompasses the definition, processes, and services of specific roles dedicated to the ordering and governance of the data space.

This section provides guidelines for the functionality of common services and defines the processes and services of specific roles. The rulebook maintainer (part of the Governance Authority) is responsible for defining audit procedures for rule adherence and quality levels related to these requirements.

Interoperability and Data interoperability in DS4MOBMODELS

This section of the rulebook outlines the decisions, actions, and instruments (legal, organisational, semantic, and technical) that ensure, supervise, and control interoperability within the DS4MOBMODELS, with other data spaces, and with other systems. It integrates the Dataspace protocol (DSP) -a set of specifications that facilitates data sharing, including the publication of data product offers, negotiation of agreements, and data access. It also covers the transfer and control planes for data exchange, ensuring data transport while validating compliance with rules and contracts.

Data interoperability describes how the governance authority and participants use these instruments to ensure, supervise, and control interoperability within the data space, with other data spaces, and with other types of systems and ecosystems. The governance model must specify how to manage the negotiation and initiation of data exchange, the control of transfers to be implemented in the

[16] IDSA Rulebook https://internationaldataspaces.org/wp-content/uploads/dlm_uploads/IDSA-White-Paper-IDSA-Rule-Book.pdf

connector, the validation of data at the time of transaction, and the type of mandatory operations, metadata, and logging data.

Technical Agreements

These agreements within the rulebook provide guidance on the implementation and use of all technical services that the Governance Authority makes available to participants. They are crucial for ensuring smooth technical operations and adherence to technical standards.

This part contains guidelines for the work and collaboration within data services, as well as the implementation guide and use of all technical services that the Governance Authority makes available to participants.

Organisational Agreements

The rulebook specifies the elements and activities for the formal constitution of the Governance Authority, its members, and execution mechanisms. It also covers organisational decisions for common aspects that define and regulate the DS4MOBMODELS, the roles of participants, and their general activities within the space. These agreements shape how the data space is structured and how its participants interact.

These include guidelines for the legal basis in compliance with the regulatory environment, with the goal of ensuring trust and security within the data space. Organisational and legal aspects must align with technical implementation. Additionally, the IDSA Rulebook includes guidelines for work and collaboration within data services. It is the Rulebook Maintainer's responsibility to manage and update the roles (e.g., in a “rolebook”), including procedures to evaluate and define new rules or roles to delete. These organizational decisions should be made before the data space enters an operational phase

Legal Dimensions

This part of the rulebook details the normative framework that directly impacts the DS4MOBMODELS. It references all relevant legal texts, such as the DGA, GDPR, Interoperable Europe Act, and national/sector-specific legislation. Key legal considerations include the Data Governance Act (DGA), which sets conditions for public sector data reuse and data intermediation services; the Data Act (DA), which grants users more control over generated data; and the General Data Protection Regulation (GDPR), which outlines principles of lawfulness, data minimization, purpose limitation, privacy by design, roles and responsibilities, and security and confidentiality measures. Additionally, it covers requirements from the European Interoperability Act (EIA) and national interoperability schemes, as well as Regulation (EU) 2019/881[17] (Cybersecurity Act) and national security schemes for cybersecurity. The Legal Expert role is crucial for translating these regulations into concrete chapters of the Rulebook.

It ensures that contractual conditions are fair, reasonable, and non-discriminatory, and that legal requirements (e.g., for personal data, trade secrets) are met. The legal form chosen for the data space is also a key consideration within these dimensions. These dimensions also involve monitoring external

[17] Cybersecurity Act: http://data.europa.eu/eli/reg/2019/881/2025-02-04

legal frameworks for new or modified regulations and standards, and providing legal advice accordingly.

Data Governance

Data governance refers to the set of principles, rules, policies, standards, and decision-making processes that regulate the functioning of a data space, the interaction among its participants, and the maintenance of sovereignty and legality principles. Its fundamental purpose is to ensure alignment with the data space's objectives, manage relationships between participants, generate and maintain trust, and guarantee regulatory compliance and adherence to established rules.

In DS4MOBMODELS, as for most of the data spaces, data governance applies to three areas: the governance of the overall data space, interoperability governance, and data governance.

