Data Platform for the Connection of Cognitive Ports

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Abstract:

This deliverable will document the activities to be performed in the implementation of the pilots and the use cases, and the description of the current progress.

Keywords:

Use cases, pilots, activities, plan, progress, initial version, status, analysis, design, development, deployment, integration

Revision History

Revision	Date	Description	Author (Organisation)
V0.1	28.09.2021	First version of the document.	Héctor Iturria (PRO)
V0.2	26.10.2021	Merged with ITI comments.	Héctor Iturria (PRO)
V0.3	28.09.2021	Second version of the document.	Héctor Iturria (PRO)
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More information available at https://DataPorts-project.eu

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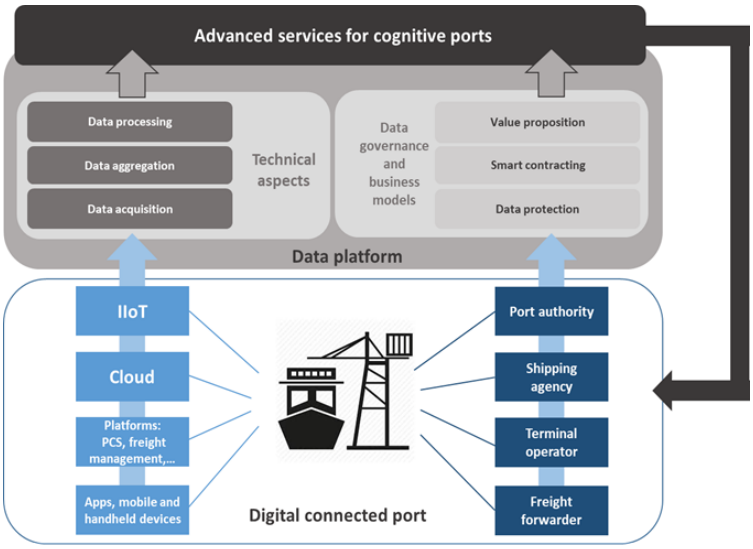
1 INTRODUCTION

1.1 DATAPORTS PROJECT OVERVIEW

DataPorts is a project funded by the European Commission as part of the H2020 Big Data Value PPP programme, and coordinated by the ITI - Technological Institute of Informatics. DataPorts rely on the participation of 13 partners from five different nationalities. The project involves the design and implementation of a data platform, its deployment in two relevant European seaports connecting to their existing digital infrastructures and addressing specific local constraints. Furthermore, a global use case involving these two ports and other actors and targeting inter-port objectives, and all the actions to foster the adoption of the platform at European level.

Hundreds of different European seaports collaborate with each other, exchanging different digital data from several data sources. However, to achieve efficient collaboration and benefit from AI-based technology, a new integrating environment is needed. To this end, DataPorts project is designing and implementing an Industrial Data Platform.



The DataPorts Platform aim is to connect to the different digital infrastructures currently existing in digital seaports, enabling the interconnection of a wide variety of systems into a tightly integrated ecosystem. In addition, to set the policies for a trusted and reliable data sharing and trading based on data owners' rules and offering a clear value proposition. Finally, to leverage on the data collected to provide advanced Data Analytic services based on which the different actors in the port value chain could develop novel AI and cognitive applications.

DataPorts will allow establish a future Data Space unique for all maritime ports of Europe and contribute to the EC global objective of creating a Common European Data Space.

1.2 DELIVERABLE PURPOSE AND SCOPE

Specifically, the DOA states the following regarding this Deliverable:

This will contain an analysis and design of each one of the pilot activities to be performed in tasks T5.2-T5.5. Additionally, this deliverable will include the first version of the applications developed documenting features implemented, build and deployment process and other usage aspects.

The purpose of this document is to describe the initial state of the pilots on M24, with a description of what has been done and the activities planned until the end of the project. With that view in mind, this document splits the content in two different kind of progress reports.

It contains global descriptions of activities that are being performed by many involved partners without considering the concrete use cases or scenarios, since they are general tasks or actions repeated in some of them, having little differences that would not require separated descriptions.

Then there are described all the rest of activities by scenario, showing the current progress, the activities ongoing and the future actions in the form of a roadmap. Also, an updated, more graphical and detailed description of each scenario is provided.

1.3 DELIVERABLE CONTEXT

Its relationship to other documents is as follows:

Primary Preceding documents:

- Description of Action (DOA): Provide the foundation for the actual research and technological content of DataPorts. Importantly, the Description of Action includes a description of the overall project work plan.
- D2.1 - Industrial Data Platforms and seaport community requirements and challenges: the content of the analysis of current infrastructures is the basis for the use case definitions.
- D5.1 - Integration, software quality assurance and deployment plan: it describes the plan of activities for the pilots' implementation.
- D5.2 - Evaluation plan: contains the evaluation plan of the pilots and describes the tasks related with this objective.

Primary Dependant documents:

- D5.4 - Use case oriented pilots final version: The activities performed from M24 to M36, whose descriptions should be included in the deliverable, will be guided by this document.
- D5.5 - Use cases and applications evaluation report: Contains the results of the DataPorts requirements and use cases evaluation.

1.4 DOCUMENT STRUCTURE

This deliverable is broken down in the following sections:

- **Section 1 Intro**: It includes an introduction to the project, a short description of the purpose and scope of this document and the dependencies with other deliverables.
- **Section 2 General**: A project progress overview, functionalities and usage of the components in the pilots. Also, description of the status of the activities that can't be split by scenario.
- **Section 3 Port of Valencia:** It describes the task and activities progress status according to the plan detailed in the D5.1 - Integration, software quality assurance and deployment plan for the Valencia scenarios.
- **Section 4 Port of Thessaloniki:** It describes the task and activities progress status according to the plan detailed in the D5.1 - Integration, software quality assurance and deployment plan for the Thessaloniki scenarios.
- **Section 5 Smart containers:** It describes the task and activities progress status according to the plan detailed in the D5.1 - Integration, software quality assurance and deployment plan of the global scenario.
- **Section 6 Port management system integration:** It describes the task and activities progress status according to the plan detailed in the D5.1 - Integration, software quality assurance and deployment plan of the global scenario.
- **Section 7 Requirements evaluation:** It describes the current progress of the evaluation tasks according to the plan detailed in the D5.2 – Evaluation plan**.**
- **Section 8 Conclusions**: It resumes the global status of the demonstrations and the goals coverage.

Annexes:

- **Annex A:** Requirement's evaluation details.

2 GENERAL

2.1 PROJECT OVERVIEW

The DataPorts project is split in several work packages that cover all the needed steps, from defining the initial concepts of the platform to the evaluation in real environments. The work package five (5) describes the tasks and milestones to achieve regarding the integration and validation, through the implementation of the pilots and their scenarios.

As a reminder, the project will demonstrate the platform's functionalities through two pilots at the ports of Valencia and Thessaloniki and two global use cases about Smart Containers and the integration with an existing Port Management System.

In the previous deliverable D5.1 (M15) there were described the use cases and all the activities to carry out along the rest of the project. Also, the D5.2 (M15) defined the evaluation plan for the validation of the functionalities of the platform.

During last months all participant partners have been working on the planned activities in order to get ready for the pilot start, so most of the effort was focused on the use case descriptions, adding details about the data to use, the participants, and how the platform is going to be used. As this document aims to describe the initial state of the pilots, it includes information about these tasks, and about the work in progress activities, so it contains a complete overview of the current state.

The Figure 1 – Activity plan depicts the tasks and plans for the last twelve (12) months of the project.

	Year 2	Year 3											
	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	24	25	26	27	28	29	30	31	32	33	34	35	36
Use cases specifications													
Common vocabulary													
Description of scenarios													
Functionalities demonstration matrix													
Roles													
Data access													
Data models													
Required infrastructure													
Implementation													
Platform components													
Current applications													
New applications													
Integration													
Platform components													
Current applications													
New applications													
Security and quality assurance													
Testing and evaluation													
Deliverables	D5.3												D5.4
													D5.5

Figure 1 – Activity plan

As shown in the activity planning figure, the last year of the project requires most of the effort in the development and integration of components and applications that take part in the pilots.

Once the platform components are developed, the integration in each of the scenarios will demand the extension of the platform, like the development of agents to acquire data from the data sets, and the deployment and configuration of on-premises components. Also, other applications, existing or new, will be improved or created to be able to share information in or use information from DataPorts.

2.2 GLOSSARY

2.2.1 DataPorts Components

The Table 1 – DataPorts platform components briefly describes the components of DataPorts architecture:

COMPONENT	DESCRIPTION
Data Access Component	Responsible for gathering, transforming and publishing data from different data sources to the platform.
Semantic Interoperability Component	Exposes a unified API to access the data from the different data sources connected to the DataPorts platform, providing both real-time and batch historical data to the data consumers.
Data Abstraction and Virtualization Component	Prepares the data inputs form various sources inside the generic DataPorts architecture, exporting the result datasets through exposed RESTful APIs.
Data Governance Component	Enables the handling of high-quality data, monitoring its complete lifecycle. It increases consistency and confidence of the data registered, improving data security, and minimizing the risk of not complying with relevant regulation.
Automatic Model Training Engine	Optimises business process using machine learning techniques.
Process-based Analytics Component	Uses the data available in the DataPorts federated platform in order to train a set of specific predictive business process monitoring ML models.

Table 1 – DataPorts platform components

2.3 USE CASES AND PLATFORM FUNCTIONALITIES

The DataPorts platform has been designed to provide multiple functionalities to achieve the expected goals. The pilots and scenarios use them as part of the demonstrations of the project.

The Table 2 – Functionalities and use cases matrix shows the scenarios of the use cases where the functionalities of the platform are showcased.

ID	Functionality	Scenarios
F-2.1	The DataPorts platform provides various platform governance capabilities and interoperability among different platforms	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers

ID	Functionality	Scenarios
F-2.2	The DataPorts platform sets a data driven ecosystem ready for a comprehensive exploitation of data, and virtual data repositories	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-2.3	The DataPorts platform introduces a novel, decentralized architecture, data and events can be recorded on a blockchain for transparency and credibility	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-2.4	The DataPorts platform (through blockchain technology) implements all the authentication and authorization mechanisms to allow data sharing and trading in a secure and reliable way	Tracking of Transport Operations Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-2.5	The DataPorts platform will be aligned with International Data Spaces (IDS) reference model, offering data owners the option to describe connectors where type and conditions of data will be clearly stated and offered to data consumers	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers

ID	Functionality	Scenarios
F-2.6	The DataPorts platform provides Orion Context Broker and Blockchain component, registering the description of the data	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-2.7	The DataPorts platform enables the data owners to exchange data	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-2.8	The DataPorts platform enables data sovereignty	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-3.1	The DataPorts platform enables connections with external sources of data supported by data agents manager	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-3.2	The platform will enable a real connection among current IT systems in ports environment, allowing them to share data and knowledge	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Posidonia Notifications

ID	Functionality	Scenarios
F-3.3	The DataPorts platform provides data sanitization algorithm to guarantee data integrity	Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19
F-3.4	The DataPorts platform establishes machine learning models	Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19
F-3.5	The DataPorts platform enables the federation of data varying in syntax and semantics	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-3.6	The DataPorts platform provides efficient and effective techniques for data wrapping to represent the underlying mechanism to support a selective, release, storage, and analytics on data	Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-3.7	The DataPorts platform provides semantic stream processing	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Posidonia Notifications Smart Containers
F-3.8	The DataPorts platform provides semantic data compression	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services
F-3.9	The DataPorts platform provides declarative, distributed data aggregation	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19
F-3.10	DataPorts platform provides an innovative user interface to guide the user in specifying privacy and data access policies	Tracking of Transport Operations Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers

ID	Functionality	Scenarios
F-3.11	The DataPorts platform provides the data owners data driven analytic services	Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications
F-3.12	The DataPorts platform provides the consumers and end users new AI and cognitive applications	Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19
F-3.13	The DataPorts platform provides tools to help decision processes	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications
F-3.14	The DataPorts platform provides smart API for cognitive services	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19
F-3.15	The DataPorts platform processes streams of records and publish and subscribe to streams of data	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-3.16	The DataPorts Platform provides a framework for semantic interoperability from several sources	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers

ID	Functionality	Scenarios
F-3.17	The DataPorts Platforms offers an ontology to guarantee semantic interoperability	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-3.18	The DataPorts Platform provides REST-style interaction with Linked Data	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-3.19	The DataPorts Platform provides a data source metadata registry	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-3.20	The DataPorts Platform provides data from a federated database on demand	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Smart Containers
F-3.21	The DataPorts Platform provides data from a federated database through publish and subscribe model	Tracking of Transport Operations Posidonia Notifications Smart Containers
F-4.1	Provide a platform to ensure data sharing among the actors operating in diverse supply chains per the defined data governance rules that respect the competitive advantage of all (who access what)	Tracking of Transport Operations Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers

ID	Functionality	Scenarios
F-4.2	The DataPorts platform provides services to ensure security and protection of shared data	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-4.3	The DataPorts platform ensures the needed anonymization or de-identification mechanisms while preserving the individual features required for effective big data analytics	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19
F-4.4	The DataPorts platform provides clear rules on how data will be accessed	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-4.5	The DataPorts platform provides flexibility of policies on data distribution	Tracking of Transport Operations Posidonia Notifications Smart Containers
F-4.6	The DataPorts platform provides end to end secure environment	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers

ID	Functionality	Scenarios
F-4.7	The DataPorts platform ensures full compliance with General Data Protection Regulation (GDPR)	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
F-4.8	The DataPorts platform enables efficient processing over protected data while preventing (or limiting) access to actual data content by other parties	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Sharing Verified Gross Mass Digital Consignment Note Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers

Table 2 – Functionalities and use cases matrix

2.4 DATAPORTS COMPONENTS

From the previous Table 2 – Functionalities and use cases matrix where the scenarios and functionalities have been matched, we can go one step further and showcase which components of the platform are going to be part of the scenarios.

The Table 3 – Components and scenarios lists the usage of the different components of the platform in the scenarios implemented in the project demonstration.

Component	Scenarios
Data Access Component	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers

Component	Scenarios
Semantic Interoperability Component	Tracking of Transport Operations Port Authority Data Sharing and Analytics Services Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
Data Abstraction and Virtualization Component	Port Authority Data Sharing and Analytics Services
Data Governance Component	Tracking of Transport Operations Container Pick-up Statistics for THPA Prediction Queues Predictions Facilitation of passengers, professionals and visitors of the port Statistics for passengers/visitors - Covid-19 Posidonia Notifications Smart Containers
Automatic Model Training Engine	Port Authority Data Sharing and Analytics Services
Process-based Analytics Component	Port Authority Data Sharing and Analytics Services Posidonia Notifications

Table 3 – Components and scenarios

2.5 SECURITY AND QUALITY ASSURANCE

The security and quality assurance process consist in several tasks and activities during the project with the aim to secure the DataPorts platform.

The first task is a Risk Assessment, which is the process of identify, analyse and evaluate the risks that may affect the DataPorts platform and impact the confidentiality, integrity or availability of DataPorts data or functions. By carrying out this task, the potential attacks and risks in DataPorts are identified and measures to address them are proposed.

The next task is a Security Code Review, which is the process of reviewing the code through several tools and scans. By reviewing the code, vulnerabilities in the code will be identified. These vulnerabilities constitute a risk of attack on the platform, which will be analysed and assessed. Also, proper countermeasures will be proposed.

The next task is a Penetration Test, which is the process of carrying out a dynamic test to the platform. All vulnerabilities that the DataPorts platform present will be identified, analysed and evaluated. Each vulnerability presents a risk that will be assessed. Also, countermeasures will be proposed for addressing the vulnerabilities of the platform.

Also, the definition, implementation and testing of governance rules for data sharing, as well as, the definition, implementation and testing of smart contracts in the blockchain are part of the security and quality assurance.