The Data Space Connector is identified as the central technical solution that enables the execution of these data governance tasks, particularly through its control plane and transfer plane. The control plane is responsible for authenticating and authorising the consumer participant, managing usage policies, and negotiating contracts. On top of the connector, the Data Space Governance Authority is responsible for developing, maintaining, operating, and enforcing the data space's governance system. This also involves periodically evaluating the data space through metrics and reports on quality, legal, and technical compliance, and providing accountability. The governance authority must consider formalising its existence as a legal entity, which impacts internal organisation and governance execution.

Control of data access

This is implemented using models like Role-Based Access Control (RBAC)[18] and Attribute-Based Access Control (ABAC)[19], along with verifiable credentials[20]. The connector plays a role in controlling access by interoperating with participant registries and policy services.

Control of data usage

This is executed based on general policies, ethical codes of the data space, and contracts between the data provider and consumer. The negotiation process for these contracts involves the contract manager services of the involved connectors, with both participants accepting or rejecting proposed terms and policies. The data space protocol defines the states of exchanges between connectors during negotiation.

Data quality management

Governing data quality involves identifying and defining minimum quality characteristics, establishing acceptable levels for each, implementing metrics and monitoring mechanisms, tracking compliance, and recommending improvement solutions. Data quality refers to properties like accuracy, conformity,

[18] RBAC: https://csrc.nist.gov/files/pubs/conference/1992/10/13/rolebased-access-controls/final/docs/ferraiolo-kuhn-92.pdf
[19] ABAC: https://csrc.nist.gov/pubs/sp/800/162/upd2/final#:~:text=ABAC%20is%20a%20logical%20access%20control%20methodology%20where,allowable%20operations%20for%20a%20given%20set%20of%20attributes
[20] W3C Verifiable Credentials (VC) is the most demanding specification: https://www.w3.org/TR/vc-data-model-2.0/

confidentiality, efficiency, traceability, and recoverability. Key principles and dimensions like FAIR (findability, accessibility, interoperability, reusability) and DAMA (completeness, uniqueness, timeliness, validity, accuracy, consistency) are relevant as mentioned in section 4.6 on data quality. Ideally, data quality should be part of the metadata and verifiable automatically, also being useful for data marketplaces.

Compliance with data lifecycle policies

Ensuring data is managed throughout its lifecycle in accordance with established policies. Effective data lifecycle management relies on well-defined policies applied across six key stages.

During data creation and acquisition, policies ensure data quality, enforce metadata standards for traceability and require compliance with legal frameworks such as GDPR or DGA.

In the storage and organisation phase, governance focuses on access control, encryption and classification by sensitivity.

As data enters the usage and processing phase, policies are intended to limit unauthorised use, trail audits and promote analytics.

In the sharing and data distribution phase is where the critical polices need to be defined and structured, since the organisations should define licensing terms, interoperability and ensuring transparency.

In the archiving and preservation stage, policies should guide long-term storage formats, retention schedules and preservation of metadata.

Eventually, in the data disposal and deletion, the governance must assure deletion protocols, compliance checks and sufficient documentation to guarantee traceable data destruction.

Collectively, these policies form the foundation for robust data governance and regulatory compliance throughout the entire data lifecycle.

Conclusions

Stakeholder involvement in the project has been high. Their participation is essential, and efforts have been focused on completing the activity plan. However, the initial phases (individual interviews) reflect the need for a paradigm shift within public administrations regarding their usual working approach. The Data Space represents a collaborative challenge that explores a wide range of possibilities.

Most participating stakeholders have identified needs related to transport and mobility and consider the project as an opportunity to address specific issues (use cases) across several thematic areas. The variety of proposed use cases—ranging from operational to planning-oriented—and the multiple thematic areas they encompass make this an ambitious project in the advancement of national mobility. Furthermore, stakeholder proactivity has been reflected in the proposal of additional, new use cases.

In this context, it is necessary to support and coordinate with public administrations throughout the data-sharing process and the definition of related governance policies, as well as in the development of tools and models that will ensure the proper functioning of the data space.

To that end, the next phase (direct or online meeting groups), which consists of holding joint working sessions with the involved stakeholders, is key to the collaborative process and to the definition of the use cases to be developed within the project itself.

To effectively navigate this collaborative challenge, a well-defined governance framework is paramount, structured around three core conceptual axes: the ordering and management of the data space, governance of interoperability, and data governance.

The ordering and management of the data space, led by the Data Space Governance Authority, is crucial for public administrations to formalise their participation and adapt their working approach.