The table below present the status of the security and quality assurance tasks.

Time	Actors	Actions	Tasks Overview
M01–M06	NTT DATA	System identification during the risk assessment.	• **Status:** Done • **Issues:** None
M06-M12	NTT DATA	Risk identification, analysis and evaluation of risks. Selection of treatment options and countermeasures for facing identified risks.	• **Status:** Done • **Issues:** None
M06-M12	IBM, NTT DATA and CERTH	Definition of approach for Blockchain for governance rules. Selection of Fabric version and development language for chaincodes. Definition of a Minimum Viable Product (MVP) for VGM, CPU and data governance use cases	• **Status:** Done • **Issues:** None
M06-M12	IBM, OTE, EVR, ICCS, CERTH	Definition of the environment and components necessary for traceability and secure sharing of data.	• **Status:** Done • **Issues:** None
M12-M20	IBM, NTT DATA and CERTH	Definition of APIs, authorization roles and data access, data model and smartcontracts for each use case Development of the MVP functionalities: frontend, api's and specific chaincodes for each use case Deployment of 3 blockchain networks	• **Status:** Done • **Issues:** None.
M12-M20	IBM, OTE, EVR, ICCS, CERTH	Definition of the necessary mechanisms for the traceability and security of data and users in the blockchain network.	• **Status:** Done • **Issues:** None.
M12-M20	NTT DATA	Definition of security measures, scope and methodology of the pentest, security code review and security testing of the DataPorts platform. Definition of the data anonymization methodology.	• **Status:** Done • **Issues:** None.
M20-M30	CERTH, NTT DATA and IBM	Development of the functionality not included in MVP 1 for each use case (VGM, CPU, Data governance) Integrate the Data Governance Services into the DataPorts platform Verification in smart contracts of the validity of the identity provided by the identity manager of the platform	• **Status:** Ongoing • **Issues:** None
M20-M30	CERTH, NTT DATA and IBM	Monitoring and register of transactions in the logger chaincode (clearing house)	• **Status:** Ongoing • **Issues:** None
M20-M30	NTT DATA	To carry out the pentest, the security code review and the testing of pilots. All the results will be included in the deliverable.	• **Status:** Ongoing • **Issues:** None

Table 4 – Cybersecurity Plan Reporting Table

2.6 DATA MODELS

The data modelling is a process used to define and analyse data requirements needed to support the business processes within the scope of the corresponding information systems involved in the use cases. The data

model organizes data elements and standardizes how the data elements relate to one another. Since data elements document real life entities, places and things and the events between them, the data model represents the reality. Therefore, the process of data modelling involves the partners focused on the design (WP2) and in the implementation (WP3) of the platform working closely with end user's / business stakeholders (WP5), as well as potential users of the platform. Mainly, since M12 periodic meetings have been held with all these partners to work together on this common goal.

The DataPorts Data Model is a key element to enable the interoperability aims of the platform, since it defines the common representation of the information in the DataPorts platform. The initial version of the Data Model will be hosted in the DataPorts Git repository, which will contain the corresponding documents describing the syntax of the entities involved, as well as the documentation and examples. The DataPorts Data Model will be provided in the software deliverable "D3.5 - Data processing services M27" and will be validated and adopted in the use cases, its final status will be reflected in "D5.4 Use case oriented pilot's final version".

The Data Model has been defined considering the application domain, the needs of the pilots and the existing ontologies and data models related with the domains that must be covered by the DataPorts Data Model. The methodology to define the Data Model comprises the steps listed in the Table 5. In addition, this table contains the current status of each step.

Time	Actors	Actions	Tasks Overview
M6 -15	UPV / TRX	Technology selection and methodology and steps definition.	• **Status:** Completed • **Issues:** None
M15-M22	WP2 / WP3 /WP5 partners	Periodical meetings and workshops to get feedback from the use case owners' expertise: • Identify the concepts involved in the DataPorts use cases. • Classify the concepts as entities, attributes, and relationships. • Represent these relationships in a technical view.	• **Status:** Done • **Issues:** None. However, new input can be provided by ports in the future during the use cases integration and it will be considered
M15-M22	WP5 partners	Analyse the ontologies and data models (if this happens) currently used in each of the scenarios described in the pilots.	• **Status:** Done • **Issues:** None
M18-M24	UPV	Draft version of the DataPorts Data Model that unifies the information identified by each use case. • High-level view of the Data Model. • Classify the entities of the common Data Model into a set of domains and subjects	• **Status:** Done • **Issues:** Currently waiting the internal review of the Use Case owners.
M22-M24	UPV	Git repository structure creation and collaboration guidelines.	• **Status:** Done • **Issues:** None
M22-M24	WP2 / WP3 /WP5 partners	Analyse the existing ontologies and data models from standardization committees that could be reused to define the DataPorts Data Model.	• **Status:** Ongoing • **Issues:** None

Time	Actors	Actions	Tasks Overview
M22-M25	WP2 / WP3 /WP5 partners	Data Model Version 1.0: • Detailed specification of the Data Model.	• **Status:** Ongoing • **Issues:** None
M25-M32	WP5 partners	Taking as reference the first version of the Data Model: • Data Model improvement and integration in the use cases. Each Data Model folder defined in the Git Repository is going to follow this lifecycle: Incubated / Harmonized / Adopted.	• **Status:** Not started • **Issues:** None

Table 5 – Data Model Plan Reporting Table

3 PORT OF VALENCIA

This section describes the four scenarios defined for the Valencia pilot including a description, flow of information, data sources, action plans, applications, etc.

For each of the scenarios is described which DataPorts components are used, and which are their interactions. Furthermore, there are two types of Blockchain solutions developed for these scenarios. On one hand, there is the Data Governance component based on Blockchain, which is part of the platform, and it is used in one of the scenarios. On the other hand, there are Blockchain based port applications, which do not make use of a platform, but rather utilize Blockchain technology to build custom solutions to improve internal port operations within the ports' ecosystem.

3.1 TRACKING OF TRANSPORT OPERATIONS

3.1.1 Scenario Description

This scenario defines DataPorts as a hub for tracking events in the context of ValenciaPort to which port stakeholders could subscribe to. The data providers will publish relevant information related to a unique identifier relevant in a maritime logistic chain: a container identification number, a ship identifier, or a goods identifier. Such published events will be available to data consumers using the DataPorts data governance framework. For instance, a freight forwarder using DataPorts subscribes to every event related to a container identification number and/or the vessel transporting such container. If access is granted by the owners of the data, this freight forwarder will receive in near real-time such events, which can then be used to improve its transport operations. The freight forwarder could, for example, be notified when the vessel with the container has arrived at the port, or when the container has left the port premises by truck, etc.

DataPorts will provide a single access point for all the relevant events without the need of implementing specific integration or authentication mechanisms for each data provider. As every event data/message follows the data model already defined by DataPorts, also the process of understanding the received data is simplified: there is no need of understanding the underlying information system of the data provider.

The Figure 2 depicts the workflow and interactions of the scenario:

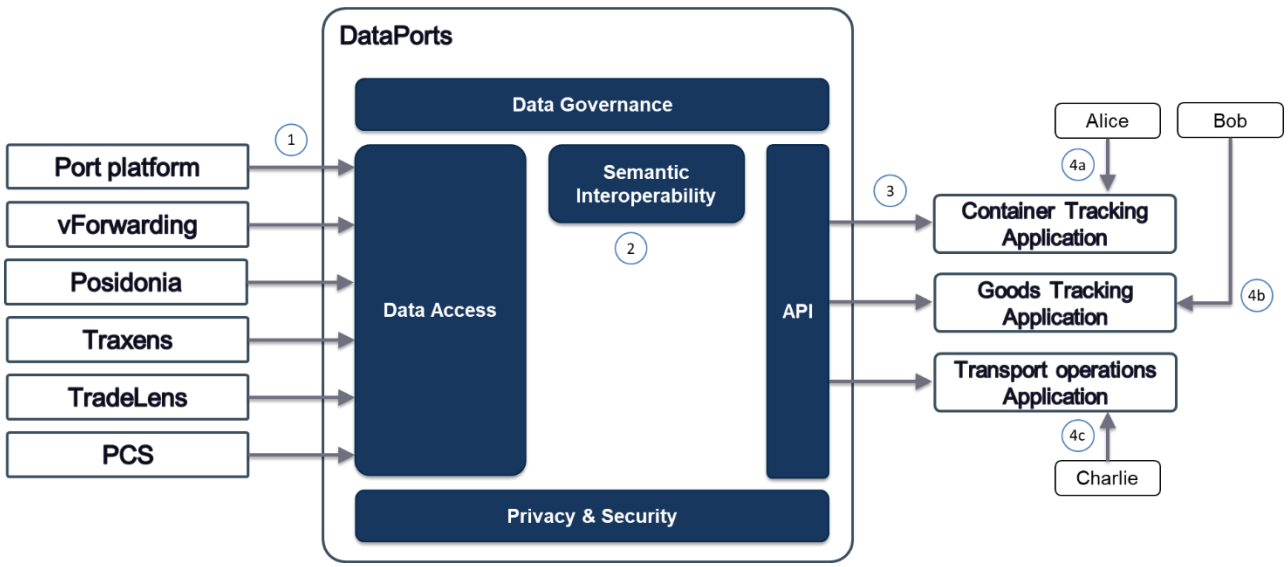


Figure 2 – Tracking of Transport Operations workflow

The Table 6 lists the interactions, events and processes of the scenario:

Step	Description
1	The Data Access component has an agent for each of the data sources to receive real-time data about container location or transport events
2	The Semantic Interoperability component checks with the Data Governance component if the user has permission to the requested data and transform it to the common model
3	The data is sent to the subscribed applications through the common API
4a	Alice uses the Container Tracking application to get the location of all her containers
4b	Bob uses the Container Tracking application to get the location of all her containers
4c	Alice uses the Container Tracking application to get the location of all her containers

Table 6 – Tracking of Transport Operations Scenario Description

The datasets shown on Table 7 will be used in this scenario:

Datasource	Description of data
Valencia port authority platform	Gate access data including truck plates and containers number
vForwarding	Cargo and transport operations data from the freight forwarder
Posidonia Operations	Vessel events in the port of Valencia
Traxens	Container location for the containers monitored
TradeLens	Container transport events related to the port of Valencia
PCS	Road transport transactions in the Valencia port

Table 7 – Tracking of Transport Operations Scenario Datasets

3.1.2 DataPorts roles

The Table 8 shows the organizations that take part in the scenario implementation and their roles:

Organisation	Role
VPF	Fundación Valenciaport is the scenario leader, will provide the infrastructure and knowledge to successfully run the demo, and will develop the applications.
PRO	Prodevelop will develop the agent to acquire vessel data at port premises and will deploy the Data Access component
UPV	UPV will be in charge to transform data to a common data model with the Semantic Interoperability component
EVR	Everis will deploy the data governance component and manage the permissions
TRX	Traxens will develop the agent to integrate container position from its platform

Table 8 – Tracking of Transport Operations Roles

3.1.3 Action Plan

The Table 9 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions	Tasks Overview
M20-M24	VPF	Provide the scenario specification with the support of all involved partners	• **Status:** Completed • **Issues:** None

Time	Actors	Actions	Tasks Overview
M24-M26	VPF, PRO, UPV, EVR	Deploy the necessary infrastructure for the scenarios and the DataPorts Components	• **Status:** Not started • **Issues:** None
M25-M28	PRO, VPF, TRX	Development of the Agents for all the data sources	• **Status:** Not started • **Issues:** None
M28-M32	VPF	Develop the three applications	• **Status:** Not started • **Issues:** None

Table 9 – Tracking of Transport Operations Action Plan Reporting Table

3.1.4 Applications

The Table 10 describes the applications that are part of the scenario that interact with the platform and should be modified or implemented:

Application	Action	Status
Container Tracking Application	New application	0%
A shipping line is interested in monitoring all its own containers. The application allows real-time location of the containers		
Application	Action	Progress
Goods Tracking Application	New application	0%
An importer or exporter can access to the cargo tracking data that any data provider is sharing		
Application	Action	Progress
Transport operations Application	New application	0%
A freight forwarder can monitor the status of all the transport operations that is managing. It includes location events, status, delays, etc.		

Table 10 – Tracking of Transport Operations Applications

3.1.5 Testing and evaluation

Test ID	Description
TTO.1	The Agents are deployed, configured, and receiving data
TTO.2	The common API allows to access de transport data
TTO.3	The Container Tracking Application shows the container location in a map
TTO.4	The Goods Tracking Application shows the goods location in a map
TTO.5	The Transport operations Application includes a list of events per transport operation

Table 11 - Tracking of Transport Operations Test Cases

3.2 PORT AUTHORITY DATA SHARING AND ANALYTICS SERVICES

3.2.1 Scenario Description

The Valencia port authority requires to receive data from different companies in the port in order to monitor and control the activity. For that, it uses different systems and channels to gather historical data. Furthermore, the port authority is interested in analysing what will happen in the following days and months to provide statistical reports to other companies operating.

Some of this data is received through the ValenciaPort PCS, but this system is only focused on transport transactions. At this moment, there is no standard way to share data with the Valencia Port Authority: this data is sent by different communication channels and using several data formats. Therefore, a specific process for each data source is required, and it is not straightforward to build such services.

The DataPorts platform will improve the current data sharing approach. Using DataPorts historical data will be processed and transformed into a common data format. This metadata will be processed within the platform to perform predictions which can be useful for different purposes. This information will be used to provide analytical services in top of such data to help the port stakeholders.

As an example, for this scenario, we will gather data related with the customs import/export statistics and vessel calls. Using such data, it will be feasible to forecast the tons expected to be imported/exported in the following weeks or predict the estimated time of arrival for a vessel. We also foresee the use of data from the road transport operations recorded in the ValenciaPort PCS. The resulting analytical service will be made available to rest of the port stakeholders using the DataPorts platform's interoperability and governance mechanisms.

The Figure 3 depicts the workflow and interactions of the scenario:

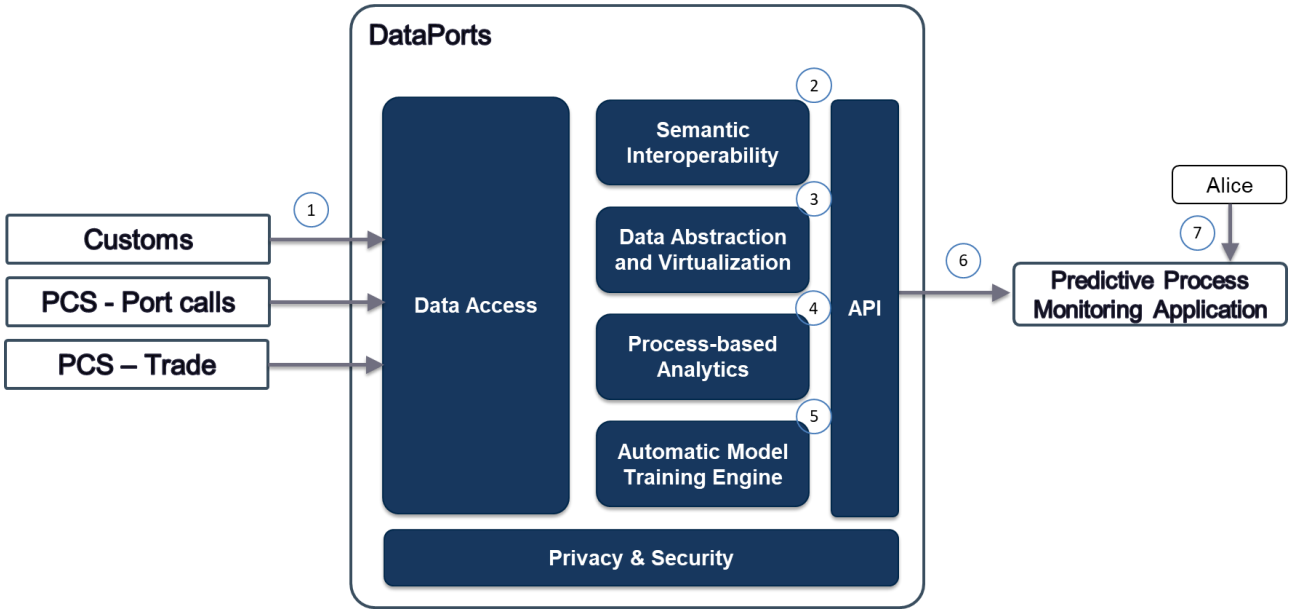


Figure 3 – Port Authority Data Sharing Workflow

The Table 12 lists the interactions, events and processes of the scenario:

Step	Description
1	The Data Access component asks for data about Vessels' port calls and container trade through an Agent
2	The Semantic Interoperability component checks with the Data Governance component if the user has permission to the requested data and transform it to the common model
3	The Data Abstraction and Virtualization component prepares the data inputs for the next components
4	The Process-based Analytics component optimizes the business process
5	The Automatic Models Training Engine searches the best ML predictive model to make a forecast based on the previous data training
6	The resulting data is sent to the subscribed application through the common API

Step	Description
7	Alice uses the Predictive Process Monitoring application to get the predictions

Table 12 – Port Authority Data Sharing Scenario Description

The datasets shown on Table 13 will be used in this scenario:

Datasource	Description of data
Customs	Anonymised Container trade data in Spain
PCS	Vessel port calls
PCS	Container trade data in the port of Valencia

Table 13 – Port Authority Data Sharing Scenario Datasets

3.2.2 DataPorts roles

The Table 14 shows the organizations that take part in the scenario implementation and their roles:

Organisation	Role
VPF	Fundación Valenciaport is the scenario leader, will provide the infrastructure and knowledge to successfully run the demo
PRO	Prodevelop will deploy the Data Access component and create the Agents
UPV	UPV will be in charge to transform data to a common data model with the Semantic Interoperability component
ITI	ITI will deploy the Automatic Models Training Engine component to IA cognitive services based on the data available in DataPorts platform
ICCS	ICCS will deploy and configure the Data Abstraction and Virtualization component
UDE	UDE will deploy and configure the Process-based Analytics component

Table 14 – Port Authority Data Sharing Roles

3.2.3 Action Plan

The Table 15 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions	Tasks Overview
M20-M24	VPF	Provide the scenario specification with the support of all involved partners	• **Status:** Completed • **Issues:** None
M24-M26	VPF, PRO, UPV, ITI, ICCS, UDE	Deploy the necessary infrastructure for the scenarios and the DataPorts Components	• **Status:** Not started • **Issues:** None
M25-M28	PRO	Development of the Agents for all the data sources	• **Status:** Not started • **Issues:** None
M20-M28	ITI	Implement the data pipelines to generate the cognitive services based on Port Authorities needs	• **Status:** Ongoing • **Issues:** None
M28-M32	ITI	Develop the application	• **Status:** Not started • **Issues:** None

Table 15 – Port Authority Data Sharing Acton Plan Reporting Table

3.2.4 Applications

The Table 16 describes the applications that are part of the scenario that interact with the platform and should be modified or implemented:

Application	Action	Status
Predictive Process Monitoring Application	New application	0%
The Valencia port authority needs to receive data from different entities in the port community for monitoring and statistics purposes. The application provides predictions about vessel calls and container trade.		

Table 16 – Port Authority Data Sharing Applications

3.2.5 Testing and evaluation

Test ID	Description
DSA.1	The Agents are deployed, configured, and requesting data
DSA.2	The Semantic Interoperability component transforms the data to the common model
DSA.3	The Data Abstraction and Virtualization component cleans the data inputs
DSA.4	The Process-based Analytics component optimizes the business process
DSA.5	The Automatic Models Training Engine component create IA cognitive services
DSA.6	The Automatic Models Training Engine component create predictions
DSA.7	The common API allows to access the foreseen data
DSA.8	The Predictive Process Monitoring shows the foreseen data

Table 17 - Port Authority Data Sharing Test Cases

3.3 SHARING VERIFIED GROSS MASS

3.3.1 Scenario Description

In the container transport operations, it is needed a complete management of the lifecycle of container weight requests in order to comply with the Convention on the Safety of Life at Sea (SOLAS) from International Maritime Organization (IMO). It is a requirement before loading a full container on a vessel for export. The shipper became the responsible for obtaining the Verified Gross Mass (VGM) of a full container and communicating it to the shipping company, with a VGM certificate.

DataPorts platform offer users an effective solution to allow containers to arrive at the port with the verified gross weight, reducing last minute incidents or delays at container terminals or the appearance of congestion situations. In addition, it offers a fast and automated method for the verified gross weight to reach the shipping company and the terminal; and allows the port to be more competitive.

The solution provides more added value than existing solutions by having a verifiable and immutable information on shared data through the entire chain to all concerned business participants serving as a source of truth and providing transparency and non-repudiation process. The VGM Blockchain implementation serves as a single source of truth and providing transparency and non-repudiation process, assuring that the weight cannot be altered at any point in the process.

The Figure 4 depicts the workflow and interactions of the scenario:

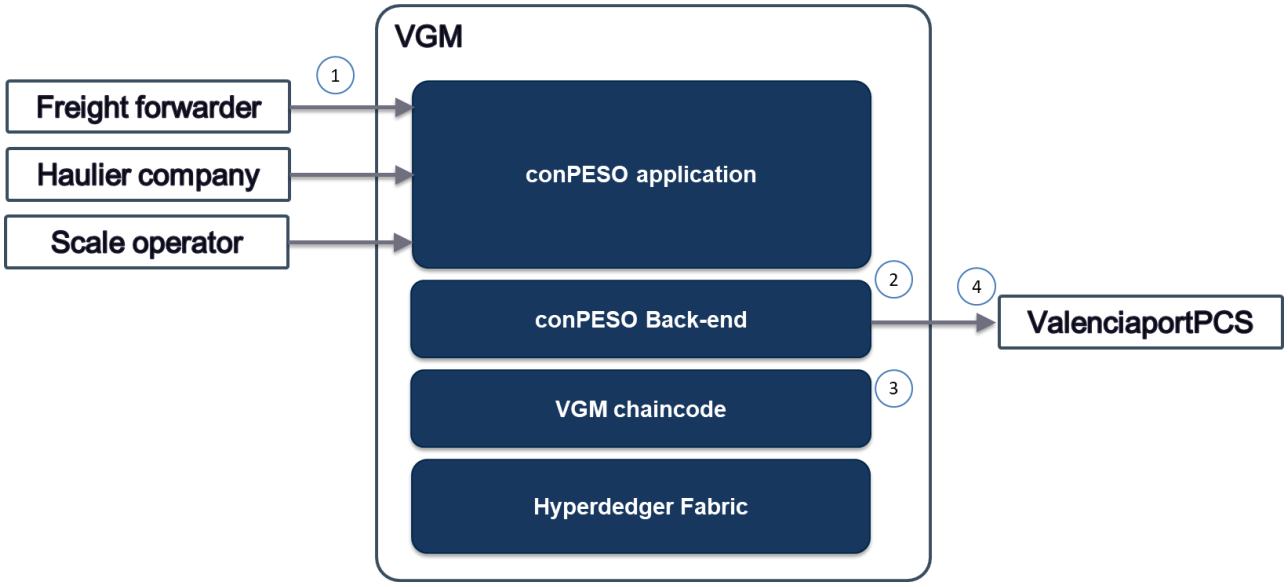


Figure 4 – Sharing Verified Gross Mass Workflow

The Table 18 lists the interactions, events and processes of the scenario:

Step	Description
1	One of the actors involved (freight forwarder, haulier company, or scale operator) provides data through the conPESO application
2	The data is processed and stored in the conPESO back-end
3	The proper data is stored in in Blockchain through the chaincodes
4	The VGM certificate is also sent to the ValenciaportPCS to be available to other companies which are not part of the process

Table 18 – Sharing Verified Gross Mass Scenario Description

The data providers of the scenario are included on Table 19:

Data Provider	Description of data
Shipper or the freight forwarder	Provide the information for the weight request
Haulier company or scale operator	Provide the truck data
Scale operator	Provides the weight data from each container after it is measured

Table 19 – Sharing Verified Gross Mass Scenario Datasets

3.3.2 DataPorts roles

The Table 20 Table 8 – Tracking of Transport Operations Rolesshows the organizations that take part in the scenario implementation and their roles:

Organisation	Role
VPF	Fundacion Valenciaport is the scenario leader, provides the infrastructure and knowledge to successfully run the demo, deploys the Blockchain infrastructure, and develops the back-end services and front-end application
IBM	IMB defines the deployment and configuration of the Blockchain infrastructure and develops the chaincodes

Table 20 – Sharing Verified Gross Mass Roles

3.3.3 Action Plan

The Table 21 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions	Tasks Overview
M10-M12	VPF	Provide the scenario specification with the support of all involved partners	• **Status:** Completed • **Issues:** None
M12-M13	VPF, IBM	Deploy the local infrastructure	• **Status:** Completed • **Issues:** None
M12-M15	VPF	Develop first version of front-end and back-end	• **Status:** Completed • **Issues:** None
M14-M15	IBM	Develop the chaincode for interacting with Hyperledger	• **Status:** Completed • **Issues:** None
M16-M17	VPF, IBM	First MVP	• **Status:** Completed • **Issues:** None
M21-M24	VPF, IBM	Deploy the Blockchain infrastructure in virtual servers	• **Status:** Ongoing • **Issues:** None
M24-M30	VPF	Enhance development of front-end and back-end with extended functionalities	• **Status:** Ongoing • **Issues:** None

Table 21 – Sharing Verified Gross Mass Action Plan Reporting Table

3.3.4 Applications

The Table 22 describes the applications that are part of the scenario that interact with the platform and should be modified or implemented:

Application	Action	Status
conPESO Application	New version	0%
Actors involved in the VGM process use the application to submit the container weight request, register the certified gross mass of its trucks and semi-trailers, provide the VGM, ensure the payment, and obtain the VGM certificate		

Table 22 – Sharing Verified Gross Mass Applications

3.3.5 Testing and evaluation

Test ID	Description
VGM.1	The Blockchain infrastructure in deployed and chaincodes allow the exchange of data
VGM.2	The conPESO application allows users to provide the data
VGM.3	Users can access data through the different menus of conPESO

Table 23 - Sharing Verified Gross Mass Test Cases

3.4 DIGITAL CONSIGNMENT NOTE

3.4.1 Scenario Description

Management of road transport requires some documents which nowadays are not electronic. Exist some difficulties in using electronic transport documents identified by the European Commission. To tackle these difficulties, the EC is proposing a regulation on electronic Freight Transport Information (eFTI) that establishes the full obligation for Member State authorities to accept regulatory cargo transport information or documentation, with partially harmonised implementation. DataPorts capabilities should be able to tackle with the European Interoperability Framework and the functional requirements for eFTI platforms service providers.

In order to manage the operations, freight forwarders need to make available the electronic transport documents to all the involved organizations. The most interested parties are the haulier companies which need the consignment note during the transport operation if it is required by the authorities (e.g. police).

The Figure 5 depicts the workflow and interactions of the scenario:

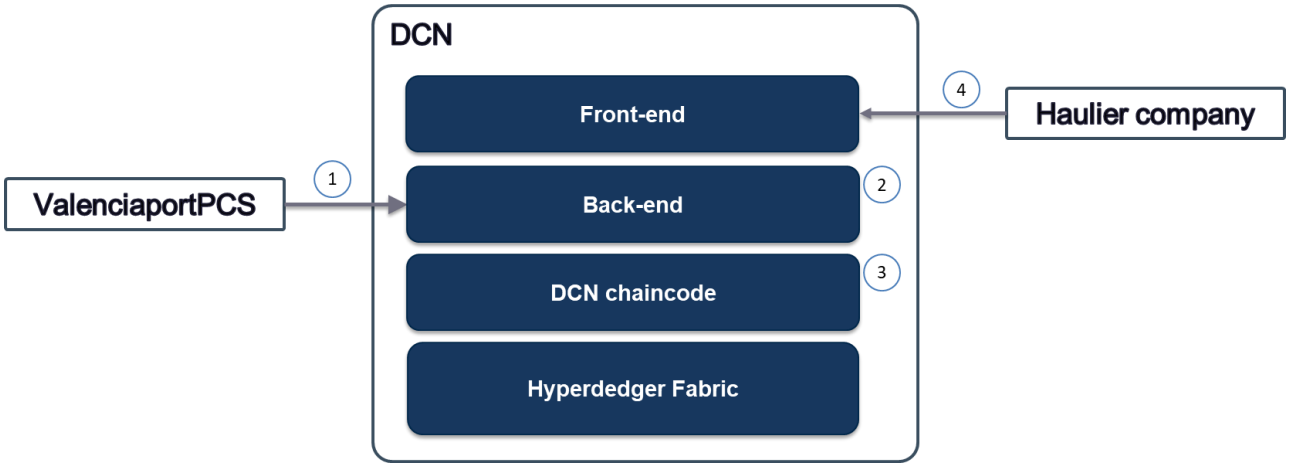


Figure 5 – Digital Consignment Note Workflow

The Table 24 lists the interactions, events and processes of the scenario:

Step	Description
1	Consignment note data is received from ValenciaportPCS to DataPorts platform
2	Consignment note is registered as PDF/A document in a document database in the back-end
3	The operation registered in Blockchain off-chain. A proof of registration is annotated in Blockchain
4	Stakeholders related to consignment note data (shipper, consignee, road haulier, container owner, empty container depot/terminal and authorities) can download the updated version of

Step	Description
	the consignment note PDF/A document and check the integrity and traceability through the DataPorts platform

Table 24 – Digital Consignment Note Scenario Description

The data providers of the scenario are included on Table 25:

Data provider	Description of data
ValenciaportPCS	Shares through to DataPorts the consignment note data with relevant stakeholders (shipper, consignee, road haulier, container owner and empty container depot/terminal)

Table 25 – Digital Consignment Note Scenario Datasets

3.4.2 DataPorts roles

The Table 26 Table 8 – Tracking of Transport Operations Rolesshows the organizations that take part in the scenario implementation and their roles:

Organisation	Role
VPF	Fundación Valenciaport is the scenario leader, provides the infrastructure and knowledge to successfully run the demo, deploys the Blockchain infrastructure, and develops the back-end services and front-end application

Table 26 – Digital Consignment Note Roles

3.4.3 Action Plan

The Table 27 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions	Tasks Overview
M30-M31	VPF	Deploy the Blockchain infrastructure in virtual servers	• **Status:** Not started • **Issues:** None
M32-M34	VPF	Develop the front-end	• **Status:** Not started • **Issues:** None
M33-M35	VPF	Develop the back-end	• **Status:** Not started • **Issues:** None

Table 27 – Digital Consignment Note Action Plan Reporting Table

3.4.4 Applications

The Table 28 describes the applications that are part of the scenario that interact with the platform and should be modified or implemented:

Application	Action	Status
Digital Consignment Note Application	New application	0%
Freight forwarder and road haulier need to access the last version consignment note for their transport operations		

Table 28 – Digital Consignment Note Applications

3.4.5 Testing and evaluation

Test ID	Description
DCN.1	The Blockchain infrastructure in deployed and chaincodes allow the exchange of data
DCN.2	ValenciaportPCS is sending the consignment notes
DCN.3	Users can access data through the application to the digital consignment note

Table 29 - Digital Consignment Note Test Cases

4 PORT OF THESSALONIKI

4.1 CONTAINER PICK-UP

The Container Pick-Up (CPU) use case has arisen from the merging of two previously defined use cases: "Data-Driven Application for Strategic and Real-Time Decisions" and "Permit ID for Container Pick-up", which were finally deemed as inseparable and, therefore, better understood as one use case.