The governance of interoperability directly addresses the technical challenge of enabling seamless data exchange for the diverse mobility use cases. It emphasises automation, security, and privacy in data sharing activities.

Finally, data governance empowers data owners, including public administrations contributing mobility data, by ensuring they retain maximum sovereignty over their data.

By systematically addressing these three governance axes, the project can build the necessary infrastructure and trust to support the ambitious range of mobility use cases, facilitate collaboration among stakeholders, and ensure the proper functioning and sustained value creation of the DS4MOBMODELS.

Annex I. Description of Pilots

Pilot 1: Spanish National pilot.

This pilot could contain many use cases, one of them could be the planning of public transport in the main corridors of the country such as the TEN-T Network. In addition, the national matrix of passenger and freight vehicle movements along the transport corridors of the trans-European network (both core and comprehensive network) and travel trends could be analyzed to ensure adequate management and planning of traffic or road and rail infrastructure solutions for different long-distance movements and national points of interest.

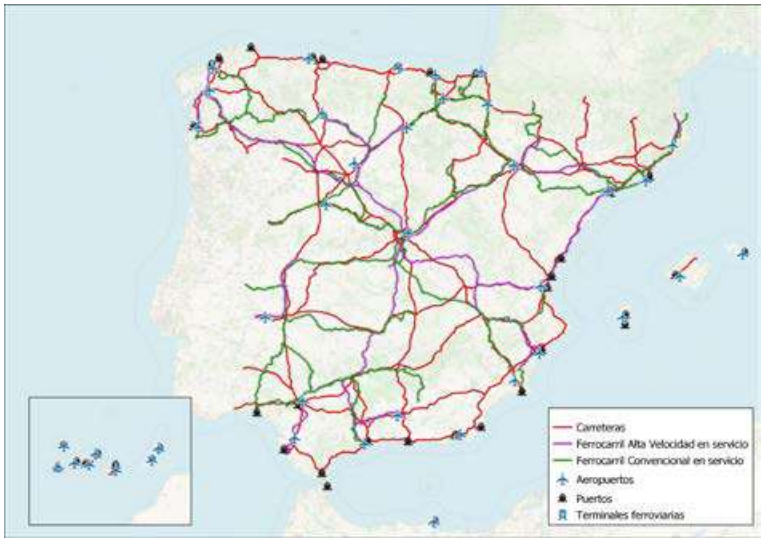


Figure 10. TEN-T Network in Spain.

The following actors will participate in this pilot:

- Public Authorities: General Directorate of Traffic DGT (which is responsible for traffic management on the roads network of Spain), SEITT, Gobierno Vasco, Servei Català de Trànsit (SCT), Junta de Andalucia, Junta de Extremadura and other national stakeholders consulted (Ministry of Transports).
- Technology & Service providers: EYSA (platform), CPS (data and models), NTT Data (platform and data), AIMSUN (data and models), INGARTEK (data and models), MINDATA (platform).
- Academia: UPC (data and models), UPM (data and models)

Pilot 2: Regional pilots in Andalusia, Catalonia and Valencian Community

2.a) Regional pilot in Andalusia.

The Andalusia regional pilot aims to solve the use cases related to sustainable mobility management planning in the region and, in particular, in the TEN-T network corridors (both basic and comprehensive) that run through the region, paying special attention to the Mediterranean and central corridors. Likewise, Operation Marhaba or Operation Crossing the Strait is a very interesting case study at cross-border level to analyse in order to ensure the traffic solutions carried out in Spain in this Special Operation. Crossing the Strait Operation is a special traffic operation that takes place

during the summer months and involves a large volume of traffic coming from all over Europe and bound for North Africa, which passes through the roads of Spain to use the ferries of the Andalusian ports. For example, the main objective of Operation Crossing the Strait is the correct planning so as not to collapse the ports and access roads, especially in the central corridor and the Mediterranean corridor.