4.1.1 Scenario Description

Ports are the nodes in the global network providing a key link between sea and land and the connection with the hinterland. The port community or the port ecosystem consists of a variety of stakeholders like port authorities, terminal operators, shipping companies, trucking companies etc. As the transport industry becomes more demanding in terms of increased efficiency and lowered costs, sharing and timely provision of accurate information between the business network is more critical than ever.

Container loading and discharge is a core port activity for the port of Thessaloniki. The following description refers to the case of a container discharge from the port premises. The procedures involve a Shipping Agent, as the beneficial cargo owner at the time, who wishes to pick-up a container from the yard and a trucking company, which picks-up the container, on his behalf.

Currently, for ThPA to release a container from its premises, all relevant paperwork must be in place (customs clearance, invoicing, etc); however, it requires sometimes the physical presence of the respective shipping agent in ThPA premises for the issuing or filling in of relevant documentation. After evaluation, ThPA then notifies only the related shipping agent, and he in turn contacts the trucking company to pick it up, without further THPA involvement.

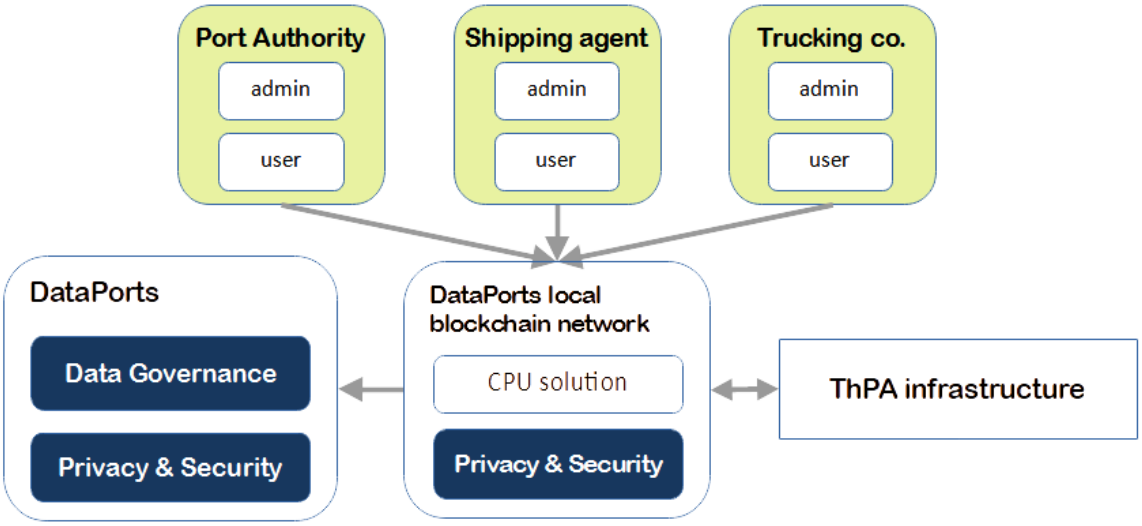


Figure 6 – Workflow Diagram of the CPU Use Case

Through the DataPorts solution for the CPU use case, a new environment is set up where the entire lifecycle of the container release/pick-up can be followed by all three involved parties. The interconnection of different systems in this environment is depicted diagrammatically in Figure 6. Table 30 lists the interactions, events and processes of the scenario.

Step	Description
1a	The Shipping Agent uses the DataPorts CPU solution frontend to register a COntainer RElease ORder (COREOR) request[1], specifying the Trucking Company to pick-up the container.
1b	A copy of this request is saved on the local blockchain infrastructure.
1c	The COREOR request is sent in XML format, to ThPA's TOS (Terminal Operating System).
2a	A ThPA Operator checks the request through the TOS and other relevant processes (invoicing, customs clearance); if everything is in order, the employee approves the request and a Permit ID is issued for that COREOR, otherwise it is rejected.
2b	The Permit ID is communicated to the DataPorts CPU solution blockchain backend through an API that exposes the CPU smart contracts. This updates the request in the blockchain, adding the Permit ID.
3a	The Shipping Agent can view the complete COREOR request information in their DataPorts CPU solution dashboard.
3b	The Trucking Company receives only a notification containing the Permit ID.
4a	Using the issued Permit ID, the Trucking Company can proceed to arrange the pick-up of the container, following the normal process of booking an available timeslot through the TAS and Freezone port systems.
4b	The ThPA systems notify the DataPorts CPU solution, through our API, of the new booking.
4c	Through a second API call, the blockchain backend is notified of whether the booking was accepted or rejected.
5	When the booking is accepted, the Trucking Company can view, in their DataPorts CPU solution dashboard, the QR code issued for it.
6	At a later stage, the ThPA operator can make the COREOR dataset available on Data Governance.

Table 30 – CPU Scenario Description

The use case both COREOR and booking information is saved on-chain in our local ThPA Fabric network. Figure 7 is a sequence diagram showing the "success" scenario of the use case, i.e., both COREOR and corresponding booking are accepted.

The data sources used in the CPU scenario are shown in Table 31.

Data source	Description of data
Local DataPorts frontend	Produces the COREOR XML message, containing all the necessary details about the container to be picked-up.
Terminal Operating System (TOS)	Issues a unique Permit ID number that is attached to the COREOR. The Permit ID is essentially the approval of the COREOR request.
Truck Appointment System (TAS)	Application used by authorized users (mainly truckers and forwarders) to book timeslots for the delivery and/or pick up of containers. Produces part of the booking data.

1 The COREOR message is an order to release containers, which gives permission for them to be picked up by, or on behalf of, a specified party. It is used in Electronic Data Interchange (EDI) between trading partners and is specified by the United Nations Directories for Electronic Data Interchange for Administration, Commerce and Transport (UN/EDIFACT)

Data source	Description of data
THPA Freezone system	Application where the trucker logs in on the day of the booking to get a ticket with the QR code.

Table 31 – CPU Scenario Data Sources

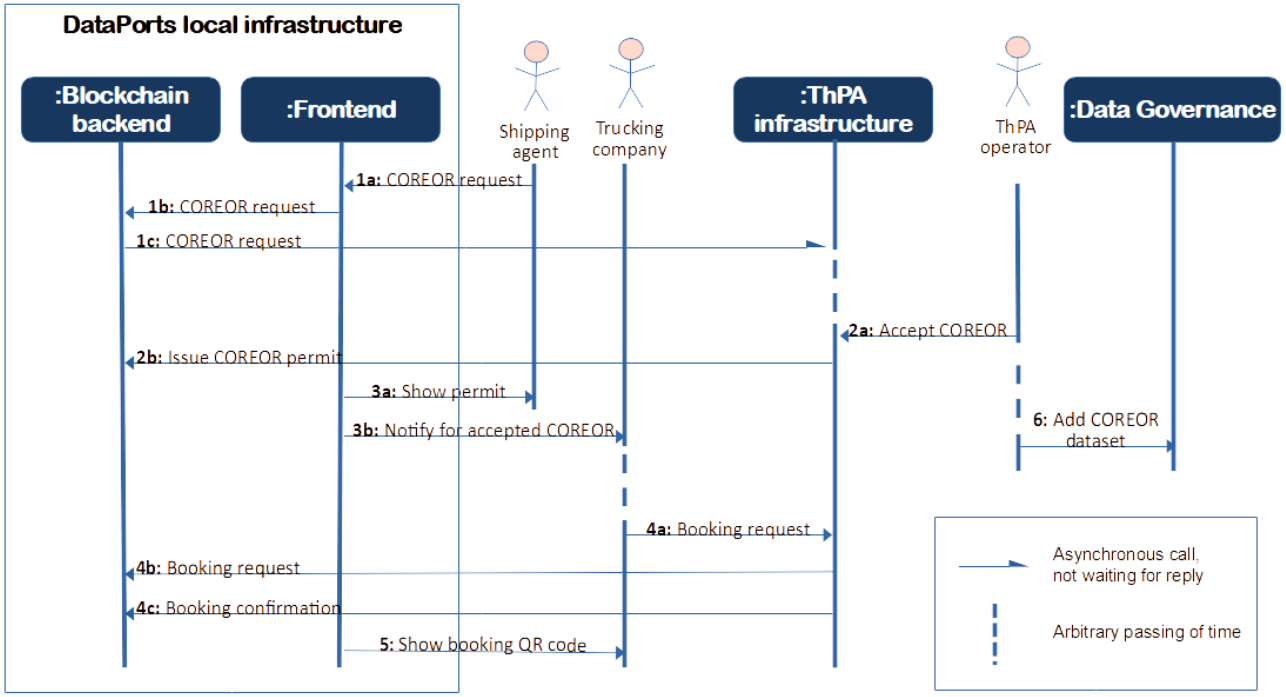


Figure 7 – Sequence diagram for the main scenario of the CPU use case

4.1.2 DataPorts roles

Table 32 shows the organizations that take part in the scenario implementation and their roles.

Organisation	Role
ThPA	THPA will be the scenario leader, providing the infrastructure and knowledge to successfully run the demo.
CERTH	CERTH defines the blockchain configuration and deploys the blockchain infrastructure, develops the chaincode and develops the back-end services and front-end application.

Table 32 – CPU Use Case Roles

4.1.3 Action Plan

Table 33 contains the tasks involved in the implementation of the scenario.

Time	Actors	Actions	Tasks Overview
M10-M12	ThPA	Provide the scenario specification with the support of all involved partners	• **Status:** Completed • **Issues:** None
M11-M12	CERTH	Deploy test infrastructure	• **Status:** Completed • **Issues:** None
M11-M16	CERTH	Develop first version of front-end and back-end	• **Status:** Completed • **Issues:** None

Time	Actors	Actions	Tasks Overview
M11-M15	CERTH	Develop the chaincode for interacting with Hyperledger	• **Status:** Completed • **Issues:** None
M16-M17	CERTH	First MVP	• **Status:** Completed • **Issues:** None
M18-M30	CERTH	Continuous development of frontend and backend with extended functionalities; continuous improvement/bug fixing of frontend/backend	• **Status:** Ongoing • **Issues:** None
M24-25	CERTH, ThPA	Integration with ThPA infrastructure	• **Status:** Ongoing • **Issues:** None
M24-M27	CERTH, ThPA	Deploy the Blockchain infrastructure on port premises	• **Status:** Not started • **Issues:** None

Table 33 – CPU Use Case Action Plan Reporting Table

4.1.4 Applications

Table 34 describes the applications that are part of the scenario that interact with the platform and should be modified or implemented:

TOS (FRETIS)	Modification	0%
Add the functionality to import the incoming COREOR message from the new THPA/DataPorts page and store it internally. Add the functionality to send the notification to the Platform, when the request is approved.		

Table 34 – CPU Use Case Applications

4.1.5 Testing and evaluation

Test ID	Description
CPU.1	The CPU solution frontend is deployed and allows users to enter data
CPU.2	The CPU solution backend (blockchain infrastructure + Node.js API gateway) is deployed and the smart contracts allow the on-chain persistence and exchange of data
CPU.3	The ThPA infrastructure can receive and send data (COREORs and bookings)
CPU.4	The CPU solution frontend allows users to read updated data, received from the ThPA infrastructure

Table 35 – CPU Test Cases

4.2 ANALYTICS USE CASES FOR THPA

The Thessaloniki Port Authority will be taking advantage of four analytics use cases developed specifically for its needs. These are briefly described in the following subsections.

4.2.1 General Workflow and Scenario Description

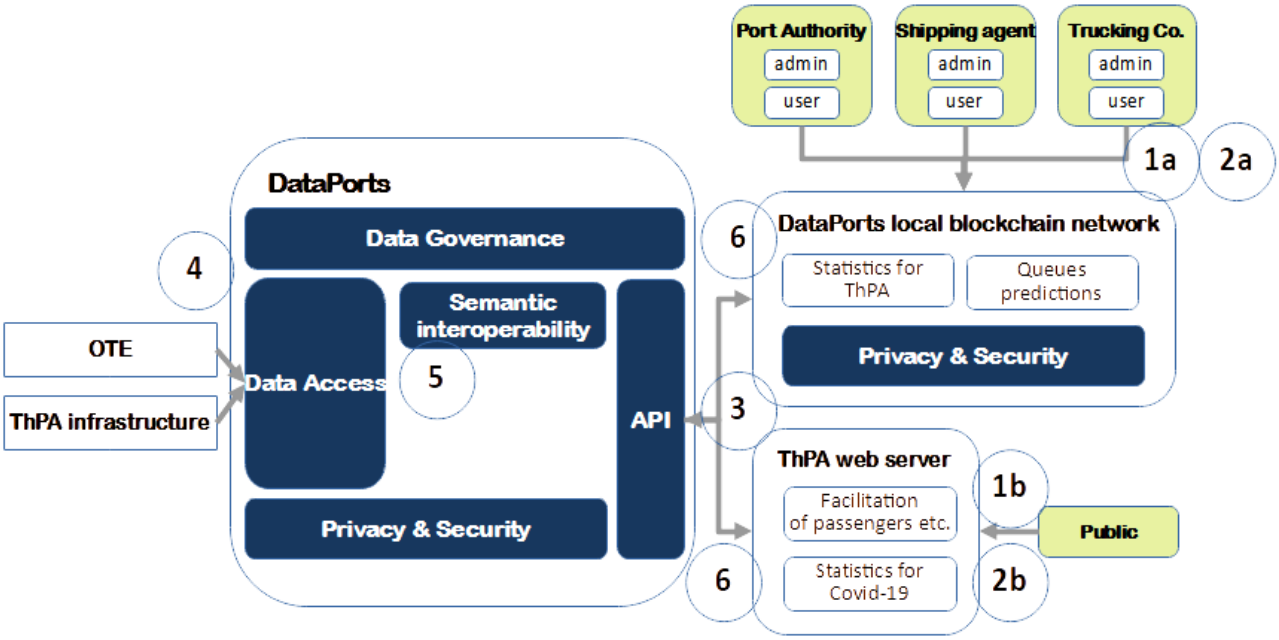


Figure 8 – Workflow Diagram of the Analytics Use Cases for ThPA

The interconnection of different systems in the analytics use cases is depicted diagrammatically in Figure 8. The analytics solutions are split into those that are used only by registered users of the local infrastructure frontend (statistics for ThPA, queues predictions) and those that are used by the general public through the port's website (facilitation of passengers, statistics for Covid-19), but apart from the way each application is accessed by the end user, they all follow the same scenario of use. As soon as an analytics solution (statistics for ThPA, queues predictions etc.) asks the platform for an input dataset, the relevant source dataset is fed into the DataPorts platform through the Data Access component, with the use of an agent. Following, the Semantic Interoperability component checks with Data Governance whether there are sufficient access rights on this dataset. If so, the dataset is forwarded to the relevant solution.

Table 36 lists the interactions, events and processes of the analytics scenarios, with the only differentiation being the first step in the sequence. The "Statistics for ThPA" and "Queues Predictions" analytics applications are used from within the local DataPorts frontend, and therefore need the user to first log in (steps 1a, 2a). Conversely, "Facilitation of passengers" and "Statistics for Covid-19" do not require a login, but can be accessed through the port's public website (steps 1b, 2b).

Step		Description
1	**a**	The local DataPorts user, belonging to an organisation of the port ecosystem, logs in to the local DataPorts frontend.
	b	A member of the general public accesses the analytics section of the ThPA web page.
2	**a**	The user selects either the "Statistics for ThPA" or the "Queues Predictions" analytics application.
	b	The user selects either the "Facilitation of passengers" or the "Statistics for Covid-19" analytics application.
3		For each of the needed source datasets, the application asks the DataPorts platform, through an API gateway, for that dataset.