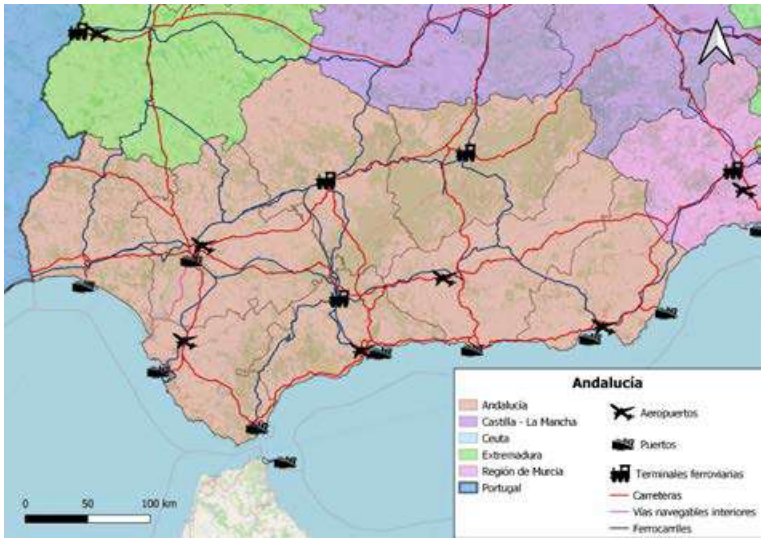


Figure 11. TEN-T Network in Andalusia.

The following actors will participate in this pilot:

- Public Authorities: General Directorate of Traffic DGT (which is responsible for traffic management on the roads network of Spain), Junta de Andalucia (associated partner/ stakeholder) that will provide the existing models as well as participate in the definitive establishment of KPIs, and other national stakeholders consulted (Ministry of Transports).
- Technology & Service providers: EYSA (platform), CPS (data and models), NTT Data (platform and data), AIMSUN (data and models), INGARTEK (data and models), MINDATA (platform).
- Academia: UPC (data and models), UPM (data and models)

2.b) Regional pilot in Catalonia.

This pilot could analyse the volume of traffic and journeys on the cross-border link between France and Spain, specifically on the cross-border links of the Mediterranean corridor and the central corridor, as well as develop a traffic map of the corridors and modes of transport of the TEN-T network.

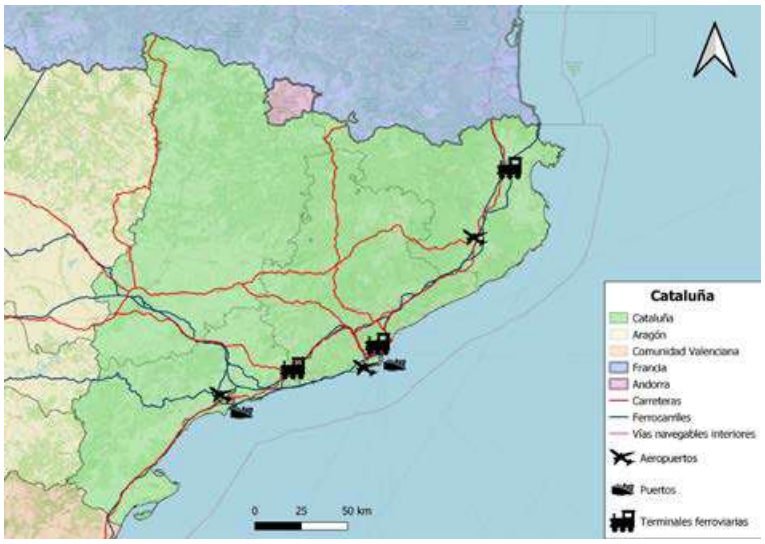


Figure 12. TEN-T Network in Catalonia.

The following actors will participate in this pilot project:

- Public Administrations: Autoritat Metropolitana de Barcelona (ATMB), Servei Català de Trànsit (SCT) that will provide the existing models as well as participate in the final establishment of the KPIs, General Directorate of Traffic DGT (responsible for ITS at border control points), and other national stakeholders consulted (Ministry of Transports).
- Technology & Service providers: EYSA (platform), CPS (data and models), NTT Data (platform and data), AIMSUN (data and models), INGARTEK (data and models), MINDATA (platform).
- Academia: UPC (data and models), UPM (data and models)

2.c) Regional Pilot in Valencian Community.