Step	Description
4	The Data Access component of the platform, using an agent, reads the dataset, either from a file or an endpoint, into the platform.
5	The Semantic Interoperability component checks with Data Governance whether there are sufficient access rights on this dataset for the specified user.
6	If access rights are sufficient, the dataset is forwarded to the application; otherwise, access is denied.
7	The application proceeds to do the same for all source datasets it requires.
8	The application produces an analytics output, which is then visualised in the user's dashboard.

Table 36 – Analytics for ThPA Scenario Description

The datasets shown in Table 37 will be used in the analytics scenarios.

Data source	Description of data
Mobility data	Data from OTE mobile phone network
Terminal Operating System (TOS)	Various operational data, including vessels arrivals, loading/unloading times, containers loaded/unloaded, etc
Truck Appointment System (TAS)	Details of truck bookings for container pick-up
Gate Access System (GAS)	Information of vehicles passing through THPA Gates
Freezone application	QR code issued for each truck booking
Vessel calls	Details of vessel calls from the ThPA statistics application
Expected container vessel calls	List of container ships to call THPA in the near future
Cruise Ships Calls	Details about cruise ships calling at the Port
Posidonia Operations	Vessel arrivals

Table 37 – Analytics for ThPA Scenario Datasets

The following subsections present a short description of each analytics use case.

4.2.1.1 Statistics for THPA Prediction

ThPA collects operational data from several internal applications; in this case the Terminal Operating System (TOS), the Truck Appointment System (TAS), and the Gate Access System. What is presently missing, is a 'fusion' of all this data, to get more meaningful information. Through DataPorts solution, these data can be combined to produce statistics while metrics and KPIs, calculated via the DataPorts platform can provide valuable insight of operations performance to the Terminal Operator. The Terminal Operator can then decide on any corrective measures, if necessary. An example of this use case's output is given in Figure 9.

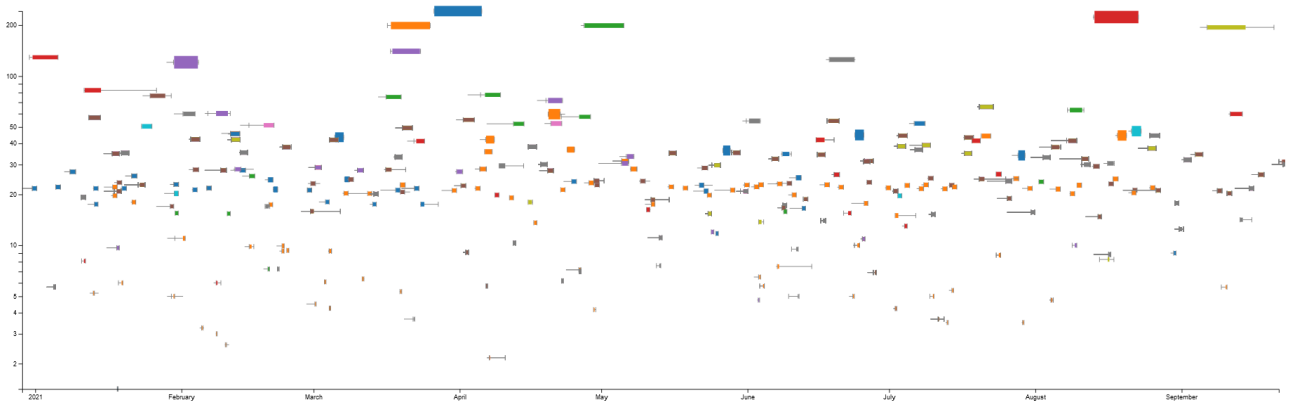


Figure 9 – Statistics for THPA Prediction Visualisation Example

In this figure we can see each vessel that arrives at the port as a bar. The colour of the bar represents the type of cargo carried by the vessel while the thickness of the bar represents the cargo mass. Each coloured bar has two lines attached to it, one at the front and one at the end of the bar. The line at the front represents the time interval from the arrival of the ship until the start of the unloading of the cargo, whereas the line at the end represents the time interval from the end of unloading until the ship's departure from the port.

4.2.1.2 Queues Predictions

Data that is stored in the port, from various sources and types, can be combined to estimate traffic in and around the port premises, in relation to its operations. Through the Dataports solution, the Terminal Operator can get queues predictions. As all movement to/from the Port is directly related to its activities, operational data will be used.

The idea is that, when fed with all this operational data, for a period, DataPorts will recognize patterns that will help make predictions. An example would be, when vessel X (traditionally involving many moves loading/unloading) calls, historically queues peak Y hours later, as trucks book/arrive to pick-up containers (or bulk cargo).

4.2.1.3 Facilitation of Passengers, Professionals, and Visitors of the Port

Through the DataPorts solution, when visitors or professionals visit the port, they may enter the DataPorts platform to evaluate the surrounding traffic in the port premises. Different users, with diverse needs, result in different time intervals or comfort conditions. A professional with an arranged appointment in or around the port (where a great number of offices and businesses are) will want to assess the traffic conditions and parking spots in the area, to avoid coinciding with passengers or trucks disembarking. On the other hand, a professional that wants to set an outdoor exhibition to promote his products/services, will want to "exploit" the disembarking of people in the port premises, while avoiding days of trucks discharging in the area. The platform "returns" information such as traffic and time required to reach the port premises. If the visitor will reach the port premises for travel, suggestions of itinerary, parking spots, points of interest and choices of means, can be returned. The use case solution is based on the mobility data provided by OTE.

4.2.1.4 Statistics for Passengers/Visitors - Covid-19

Due to the unforeseen impacts of Covid-19, ThPA as part of its CSR (Corporate Social Responsibility), wants to provide data on mobility to serve as indicators for social distancing. Through the DataPorts solution, this can be accomplished, using mobility data provided by OTE.

4.2.2 DataPorts roles

Table 38 shows the organizations that take part in the scenario implementation and their roles:

Organisation	Role
ThPA	ThPA will be the scenario leader, providing the infrastructure and business knowledge to successfully run the demo
OTE	OTE provides the mobility data that is necessary for the development and testing of the "Facilitation of passengers" and the "Statistics for Covid-19" use cases, and also participates in the scenario specification with respect to the aforementioned cases.
CERTH	CERTH will provide the local DataPorts frontend and blockchain network implementation and deployment, as well as Data Governance smart contracts implementation and deployment, and implementation of the analytics applications
PRO	PRO will develop the agents to acquire data at Port premises
UPV	UPV will be in charge of transforming data to a common data model
EVR	EVR will oversee security when it comes to communication with Data Governance, as well as deployment of the Data Governance network

Table 38 – Analytics for ThPA Roles

4.2.3 Action Plan

Table 39 contains the tasks involved in the implementation of the scenario.

Time	Actors	Actions	Tasks Overview
M21-M22	OTE	Provide the mobility data	• **Status:** Completed • **Issues:** None
M22-M24	CERTH, ThPA, OTE	CERTH and ThPA decide on a scenario specification	• **Status:** Completed • **Issues:** None
M22-M28	CERTH	Create the models to generate the services based on Port Authorities needs	• **Status:** Ongoing • **Issues:** None
M25-M28	ThPA, CERTH, PRO, UPV, EVR	Deploy the necessary infrastructure for the scenarios and the DataPorts Components	• **Status:** Not started • **Issues:** None
M25-M28	PRO	Development of the Agents for all the data sources	• **Status:** Not started • **Issues:** None
M26-M30	CERTH	Develop the applications	• **Status:** Not started • **Issues:** None
M26-M30	CERTH, ThPA	Develop the corresponding frontend	• **Status:** Not started • **Issues:** None

Table 39 – Analytics for ThPA Action Plan Reporting Table

4.2.4 Applications

Table 40 describes the applications that are part of the scenario that interact with the platform and should be implemented.

Application	Action	Status
Statistics for THPA Prediction	New application	0%
The ThPA port authority needs to have insight into the performance of its operations. The application combines the source datasets to produce statistics, metrics and KPIs.		
Application	Action	Progress
Queues Predictions	New application	0%
The application will combine input datasets to estimate traffic in and around the port premises, in relation to its operations. Through the DataPorts solution, the Terminal Operator can get queues predictions.		
Application	Action	Progress
Facilitation of Passengers, Professionals, and Visitors of the Port	New application	0%
The application produces information such as traffic and time required to reach the port premises, directed to passengers, professionals, and visitors of the port, based on which they can adjust their visit to the port.		
Application	Action	Progress
Statistics for Passengers/Visitors Covid-19	New application	0%
The application will provide data on mobility to serve as indicators for social distancing.		

Table 40 – Analytics for ThPA Applications

4.2.5 Testing and evaluation

Test ID	Description
STATHPA.1	Test KPIs: The operator asks a KPI for a pre-specified set of parameters (e.g., time period, ship type, etc.) and the system should return output identical to the expected output for the same set of input parameters.
STATHPA.2	Test for Anomaly Detection: The operator provides pre-specified data to the system and asks for outlier detection and the system responds with the expected outliers.
STATHPA.3	Visualisation Test: The operator asks for a particular type of visualization of the ones available (e.g., ship waiting and working times) and the system responds in a timely manner with the visualization.

Table 41 – Statistics for THPA Prediction Test Cases

Test ID	Description
QUEUE.1	Test Time Series of Measurements: The operator asks for a particular type of time series (e.g., vessel calls) for a pre-specified time period and the system responds with the expected output (time series).
QUEUE.2	Test Time Series Prediction: The operator provides a pre-specified time series and asks for a prediction for a future time interval and the system responds with the expected prediction.

Test ID	Description
QUEUE.3	Test Queue Prediction: The operator asks for the predicted queue time for a particular entity (ship, truck) at a particular time instance and the system responds as expected.

Table 42 – Queues Predictions Test Cases

Test ID	Description
FACIPPV.1	Test Traffic Prediction: The user asks for the predicted traffic based on pre-specified port activity data (e.g., vessel, truck).
FACIPPV.2	Test Time to Reach Prediction: The user asks for the time to reach a premise, at a pre-specified (past) time instance.
FACIPPV.3	Test Personalized Suggestions: The user provides his/her profile characteristics, and the system should return output identical to the expected output for the given user profile.

Table 43 – Facilitation of Passengers, Professionals, and Visitors of the Port Test Cases

Test ID	Description
STATCOV.1	Crowd Estimation Test: The user asks for crowd estimation for a pre-specified (past) time instance.

Table 44 – Statistics for Passengers/Visitors Covid-19 Test Cases

5 GLOBAL USE CASE: SMART CONTAINERS

5.1 SMART CONTAINERS

During any given container trip, many transport operators are involved, and no single one has total door-to-door visibility. Hence, as a common asset, a container—once equipped with smart technologies—will enable stakeholders to have better visibility based on additional reliable physical data generated by IoT devices. Visibility enables actors to enhance their processes, resulting in the reduction of transport lead time and costs.

A "Smart Container" is a marine shipping container, which is fitted with an installed smart monitoring device. A "Smart Device" (aka, IoT device) is an electronic device embedded with a set of sensors, enabling it to measure real-time information such as identifying location, door opening and closing, vibrations, temperature, humidity, and any measured physical parameters of the surrounding environment of the container. The smart device has a communication capability, which enables it to send out the measured data to a collection centre. Using the Smart Container data, new services could be generated: an example is the ETA of the container, which can be compiled based on the current position of the container and the time estimated to get to the next place (e.g., zone of interest).

The use of Smart Containers within the supply chain provides benefits in many ways to the various transport chain stakeholders. The Smart Container provides a complementary source of information for traffic management and traffic management information provides for a better understanding of what movements and operations have occurred linked to the containers. This means that additional awareness of which containers are on the move, their status, as well as opportunities to detect forgotten or delayed ones, can be derived. Smart Container data enables the supply chain stakeholders to understand, predict, anticipate, and take corrective actions to adjust their plans based on well-informed decisions.

Figure 10 - Benefits expected from Smart Containers

Smart Containers can improve:

- The global supply chain: reduce buffer stocks and stock in transit,
- Cargo quality: avoid spoiling and optimize cost of packaging (due to impact of temperature or humidity), alert of damage to goods to react quicker,
- Cargo security: prevent theft or smuggling, can allow to implement fast lanes with customs authorities,
- Transport efficiency: better CO2 impact evaluation, higher level of transparency for detention and demurrage, optimize containers reallocation thanks to route optimization and fleet management,
- Trade finance: improved credit terms and cash management,
- Insurance & process compliance: potential reduction of premiums, easier claim management.

In this Section, we explore how different port stakeholders can benefit from the integration of Smart Containers data in the DataPorts platform.

5.1.1 Scenario Description

In this use case, regular containers will be fitted with permanent IoT devices provided by Traxens. These IoT devices will periodically generate and communicate GPS position, informing about the position of the container at a given time.

A container trip plan is an end-to-end routing from first pick-up to last drop-off of the Smart Container. A Trip (voyage, journey) may consist of multiple Segments (a.k.a. legs) or may only be a single Segment. The endpoints of the segments are geographical areas which are a predefined Zones of Interest (ZOI) relevant for tracking a container or other transport equipment/means, along the supply chain.

The geofencing capability is the crossing in/out of a predefined, geofenced Zone of Interest.

By making use of the GPS positions transmitted by the Smart Container and having geofenced key ZOI, it is possible to receive notifications when the position of the subject Smart Container intersects with the geofenced area.

For example, thanks to the Smart Container solution, stakeholders can gain valuable knowledge on the exact whereabouts and status of their container, enabling them to improve their logistics. By receiving a notification that the container has been unloaded from the ship, the user is enabled to proceed to dispatch a truck to pick it up at the optimal time.

Having Smart Container data may also decrease cargo loss, legal costs, insurance fees and investigation processes and damage to goods. At the same time, door-to-door visibility may result in increased cargo security; better service level, on-time deliveries since the processes flow better.

In this global use case, Smart Container solutions provide three types of services to the supply chain stakeholder who will be empowered to react proactively and plan container operations or cargo logistics accordingly.

Service 1: The Gate In/Gate Out to a well-defined geographical zone

A message with the Gate In/Gate Out of the container from a given position can be sent out to the identified actors. When an empty Smart Container enters/departs the premises of a depot, this event can be reported to the container operator and all interested parties. This event reported by the Smart Container might be duplicate to the event that the depot operator should send out, typically by EDI message CODECO, for the same container. Making use of the GPS positions of the Smart Container and geofenced Zone Of Interest (ZOI) identified as a particular depot, the tracking solution will detect entering/departing this given ZOI and generate the Empty gate-in/gate-out at Depot event. As an example, the container operator will be able to check whether the container is back to the depot or has left the depot and at what time without having to go check the container physically.

Service 2: Container door opening or closing notification

A message notifying that the container has been opened or closed can be sent out to the identified actors. The trip plan logic integrated in Traxens' platform thanks to the integration with Shipping Lines allows to share only the trip data with the Beneficial Cargo Owner (Shipper or Consignee) and detect and transmit door openings only during the booking. This information is of interest to the customer because it can inform on stuffing processes efficiency and also unexpected door openings along the trip. It then helps to define responsibility in an intrusion.

Service 3: Raw container location information

A message providing the latest position of the container. Traxens' applications allow to visualize and contextualize the positions, but they can also be transmitted as raw data to customers. This allows to

optimize the last-mile and other logistic operations thanks to up-to-date information. It can also allow to retroactively inspect the route of containers to optimize global routing operations.