This pilot could contain many use cases, such as the planning of public transport in the main corridors of the Valencia Region and the TEN-T Network. This region is particularly important as it is served by the Mediterranean, Cantabrian-Mediterranean and Atlantic-Mediterranean corridors for both passengers and freight. The pilot could be focused on a public transport planning or multimodal travel management approach. This public transportation network will be efficiently designed and optimized based on data from public transport lines, demand, urban area growth, trips, etc. In addition, the matrix and trends of regional road passenger and freight movements could be analysed to ensure appropriate traffic management and planning or infrastructure solutions for regional movements and relate them to inter-regional movements via the TEN-T network. At the same time, we could measure the impact between the main metropolitan areas and provinces and the long-distance movements and national points of interest, coming from and through Catalonia in the north of the Mediterranean corridor and in the south of the Mediterranean corridor to Andalucia.

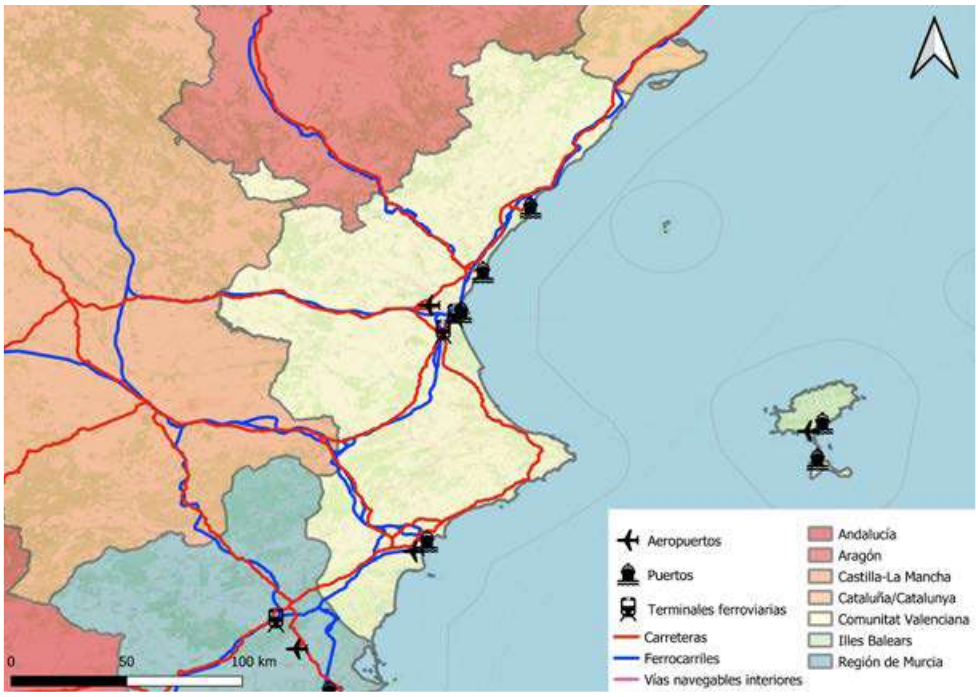


Figure 13. TEN-T Network in Valencian Community.

The following actors will participate in this pilot:

- Public Authorities: ATMV/Generalitat Valenciana, Valencia City Council, SEITT, DGT (which is responsible for traffic management on the roads network of Spain), and other national stakeholders consulted (Ministry of Transports).
- Technology & Service providers: EYSA (platform), CPS (data and models), NTT Data (platform and data), AIMSUN (data and models), INGARTEK (data and models), MINDATA (platform).
- Academia: UPC (data and models), UPM (data and models)

Pilot 3: Local pilots in the metropolitan area of Madrid, Barcelona and Valencia.

These three cities and metropolitan areas are part of the basic nodes of the trans-European network in the central, Atlantic-Mediterranean, Cantabric-Mediterranean, and Mediterranean corridors and are the three most populated nodes in Spain. It could be carried out a public transport planning or multimodal travel management for example. This public transportation network will be efficiently designed and optimized based on data from public transport lines, demand, urban area growth, trips, etc.

The following actors will participate in this pilot project:

- Public Administrations: Consorcio Regional de Transportes de Madrid (partner/associate) that will provide the existing models as well as participate in the final establishment of the KPIs, SEITT, General Directorate of Traffic (DGT), Autoritat Metropolitana de Transportes de Barcelona (ATMB), Servei Català de Trànsit (SCT), Autoritad de Transporte Metropolitano de Valencia ATMV/Generalitat Valenciana, Ayuntamiento de Valencia (Local government of the city of Valencia) and other national stakeholders consulted (Ministry of Transports).