The following stakeholders are concerned by these services:

- **Requestors**: Parties that will request and order the transportation of cargo and transport units to the carriers, establishing contractual agreements with them. The transport requestor role could be played by: (i) the cargo owners (buyers, sellers or intermediaries), the freight forwarders or cargo agents, the customs agents or officers, the shipping agents and the shippers, as well as the terrestrial carriers that act as requestors with respect to other carriers.
- **Carriers**: Parties that will execute the transportation of cargo and transport units under a contractual agreement established with the transport requestors. The carrier role could be played by road, railway and maritime transport companies as well as by their transport agencies. The freight forwarders and cargo agents can also play the role of carriers with respect to the cargo owners.
- **Shippers**: Parties that will deliver the cargo or transport units to the carriers for its transportation under contractual agreements established between the requestors and the carriers. Shippers can deliver the cargo immediately or can order to depots the delivery of cargo to the carrier. The shipper role could be played by: (i) the cargo owners (sellers or intermediaries), the freight forwarders or cargo agents, the customs agents or officers, the shipping agents and shippers, as well as the terrestrial carriers that act as shippers with respect to other carriers.
- **Consignees**: Parties that will receive the cargo or transport units from carriers at the destinations agreed at the contractual agreements established between requestors and carriers. The consignees could either receive the cargo directly or they could order to a depot its reception and entry to the depot. The consignee role could be played by the cargo owners (buyers or intermediaries), the freight forwarders or cargo agents, the customs agents or officers, the shipping agents and shipper, as well as terrestrial carriers that play the role of recipients with respect to other carriers.

However, in the case of the pilot, the ports will play the role of Requestors, Shippers and Consignees and there will be not billing for the service.

The Figure 11 depicts the workflow and interactions of the scenario:

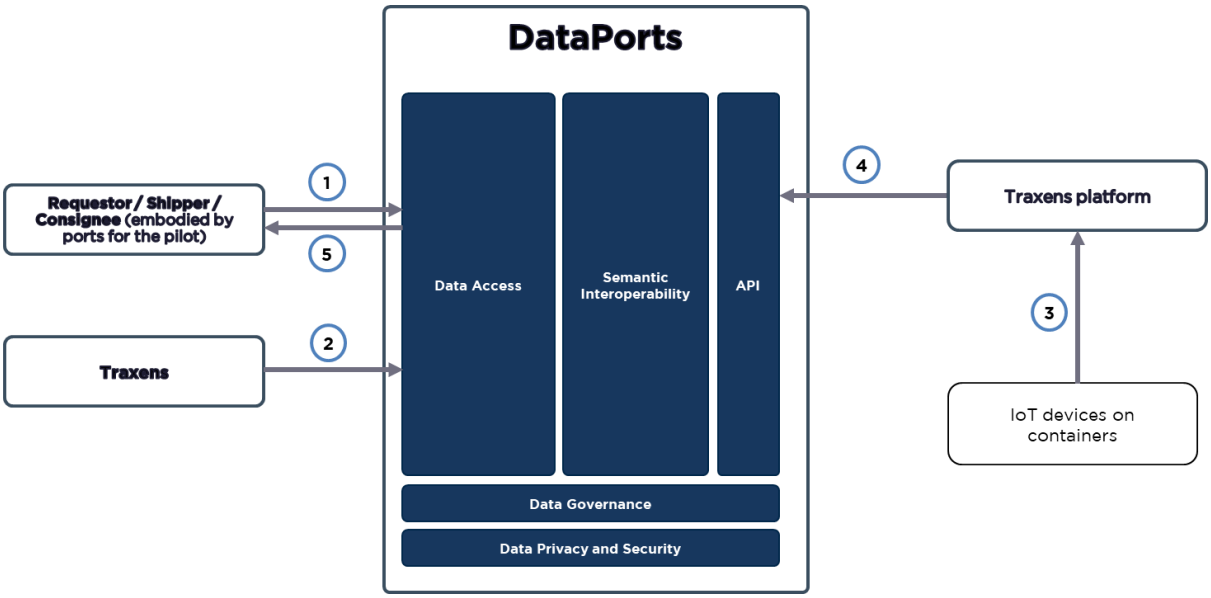


Figure 11 – Smart container workflow

However, in the case of the pilot, the ports will play the role of Requestors, Shippers and Consignees and there will be not billing for the service.

The Table 45 lists the interactions, events and processes of the scenario:

Step	Description
Pre-condition	An empty Smart container (equipped with an operational IoT device) is available on the port's depot.
1	The container is assigned to a booking and leaves for the trip. The port requests smart container data access which is transferred to Traxens platform.
2	Traxens grants access to data into DataPorts.
3	Smart container generates data integrated into Traxens platform in near real time.
4	Traxens provides trip data for the 3 different services into DataPorts.
5	Port has access Through DataPorts interface (API/UI) to regular events and alerts generated by the container including timestamped GPS positions, gate in/gate out timestamped events and timestamped door opening detections.

Table 45 – Smart Containers Scenario Description

The datasets shown on Table 46 will be used in this scenario:

Datasource	Description of data
IoT devices data for Zone of Interest Get In/Get out (Service 1)	Container ID, timestamp, GPS, ZOI ID: The place of the event per the UN/LOCODE (if any such Terminal code, Depot code, GS1 Global Location Number (GLN), etc.), boolean (IN/OUT)
IoT devices data for Container door opening or closing (Service 2)	Container ID, timestamp, door opening status (OPEN/CLOSED)
IoT devices data for Raw container location (Service 3)	Container ID, timestamp, GPS

Table 46 – Smart Containers Scenario Datasets

For ports, the benefit of this use case is to add a packaged Smart Containers service to their catalogue to gain competitive advantage compared to other ports.

For Requestors, Shippers and Consignees working closely with the ports involved in DataPorts can benefit from a single integration into DataPorts to get Smart Containers data without extra onboarding process.

Traxens can then commercialize the service through another channel and benefit from local shippers around VPF and ThPA to reuse Smart Containers initially equipped at remote origin (Asia, South America…) on a paid service. Moreover, this use case is fully covered by the contracting structure with Carriers as asset owners.

As an opportunity, we will use the pilot to assess improvement of port operations with container IoT devices. Indeed, containers are intermodal (e.g., the door-to-door trip relies on several different modes of transportation: ocean freight, air freight, rail, trucking) by definition, and the terminals are the place where they change transportation modes. Hence, having access to reliable physical data on the trip execution using the Smart Container technologies can help improve the scheduling of port operations.

Container terminals play an instrumental role in the movement of containerized cargo from consignor to

consignee. Smart Container solutions will enable terminal operators to verify the exact location of each container in their yard efficiently, and in real time.

This part of the use case is not planned as a defined service, we expect to exploit data generated during the Door-to-door visibility pilot to evaluate the benefits Smart Containers can bring to the port stakeholders. The benefits can be:

- Increase in container reuse rate in ports: Smart containers enable terminal operators to verify the exact location of each container in real time, to estimate their Estimate Time of Arrival (ETA) for a given containers and plan their operations accordingly.
- Reduction in the number of containers not loaded due to delays in the port: Smart containers enable terminal operators to verify the exact location of each container in real time, to estimate their time of arrivals (ETA) for a given containers and plan their operations accordingly.
- Improvement of berthing/unberthing smart container operations: enable terminal operators to verify the exact location of each container in their yard in real time, advise of mishandling or equipment failures, and assist in locating dangerous goods to enhance safety.

Having enough data to evaluate the benefits requires the deployment of 20 Smart containers in each port with at least one export trip each, ideally several thanks to closed loops.

5.1.2 DataPorts roles

The Table 47 Table 8 – Tracking of Transport Operations Rolesshows the organizations that take part in the scenario implementation and their roles:

Organisation	Role
TRX	TRX will provide the devices on containers and develop the logic to provide smart containers data on-demand from Traxens platform.
VPF	VPF will evaluate the results from data issued by the containers installed in Valencia.
ThPA	ThPA will evaluate the results from data issued by the containers installed in Thessaloniki.
PRO	PRO will develop the agent to integrate smart containers data into DataPorts and share data with ports.
UPV	UPV will be in charge to transform data to a common data model.

Table 47 – Smart Containers Roles

5.1.3 Action Plan

The Table 48 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions	Tasks Overview
M10-M15	TRX	Provide a scenario for the use case review by all partners	Action Completed • **Status:** Closed • **Issues:** Limitations in the Smart Containers use case described in D5.1 led to an update in this deliverable D5.3
M15-M18, delayed to M24	TRX, VPF and ThPA	Deploy the necessary infrastructure of IoT devices on containers	Progressing with delay and limitations • **Status:** Ongoing • **Issues:** Unable to find a shipper or freight forwarder close to the ports which will hinder the capability of benefits

			evaluation and quick deployment
M15-M25	TRX and UPV	TRX and UPV integrate Smart containers data model requirements into DataPorts model	Progressing as expected • **Status:** Ongoing • **Issues:** None
M25-M28	PRO and TRX	PRO develops the agents following TRX data sources specifications and requirements	Progressing as expected • **Status:** Not started • **Issues:** Skills not present in TRX to develop the agents
M25-M34	TRX, VPF and ThPA	Evaluate Smart Containers benefits for the ports	Progressing as expected • **Status:** Not started • **Issues:** Unable until now to extend the evaluation beyond ports (shippers)

Table 48 – Smart Containers Action Plan Reporting Table

5.1.4 Testing and evaluation

Test ID	Description
SCO.1	Create or verify the port Zone Of Interest. Have the container leave or enter the port. Verify that event is issued from DataPorts at the right timestamp.
SCO.2	Open or close container door. Verify that event is issued from DataPorts at the right timestamp.
SCO.3	Check container position at a given time. Verify that event is issued from DataPorts at the right timestamp and right position.

Table 49 – Smart Containers Test Cases

6 GLOBAL USE CASE: PORT MANAGEMENT SYSTEM INTEGRATION

6.1 POSIDONIA NOTIFICATIONS

6.1.1 Scenario Description

In this scenario there will be integrated up to three different Posidonia Port Solution (1) applications with DataPorts. Thanks to this integration, the platform will be able to publish some of the events that happen due to the user interactions or automatic detections on the Posidonia Port Solution modules. On the other side, Posidonia Notifications will retrieve these events and manage an alerting system that will inform the users that are interested in the message's subject. The applications that will generate or detect the events are Posidonia Management (2), Posidonia Operations (3) and Posidonia PCS (4).

The Figure 12 depicts the workflow and interactions of the scenario:

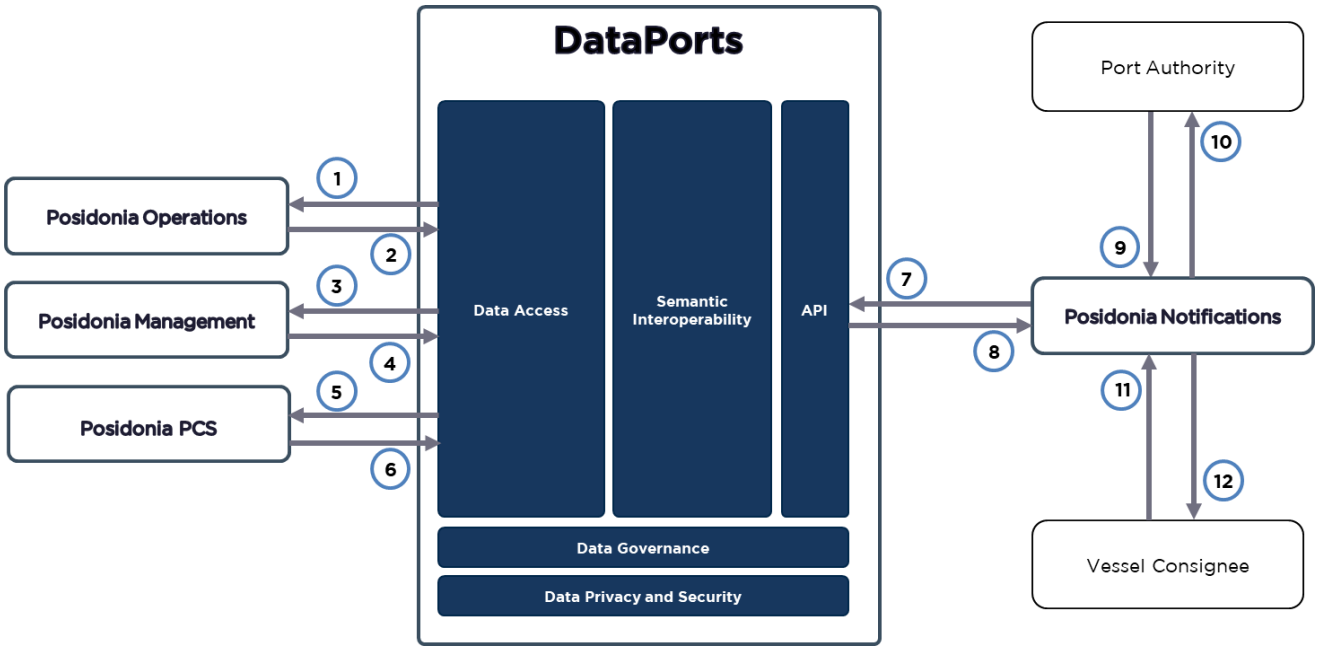


Figure 12 – Posidonia Notifications Workflow

The Table 50 lists the interactions, events and processes of the scenario:

Step	Description
1	An agent from the Data Access Component subscribes to the message queue of vessel events of Posidonia Operations
2	When Posidonia Operations processes a vessel event it is retrieved by the agent. This data will be transformed using the data models of the platform and stored for processing.
3	An agent from the Data Access Component subscribes to the message queue of management events of Posidonia Management.
4	When a user of Posidonia Management generates an event using the application it is retrieved by the agent. For example, when the user changes the ETA of a port call. This data will be transformed using the data models of the platform and stored for processing.
5	An agent from the Data Access Component subscribes to the message queue of management events of Posidonia PCS.

Step	Description
6	When a user of Posidonia PCS generates an event using the application it is retrieved by the agent. For example, when a consignee creates a water supply request. This data will be transformed using the data models of the platform and stored for processing.
7	Subscriptions will be created through the platform's API setting the Posidonia Notifications application as target.
8	When any of the subscribed events happen, the Semantic Interoperability Component will send the data to the application.
9	A user of the Port Authority registers into the Posidonia Notifications application and configures its preferred settings for alerts. It also subscribes for change of ETA and anchorages in forbidden areas.
10	When Posidonia Notifications gets a message of ETA change it alerts the user of the Port Authority, for example by email.
11	A vessel consignee registers into the Posidonia Notifications application and configures its preferred settings for alerts. It also subscribes for its requests status changes.
12	When a request is accepted or declined in Posidonia PCS it creates and event that will be sent to Posidonia Notifications, that will notify the vessel consignee by email.

Table 50 – Posidonia Notifications Scenario Description

The datasets shown on Table 51 will be used in this scenario:

Datasource	Description of data
Posidonia Management	Json messages with events for: • ETA/ETD visit changes • Start/End of visit • Visit Authorisation • Manifest Activation
Posidonia Operations	Json messages with events for: • Vessel flow events
Posidonia PCS	Json messages with events for: • Water supply requests • Electricity supply requests • Port surface occupation requests • Water removal requests • Access to port requests

Table 51 – Posidonia Notifications Scenario Datasets

6.1.2 DataPorts roles

The Table 52 Table 8 – Tracking of Transport Operations Rolesshows the organizations that take part in the scenario implementation and their roles:

Organisation	Role
PRO	Will lead the use case, implement the agents for acquiring data, provide the data sources applications, modify current and implement new applications for the scenario, define the test cases and evaluate them.

UPV	Will participate in the data model definition for the data sources of this scenario
UDE	Given the scenario, will identify ports prediction variables for cognitive services. Will exploit the data provided by the data source application to adapt the current implementation, test and evaluate the ensemble predictive models together with the reinforcement learning agent to provide real-time accurate explainable predictive results, and when necessary, suggest proactive adaptions.

Table 52 – Posidonia Notifications Roles

6.1.3 Action Plan

The Table 53 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions	Tasks Overview
M12-M15	PRO	PRO provides a scenario specification and it is revised by all participant partners	Action Completed • **Status:** Closed • **Issues:** None
M12-M18	PRO	PRO involves the Baleares Port Authority in the project in order to use its environment, data and events in the pilots.	Action Completed • **Status:** Closed • **Issues:** None
M18-M27	PRO and UPV	PRO and UPV analyse the requirements for the semantic transformation and representation of the data	Progressing as expected • **Status:** Ongoing • **Issues:** It takes a long time to analyse all the entities, properties and relationships of the process and try to match them with existing data models.
M23-M28	PRO	PRO develops the Agents for the integration of the data sources following the specifications and requirements	Progressing as expected • **Status:** Ongoing • **Issues:** None
M25-M27	PRO	PRO will develop a small utility that will extract historical data from the Posidonia Operations of the Port of Baleares so it can be shared with UDE for data analytics and training purposes.	Only evaluated the need of developing the functionality. • **Status:** Not started • **Issues:** None
M25-M34	PRO	PRO will extend the current Posidonia Management application so when the events that need to be shared happen, it gathers all the needed information, builds a json message and publishes it into a broker message queue.	Only first internal conversations to study the different ways to share the information and evaluate the future action plan for the modifications. • **Status:** Not started • **Issues:** None
M25-M34	PRO	PRO will extend the current Posidonia PCS application so when the events that need to be shared happen, it gathers all the needed information, builds a json message and publishes it into a broker message queue.	Only first internal conversations to study the different ways to share the information and evaluate the future action plan for the modifications. • **Status:** Not started • **Issues:** None
M23-M36	PRO	PRO will develop an alert application, making the analysis, design, implementation and integration with	Analysis of the application has started and requirements and functionalities are being captured.

		DataPorts.	• **Status:** Ongoing • **Issues:** None
M25-M30	PRO	PRO will deploy all the required components and applications for the scenario demonstration.	Nothing to report yet. • **Status:** Not started • **Issues:** None
M23-M27	UDE	UDE will analyse the data that will be shared in the DataPorts platform through the Semantic Interoperability component, identifying instances of business process data. For this purpose, UDE will receive historical data from PRO, TRX, VPF and EVR.	Analysis of the available historic data has started and first candidates for potentially containing business process data have been identified. • **Status:** Ongoing • **Issues:** None
M25-M30	UDE	UDE will adapt the process-based analytics services that will be developed as part of Task 3.4 to the identified business process data.	Nothing to report yet. • **Status:** Not started • **Issues:** None
M27-M30	UDE	UDE will develop the Process-based Analytics component in preparation for deployment by PRO.	Nothing to report yet. • **Status:** Not started • **Issues:** None

Table 53 – Posidonia Notifications Action Plan Reporting Table

6.1.4 Applications

The Table 54 describes the applications that are part of the scenario that interact with the platform and should be modified or implemented:

Application	Action	Status
Posidonia Management	Modification	0%
The Posidonia Management application will build and send a json message with all the required data for each of the events that will publish in DataPorts. The new functionality will collect all the relevant information about the event that is going to be published in DataPorts and publish it into a RabbitMQ (5) message broker from where the agent of the platform will get it. This will be repeated for each of the events.		
Application	**Action**	**Progress**
Posidonia PCS	Modification	0%
The Posidonia PCS application will build and send a json message with all the required data for each of the events that will publish in DataPorts. The new functionality will collect all the relevant information about the event that is going to be published in DataPorts and publish it into a RabbitMQ message broker from where the agent of the platform will get it. This will be repeated for each of the events.		

Application	Action	Progress
Posidonia Operations	Modification	10%
A new feature for Posidonia Operations will be implemented so it is able to build events from historical data and publish them through DataPorts for model training purposes. A java application will get data from the internal logs currently stored in the Posidonia Operations database in a relational structure and convert it in json messages with the same format of the real-time shared ones. The input will take two dates for the interval to export and a single file with the json messages will be output of the process.		
Application	Action	Progress
Posidonia Notifications	New application	5%
A new interface will be implemented for the configuration and sending of alerts, in this scenario of events in the Posidonia applications. This application will use the DataPorts platform for subscribing to events and sending notifications about the selected topics in the chosen communication channel. Users of the application, like the Port Authority or consignees, will be able to set up their contact data, like email or phone number, and the default way of notification.		

Table 54 – Posidonia Notifications Applications

6.1.5 Testing and evaluation

Test ID	Description
PNO.1	Posidonia Operation processes a vessel event (any kind) and the information arrives to the Data Access context broker.
PNO.2	A user that is subscribed for the vessel event type alerts by email in Posidonia Notifications receives the message in his/her inbox.
PNO.3	A user of Posidonia Management changes the ETA of a visit though the application interface and the information arrive to the Data Access context broker.
PNO.4	A user that is subscribed for ETA change alerts by email in Posidonia Notifications receives the message in his/her inbox.
PNO.5	A user of Posidonia PCS creates a water supply request through the application interface and the information arrives to the Data Access context broker.
PNO.6	A user that is subscribed for water supply request alerts by email in Posidonia Notifications receives the message in his/her inbox.
PNO.7	The water request is accepted through the PCS application and the information arrive to the Data Access context broker.
PNO.8	A user that is subscribed for water supply request alerts by email in Posidonia Notifications receives the message in his/her inbox.

Table 55 - Posidonia Notifications Test Cases

7 REQUIREMENTS EVALUATION

7.1 METHODOLOGY

During the month of November, all partners reviewed and evaluated the requirements they are responsible for, as shown in Table 56. Besides requirements presented in the Table, TRX added 2 requirements in WP5, for which it is responsible for the evaluation.

Responsible Partner	IDs	Number	Related Tasks(s)
PRO	3.1 - 3.4, 3.6, 3.8, 3.9, 3.31 - 3.36, 3.43, 5.7 - 5.9	17	T3.1, T5.4
IBM	3.11 - 3.17, 4.1 - 4.4	11	T3.5, T4.2, T4.3
CERTH	3.38 - 3.40, 3.47, 4.5 - 4.7, 5.2 - 5.4, 5.21	11	T3.5, T4.2, T4.3, T4.4, T5.1, T5.3, T5.4
ThPA	5.10 - 5.20	11	T5.2, T5.3, T5.4
EVR	4.8 - 4.17	10	T4.1, T4.4
ICCS	3.18 - 3.22, 3.41, 3.42, 3.44, 3.46	9	T3.3
UPV	3.5, 3.7, 3.10, 3.23 - 3.25, 3.37	7	T3.2
ITI	3.26 - 3.30, 3.45, 5.1	7	T3.4, T5.5
UKL	2.1 - 2.7	7	T2.5
VPF	5.5, 5.6	2	T5.2, T5.3, T5.4

Table 56 - Requirement evaluation responsible partners

As described in detail in Deliverable D5.2 Evaluation Plan, each requirement must be evaluated and assigned one of the following values:

- Pass – The requirement is satisfied
- Fail – The requirement is not satisfied
- Minor rework – The requirement is almost completely satisfied, however there is still some missing development to do or contributions to provide. During the analysis, those will be treated as having status Pass.

Afterwards, requirements are grouped by work packages, and for each package the pass percentage is computed by summing up the number of requirements with a “Pass” or “Minor Rework” state and dividing it by the total number of requirements in that work package. For the final evaluation of the project, those requirements will be evaluated against the priority of the requirement; however, since this is an intermediate evaluation and many requirements directly dependant on ongoing development will have an evaluation status of “Fail”, for this evaluation the requirement priority will not be considered, and the focus will be on the pass percentage of each work package.

The expectation is that lower-numbered WP will have a higher pass percentage, as the corresponding development is expected to complete before higher-numbered WP, such as WP5, whose implementation is depending on components developed in WP2, 3 and 4.

The DataPorts project has a total of 94 requirements, with the following distribution:

- WP2 has 7 requirements
- WP3 has 47 requirements
- WP4 has 17 requirements
- WP5 has 23 requirements

Table 60, Table 61, Table 62 and Table 63 in ANNEX A: Requirements Evaluation Details present a detailed analysis of the requirements analysis of each work package. Evaluation results are analysed and presented in the Section 7.2.

7.2 EVALUATION RESULTS

The evaluation of the 94 requirements of DataPorts resulted in the following status distribution presented in Table 57. The requirements pass percentage, which includes both requirements in status Pass and Minor Rework, is 50% (47 / 94), which is expected at this intermediate review stage, since the software development and integration is still ongoing.

Status	# of requirements
Pass	38
Fail	47
Minor rework	9

Table 57 - Requirements status distribution

The evaluation of requirements for single work packages is presented in Table 58.

Work package	Pass	Fail	Minor rework	Pass percentage
WP2	1	6	0	14%
WP3	27	14	6	70%
WP4	10	6	1	65%
WP5	0	21	2	9%

Table 58 - Requirements evaluation per WP

Looking at those data can provide interesting insights on the development status:

- WP2 has a surprisingly low pass percentage, mainly due to incomplete component development and integration.
- WP3 is in good shape, with a 70% pass percentage. In this case, in most cases Fail requirements are due to missing data sources, with a few depending on ongoing implementation.
- WP4 is also looking good, with the Fail requirements expected to be fulfilled after having performed the penetration testing in M27 or the audit due in M30.

- As expected, WP5 is the one with the least progress in fulfilling its requirements, as it requires development and integration of other; these contributions are expected during the third year of the project.

The analysis of those results suggests that the general progress of the platform's development is fine.

8 CONCLUSIONS

DataPorts is a data platform developed as a result of the project over three years, with two main pilots in the ports of Valencia and Thessaloniki and two global use cases.

This document, written at the end of the second year of the project, is always focused on the development, integration and demonstration of the use of the platform in the defined use cases through a series of real scenarios in order to demonstrate the benefits of the platform, improving current port processes or making it possible to carry out new activities.

As its name suggests, it reflects the initial state of the pilots and is taken as a starting point for the final year of work.

In one hand, tasks carried out in recent months have been described, broken down by scenario when appropriate or at a general level when it has not been necessary, showing the participation of the different parties and the methodology followed, as well as the current status of these actions.

On the other hand, descriptions of the scenarios have been included, adding the interactions with and use of the platform, identifying the different actors that form part of each of them at both the development and execution levels.

In addition, an action plan has been established between now and the end of the project with the activities to be followed in each of the scenarios, including the participants and the planning of these activities, which will provide a roadmap until the final evaluation of the pilots. During the next year, new applications will be developed and existing systems will be adapted. DataPorts components will be integrated into the ports and the necessary improvements and elements will be implemented to build the data platform, connect it to the sources of the environment and configure the data processing and analysis services and model training for use in predictions and cognitive services.

9 REFERENCES AND ACRONYMS

9.1 REFERENCES

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2. Posidonia Management. [Online] https://www.prodevelop.es/en/ports/posidonia/posidonia-management.

3. Posidonia Operations. [Online] https://www.prodevelop.es/en/ports/posidonia/posidonia-operations-2.

4. Posidonia PCS. [Online] https://www.prodevelop.es/en/ports/posidonia/posidonia-pcs.

5. RabbitMQ. *RabbitMQ.* [Online] https://www.rabbitmq.com/.

9.2 ACRONYMS

Acronym List	
API	Application Programming Interface
COREOR	Container Release Order
CP	Consortium Plenary
CPU	Container Pick-Up
DoA	Description of Action
EC	European Commission
eFTI	Electronic Freight Transport Information
ETA	Estimated Time of Arrival
GAS	Gate Access System
GDPR	General Data Protection Regulation
IDS	International Data Spaces
IMO	International Maritime Organization
IoT	Internet of Things
JSON	JavaScript Object Notation
ML	Machine Learning
MVP	Minimum Viable Product
PC	Project Coordinator
PCS	Port Community System
PMB	Project Management Board
PPR	Project Periodic Report
QM	Quality Management
RM	Risk Management
SOLAS	Convention on the Safety of Life at Sea
TAS	Truck Appointment System
TM	Technical Manager
TOS	Terminal Operating System
VGM	Verified Gross Mass
WPL	Work Packages Leaders
ZOI	Zones of Interest

Table 59 – Acronyms

10 ANNEX A: REQUIREMENTS EVALUATION DETAILS

WP2 Data Platform Design

WP2 has 1 requirement with Pass status, and 6 requirements with Fail status, with a pass percentage of 14%.

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
2.1	MUST	The DataPorts Platform must be interoperable to be used for alternative architectures and dynamic systems	Several data sources and organizations (together with their corresponding systems) will interact and share data with the DataPorts Platform. Test the platform by sharing/exchanging data between different data sources and organizations	11/17/2021	Fail	
2.2	MUST	The DataPorts Platform must provide a secure interface framework for data exchange between itself and the potential data sources	The DataPorts Platform must provide a secure interface framework for data exchange between itself and the potential data sources Any platform's component to fulfil minimum security and privacy constraints	11/17/2021	Fail	The connectors are still not realized, in case of blockchain some prototypes are already developed
2.3	MUST	The definition of the architecture must be aligned with the last version of the Industrial Data Space Architecture Reference Model	Verify if the major roles of the IDS RAM are implemented and included in the DataPorts Platform. Try to interact with the existing connectors, data sources of the IDS environment	11/17/2021	Fail	Some major roles of IDS RAM such as broker and identity manager, and clearing hour are realized in the blockchain component. The connectors are conceptualized

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
2.4	MUST	The architecture must follow a federated data approach avoiding the "data-centric model".	Apart from temporal data stored for integration or data analytics, no data is stored in the platform, and the platform is completely decentralized	11/17/2021	Fail	Development and the integration are not completed
2.5	MUST	The DataPorts Platform must be deployed in different infrastructures (cloud, on premise, etc.)	Choose at least one of the pilot scenarios and test the platform in their ecosystem (the platform is on prototype level)	11/17/2021	Fail	Development and the integration are not completed
2.6	SHOULD	DataPorts should follow the Big Data Analytics as a Service (BDAaaS) paradigm, providing a level of abstraction to application developers about the implementation and set-up details of the data platform, thus simplifying deployment	With different data sets as input, test the functionality of the data analytics as a service in the pilot scenarios	11/17/2021	Fail	Development and the integration are not completed
2.7	MUST	The DataPorts Platform must provide resources (user guides, documentation, etc.) to support the provided functionalities of the platform	Review there exist links with information, instructions and guides, they are accessible, and can be downloaded/read by any user	11/17/2021	Pass	There are some links, information and guidelines already provided in the submitted deliverables

Table 60 - WP2 requirements evaluation

WP3 – Data Platrofm Implementation and Services

WP3 has 27 requirements with Pass status, 14 requirements with Fail status, and 6 requirements with a Minor Rework status, with a pass percentage of 57%.

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
3.1	MUST	The DataPorts Platform must homogenize the input data so that it can be retrieved in the same format and data model regardless of the data source	Check that the data stored in the context broker from the data access agents meets the structure and requirements of the defined data model	11/17/2021	Pass	The data model is not defined yet, neither the agents for the scenarios of the pilots, so this is works for the sample agents that work with existing data models.
3.2	SHOULD	The Data Access component should be able to make use of the interface of each data source connected to the DataPorts Platform in order to retrieve the data in its original format. Supported data interchange formats should be at least: XML and JSON. The Data Access component should also support the security mechanisms implemented in each data source	Check that the Data Access component has connectivity to the data sources APIs and the data retrieved is secured under the DataPorts Platform security components	11/17/2021	Fail	Agents are not developed yet and the Data Access component still has to be deployed at ports' premises.
3.3	COULD	Each data source that is going to be connected to the DataPorts infrastructure through an API could provide version management for its API, in order to allow a proper identification of the API and the data formats	Check that every data source connected to DataPorts through an API provides version management	11/17/2021	Fail	Data sources are not available yet.
3.4	SHOULD	Each data source that is going to be connected to the DataPorts infrastructure through an	Check that every data source connected to DataPorts	11/17/2021	Fail	Data sources are not available yet.