- Technology & Service providers: EYSA (platform), CPS (data and models), NTT Data (platform and data), AIMSUN (data and models), INGARTEK (data and models), MINDATA (platform).
- Academia: UPC (data and models), UPM (data and models).

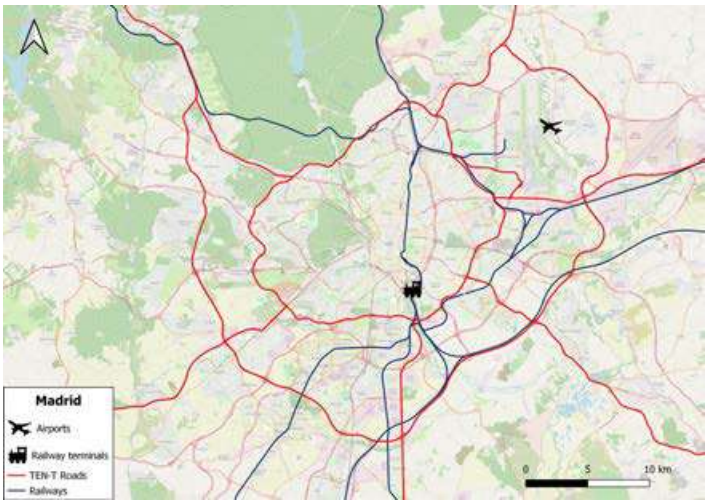


Figure 14. TEN-T Network in the metropolitan area of Madrid.

Pilot 4: Cross-border pilots in Portugal-Spain and France-Spain:

Pilot 4.1. Nouvelle-Aquitaine-Euskadi-Navarre Euroregion:

This pilot will contain different cross-border use cases in the Nouvelle-Aquitaine-Euskadi-Navarre Euroregion, which is a European Grouping of Territorial Cooperation (EGTC) subject to Regulation (EC) No 1082/2006 of the European Parliament and of the Council, by common agreement with the States, regions or communities that make it up. It therefore incorporates the regions of the Basque Country and Navarre on the Spanish side and the Nouvelle-Aquitaine region on the French side. The main objective of the EGTC is to develop a transversal and global territorial cooperation from a European perspective, which includes, among other specific objectives, sustainable territorial development in the field of mobility.

In this sense, this pilot may contain various use cases that guarantee the interoperability of data between the Spanish and French regions and, consequently, guaranteeing the joint management of the cross-border transport corridors of the TEN-T network. The cross-border corridors of the TEN-T network included in this pilot are the Atlantic corridor and the Atlantic-Mediterranean corridor.



The following actors will participate in this pilot:

- Public Administrations: Nouvelle-Aquitaine-Euskadi-Navarra Euroregion, Gobierno Vasco, General Directorate of Traffic DGT, and other national stakeholders consulted (Ministry of Transports).
- Technology & Service providers: EYSA (platform), CPS (data and models), NTT Data (platform and data), AIMSUN (data and models), INGARTEK (data and models), MINDATA (platform).
- Academia: UPC (data and models), UPM (data and models)

Pilot 4.2. Iberia Central West Region.

This pilot will contain different cross-border use cases between the Central Portugal Region and Central West Spanish Region.

The pilot includes the region of Portugal to connect the country to Europe through the Spanish territory.

The objective is to promote cross-border cooperation in the areas of interconnected and cohesive territory.

Includes the districts of Coimbra, Castelo Branco and Leiria, most of the districts of Aveiro, Viseo and Guarda, northern part of the District of Lisbon and about one third of the District of Santarém. As well as the region of the Junta de Extremadura.

This pilot may contain various use cases that guarantee the interoperability of data between the Spanish and Portugal region and, consequently, guaranteeing the joint management of the cross-border transport corridors of the TEN-T network. The cross-border corridors of the TEN-T network included in this pilot are the Atlantic corridor.



The following actors will participate in this pilot:

- Public Administrations: Comissão de Coordenação e Desenvolvimento Regional do Centro, I. P.: Junta de Extremadura, General Directorate of Traffic DGT, and other national stakeholders consulted (Ministry of Transports).
- Technology & Service providers: EYSA (platform), CPS (data and models), NTT Data (platform and data), AIMSUN (data and models), INGARTEK (data and models), MINDATA (platform).
- Academia: UPC (data and models), UPM (data and models)

Annex II. Stakeholders involved in each pilot

Table 6. Stakeholder–Pilot Relationship Overview

STAKEHOLDERS	Pilot 1. National	Pilot 2.a Andalusia	Pilot 2.b Catalonia	Pilot 2.c Valencian Community	Pilot 3. Metropolitan area	Pilot 4.1. Nouvelle-Aquitaine-Euskadi-Navarra Region	Pilot 4.2. Iberia Central West Region
DGT	X	X	X	X	X	X	X
SEITT	X			X	X		
BASQUE GOV.	X					X	
SCT	X		X		X		
MITMS	X	X	X	X	X	X	X
ATMB			X		X		
ATMV				X	X		
J.ANDALUCIA	X	X					
J. EXTREMADURA	X						X
VALENCIA C.C.				X	X		
CRTM					X		
CCDRC							X
EGCT						X	
NAVARRA GOV.	X					X	

Annex III. DS4MOBMODELS Data Governance

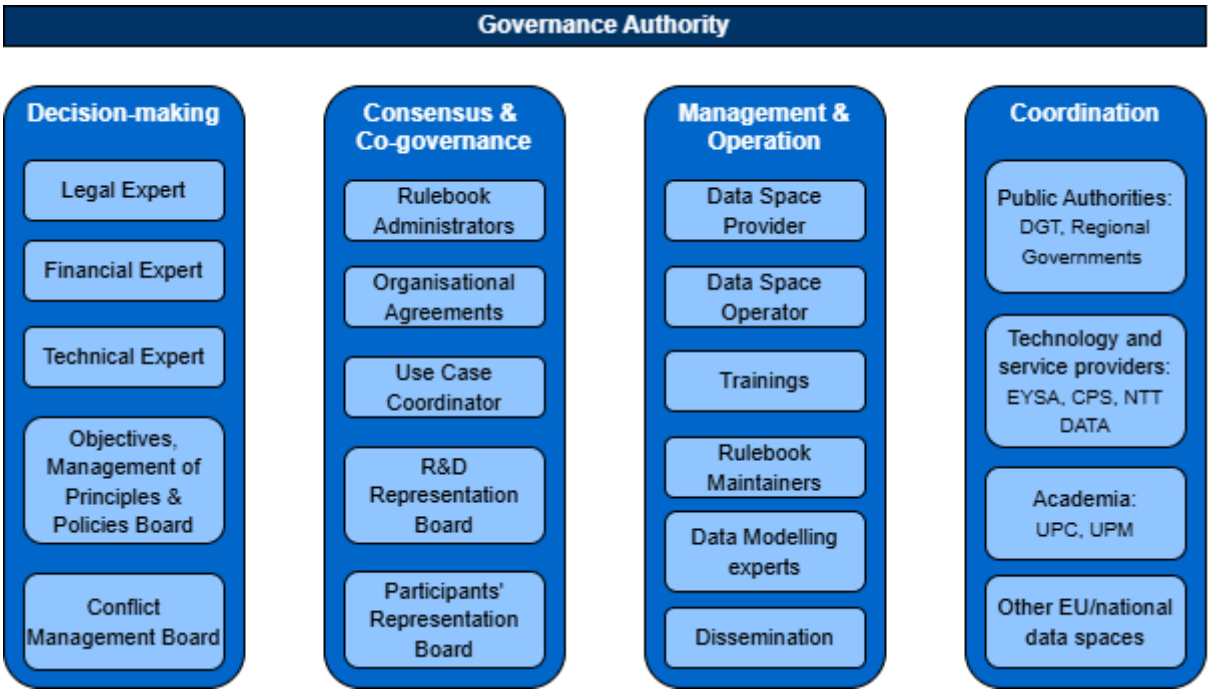


Figure 15. Data Governance pillars and actors.

Annex IV. References

Ige, A., Chukwurah, N., Adebayo, V., & Idemudia, C. (2024). Managing data lifecycle effectively: Best practices for data retention and archival processes. *International Journal of Engineering Research and Development*. *20*. 453–461.

Pol, E., Dion, O., Poikola, A., Lehtonen, K., Komulainen, A., Halenius, L., & Aarnio, R. (2023). *Towards a holistic EU data governance: Taking stock of the progress of the EU data strategy and proposals* (Sitra Working Paper, 27 September 2023). Sitra. https://www.sitra.fi/en/publications/towards-a-holistic-eu-data-governance/