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		API should provide documentation about it (such as an OpenAPI/Swagger definition)	through an API provides documentation about how to connect and gather data			
3.5	MUST	The DataPorts Platform must provide an ontology that describes the concepts from the data models of all the connected data sources so that all the input data can be represented following a common ontology	Given a set of data sources with heterogeneous data format/data model/ontology, when I want to provide a target ontology that covers this heterogeneous data sources, then the target ontology must define and describe the concepts and relationships of the data sources information	11/11/2021	Fail	Ongoing Task: The DataPorts ontology has not been defined yet. This ontology is expected to M27.
3.6	MUST	The DataPorts Platform must be able to obtain data from platform/sensors/sources with and without explicitly defined ontology in order to support as many potential data sources as possible	Given a message/data produced by a data source, when I want to perform the translation to the common ontology using the agent, then the agent must be able to translate the data independently of the existence of an ontology for the data source	11/17/2021	Pass	
3.7	MUST	The DataPorts Platform must provide publish/subscribe operations to internal components in order to provide access to business	Given a message/data produced by a data source, when I want to send the data to	11/11/2021	Pass	

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		real-time data from the connected sources	the internal components subscribed to that topic, then the information must arrive only to the subscribed internal components			
3.8	MUST	The Data Access component must provide the proper connectors to communicate with the available data sources	Given a data source, when I want to access it to retrieve data, then the framework for agent creation developed in T3.1 must provide the necessary tools to communicate with the desired data source	11/17/2021	Pass	There is already a list of templates, but also for available data sources. New templates will be added as the agents are developed.
3.9	SHOULD	The Data Access component should support the most common communication protocols in order to be able to communicate with as many potential data sources as possible	Given a data source accessible using an established communication protocol, when I want to access it using the DataPorts Platform, then the framework for agent creation developed in T3.1 should provide the necessary tools to facilitate the creation of the agent for the data source	11/17/2021	Pass	There are already templates for file import and API requests.
3.10	MUST	The Semantic Interoperability layer must support semantic modelling in order to provide an unambiguous	Given a message in the data source format, when I want to send it to	11/11/2021	Minor rework	Ongoing task migration from use of NGSI V2 to NGSI-LD. The deadline is

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		meaning of the data	components belonging to the upper layer of the DataPorts Platform, then the message must be translated to the semantic target model defined in DataPorts			M27.
3.11	MUST	As a Blockchain organization, I want to be able to interconnect with other organizations within my network in an agreed upon manner, to facilitate trust and transparency	Setup of Blockchain network based on Fabric Blockchain technology, including immutable ledger, orderer and peer nodes to ensure consensus, CA nodes to allow certification and channels to allow data privacy	28/11/2021	Pass	Blockchain networks for CPU, VGM and data governance designed and configured
3.12	MUST	As a Blockchain organization, I would like to be able to onboard an existing Blockchain network and participate as a validating member	Add a new organization to existing Blockchain network: configure a new CA node, add the organization with appropriate access roles to network configuration, join organizational peer to channels	28/11/2021	Pass	All BC networks are extendable and can allow new organizations to join and add its own nodes to the network
3.13	MUST	As a participating Blockchain organization, I would like to be able to agree on a consensus algorithm which will provide pilot appropriate transaction validation and	Use a validated and known consensus algorithm in setting up ordering service of Blockchain	28/11/2021	Pass	Part of all BC networks use ordered nodes to order transactions into blocks. They use

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		ordering functionality for the network	network, i.e. RAFT			endorsement policies to reach consensus on chaincode execution results on endorsing peers.
3.14	MUST	As a participating Blockchain organization, I would like to be able to securely sign in my network components (peers, CAs) and clients (end-users/application clients) to a Blockchain network	Design of CA and MSP configuration for each pilot ensuring proper certification, configure organization access roles in network and channel configuration, encode attribute-based access restrictions in pilot's chaincodes	28/11/2021	Pass	All BC networks were setup with organizational CA's providing certification for authorization of users, transaction signing and network administration. BC configuration also includes role based authorization for various activities of nodes and users on the network
3.15	MUST	As a participating Blockchain organization, I would like to be able to maintain my own copy of distributed ledger while being assured other organizations on the network have exact same replica of the ledger	Create channels as appropriate for each pilot to ensure privacy of data within the Blockchain network. Add peers of organizations that need separate copy of the ledger to the channels	28/11/2021	Pass	All BC networks have designated channels, each channel representing a single shared immutable copy of the ledger held by each and every channel member. In VGM use case on top of the shared ledger there is also a

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
						private data ledger shared among subset of the BC network peers to hold some sensitive data which should be seen only by those particular peers and not all BC orgs.
3.16	MUST	As a participating Blockchain organization, I would like to be able to endorse transactions by executing agreed upon business logic specified as a bounding contract between network organizations	For organizations required to endorse transactions for a particular pilot, add endorsing peers to the appropriate channels	11/28/2021	Pass	All BC solutions include chaincodes which allow execution of the particular business logic pertaining to the solution. For each network endorsing peers are configured as part of chaincode instantiation to indicate which peers will be executing the chaincode and endorsing the transactions
3.17	MUST	As a participating Blockchain organization, I would like to be assured of immutability and permanent availability of the shared data	Use appropriate Blockchain technology (agreed upon Hyperledger Fabric) which ensures immutability and untamperability of the underlying ledger	11/28/2021	Pass	In all BC solutions underlying chosen technology used is Hyperledger Fabric, part of which is immutable chain of

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
						transactions based on transaction blocks' hashes, ensuring that the history of transactions is immutable and verifiable
3.18	MUST	The Data Abstraction and Virtualization component must have an open API in order for big vendors as well as new providers to be able to publish their services and components	Rely on the OpenAPI specification, which is a homogenous standardized solution for describing REST services	11/18/2021	minor rework	The exposed REST API of VDC is implemented, but its OpenAPI specification is still pending
3.19	MUST	The Data Abstraction and Virtualization component must be data-source independent	Data Abstraction and Virtualization component takes input from the Data Access / Semantic Interoperability layer, where the data has been already transformed into JSON format	11/18/2021	Pass	
3.20	SHOULD	The data model specification should follow the semi-structured format	The data model specification is created using JSON semi-structured markup language	11/11/2021	Pass	
3.21	MUST	The notation language must be able to be parsed by multiple different programming languages	The selection of JSON language is vital cause of the ease of its implementation to the majority of the programming languages such as Python, Java, C# etc. JSON libraries are very easy to include in	11/18/2021	Pass	

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			any of the aforementioned languages (JSON's library for Python is called... json)			
3.22	SHOULD	The notation language should be human readable, easy to script and to understand	The data model is described using JSON schema	11/18/2021	Pass	
3.23	COULD	The components of the DataPorts Platform could be virtualized, in order to ease its deployment and portability	Given a DataPorts Platform component, when I want to deploy and run a new instance, then it has to be able to be containerized and deployed in a Docker environment	11/11/2021	Pass	
3.24	COULD	The DataPorts Platform could offer mechanisms for the automatic deployment, maintenance and scaling of the developed components	Given a DataPorts Platform component, when I want to run a new instance of this component, then it has to be automatically deployed and configured	11/11/2021	Fail	This will be discussed with al WP3 partners, once the first prototype of the platform will be available. This prototype, expected to M24, is going to integrate all the WP3 components working together and exchanging messages and flows of information.
3.25	MUST	The Semantic Interoperability component must support distributed real-time	Given a considerable amount of real time data, when	11/11/2021	Fail	This will be discussed with al WP3 partners, once

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		stream processing in order to avoid the overload of specific components when high data volumes are processed	the performance of the platform could be affected, then a new instance of the data broker could be deployed in order to process the information without affect the work and performance of the whole DataPorts Platform			the first prototype of the platform will be available. This prototype, expected to M24, is going to integrate all the WP3 components working together and exchanging messages and flows of information.
3.26	MUST	As an end-user, I want the platform to provide cognitive services specific to ports requirements, so that I could improve my decision making processes and/or KPIs	Given a cognitive service to predict the future value of a ports KPI or event, when I request the expected value for a specific time period (i.e. the next hour), then the service must report visually the prediction and the accuracy	29/10/2021	Fail	Performed in Jupyter Notebook. Not implemented in the frontend yet
3.27	MUST	As a developer, I want an abstraction mechanism regarding the implementation and set-up details of the data sources connection, so that the deployment will be faster and easier	Given a data source available in the DataPorts Platform, when I want to query such data, then the retrieved data must be the same as if I connect directly to the original data source	29/10/2021	Fail	There are not data sources available in Dataports Platform yet
3.28	MUST	As an end-user, I want software components based on State-of-the-Art Machine Learning (ML) algorithms, specifically	Given a port-oriented indicator that I want to predict, when I require to	29/10/2021	Pass	

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		customized to the ports domain, so that I could easily and automatically create models	build a ML model to fulfil such task, then the DataPorts Platform must test several techniques (ARIMA, LSTMs, Random Forest etc.) and select the best model according to accuracy metrics (RMSE, MAPE etc.)			
3.29	MUST	As an end-user, I want a distributed AI platform, so that huge data volumes and time consuming tasks could be achieved	Given a dataset which cannot be analysed in a single computer, when I require to build a ML model using that dataset, then the DataPorts Platform will distribute such processing in a distributed infrastructure for improving performance	29/10/2021	Fail	No distribution system has been implemented yet
3.30	SHOULD	As an end-user, I want to use continuous data streams, so that the platform provides predictions in near real-time	Given a data source in the DataPorts Platform that periodically generates new data, when I want to generate new predictions as new data arrives, then a ML model subscribed to such data publishes such predictions	29/10/2021	Fail	There are no continuous data streams from any Data Provider. Additionally, no Real Time approach has been developed.
3.31	MUST	As a developer, I want the platform to deal with the	Given a data source available	11/17/2021	Pass	Data can be requested

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		original data sources heterogeneity, real-time (streaming) or persistent data, relational or non-relational databases (NoSQL), so that I can use the data without taking into account the underlying storage system	in the DataPorts Platform, when I want to query such data, then the data must be retrieved without specifying technological implementation details			using the built on demand agents but queries are not available. Maybe I would change the definition of the test case to "request" data instead of "query" data.
3.32	MUST	As a data provider, I want to publish data in the DataPorts Platform, so that it is available for the platform users with the access rights	Data shared from the data sources is sent/gathered to/from the DataPorts Platform through the existing agents	11/17/2021	Pass	Not for all data sources, only for sample and test. More data sources will be included in the next months.
3.33	MUST	As a data consumer, I want to get the list of the available data sources and all the methods provided by the platform to subscribe or request data on demand	Given a data source available in the DataPorts Platform, when a data consumer wants to know the full list of available methods, then the platform must return all the information needed to retrieve the data	11/17/2021	Fail	Technology ready, but not agents available with this functionality yet
3.34	MUST	As a data consumer, I want to subscribe to an available subscription provided by the DataPorts Platform	Given a data source available in the DataPorts Platform, when a data consumer wants to get updates from it and subscribes through the provided methods, then the platform must create a subscription for	11/17/2021	Pass	

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			the user			
3.35	MUST	As a data consumer, I want to be able to cancel a current subscription, so that I stop receiving data modifications	Given a data source available in the DataPorts Platform, when a data consumer wants to delete an active subscription, then the platform must delete the subscription and stop sending updates	11/17/2021	Pass	
3.36	MUST	As a data consumer, I want to request data on demand from the data sources using the methods provided by the DataPorts Platform	Given a data source available in the DataPorts Platform, when a data consumer wants to get data from it and calls an on demand provided method, then the platform must return the data to the user	11/17/2021	Pass	
3.37	COULD	The DataPorts Platform could reduce and process the data on the ports' side, before they reach the Data Abstraction and Virtualization component's repository (Virtual Data Repository – VDR) and become available to distributed resources	Process the semantic transformation as close to the source as possible / Deploy and run the Semantic Interoperability component on one of the pilots premises	11/11/2021	Minor rework	The component is ready, but it is not deployed in a Port premise yet.
3.38	SHOULD	As a data consumer, I want low latency in order to gain quick access and precise feedback	Design a hierarchy of smart contracts as appropriate for each pilot to ensure scalability and efficiency of transaction	11/29/2021	Minor rework	Smart contracts have been appropriately designed with scalability and efficiency in mind.

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			processing. Ensure separation of concerns when designing the smart contracts			However, no large scale testing has taken place yet and, therefore, there cannot be a verdict on low latency at the moment.
3.39	MUST	As a data provider, I want to retrieve the history of transactions, so that I am able to track the information flow	As appropriate for each pilot, add invoke functions in chaincode to return a list of historical transactions	11/29/2021	Pass	
3.40	MUST	DataPorts must provide a common data model schema to get the training data	Given a data source available in the DataPorts Platform, when I want to query such data, then the data description (schema, columns, metadata) must conform to the DataPorts ontology	11/29/2021	Minor rework	Not sure what the term "training data" refers to. We have, however, implemented an on-chain metadata repository, which can be used to query for datasets. We are currently in the process of incorporating metadata given by UPV, in order to augment the metadata schema.
3.41	SHOULD	The DataPorts Platform should have (efficient) provisions for checking data quality (e.g., to detect concept drift, missing data, inconsistent data etc.)	Outliers detection based on statistical measures like standard deviation or quantiles. Checking for missing values to	11/18/2021	Pass	

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			be removed or replaced. Searching for duplicates that must be eliminated, based on statistical methods. Tests using unclean datasets will be taken place. Data Abstraction and Virtualization's (DAV's) efficiency will be evaluated based on how well the unclean datasets were "cleaned" and corrected. Cleaning will take place in DAV's Processing & Filtering Software, with the cleaned datasets being stored at Virtual Data Repository later on			
3.42	SHOULD	The DataPorts Platform should deliver cleansed, integrated etc. data to the analytics services	Outliers detection based on statistical measures like standard deviation or quantiles. Checking for missing values to be removed or replaced. Searching for duplicates that must be eliminated, based on statistical methods. Tests using unclean	11/18/2021	Pass	

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			datasets will be taken place. Data Abstraction and Virtualization's (DAV's) efficiency will be evaluated based on how well the unclean datasets were "cleaned" and corrected. Cleaning will take place in DAV's Processing & Filtering Software, with the cleaned datasets being stored at Virtual Data Repository later on			
3.43	MUST	Integration of legacy sources. The DataPorts Platform must be able to integrate with relevant port platforms	Data from existing data sources is published into the DataPorts Platform through the Data Access component agents	11/17/2021	Fail	The component is ready but agents need to be developed.
3.44	SHOULD	Data correlation. The data from different sources should be correlated (virtual object) or in the same process	Using correlation algorithms such as Pearson's and Spearman's to summarize the strength of the linear relationship between two data samples. Correlation functions will be included in the Data Abstraction and Virtualization component. Correlated data sets' scores will be close to 1 or -	11/18/2021	Fail	Data sources are not available yet

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			1 (that is, positive or negative correlation). Uncorrelated datasets' scores will be close to 0			
3.45	MUST	The DataPorts Platform must provide and API for developers in order to build specific applications or services	Given the API of a specific component, when I request the documentation of such API, then it must be properly documented (for REST APIs we will use OpenAPI specifications) pointing out the input and output messages	29/10/2021	Fail	We are still developing the specific APIs, although we are close to finalize the task
3.46	SHOULD	Data quality. Before correlate data from different sources, quality should be checked to guarantee the correct interpretation	Outliers detection based on statistical measures like standard deviation or quantiles. Checking for missing values to be removed or replaced. Searching for duplicates that must be eliminated, based on statistical methods. Tests using unclean datasets will be taken place. Data Abstraction and Virtualization's (DAV's) efficiency will be evaluated based on how	11/18/2021	Pass	

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			well the unclean datasets were "cleaned" and corrected. Cleaning will take place in DAV's Processing & Filtering Software, with the cleaned datasets being stored at Virtual Data Repository later on			
3.47	SHOULD	As a Blockchain organization, I would like to be informed about the name and number of the other participant organizations	Deploy a fabric network and create a mechanism to get info about the participant organizations. It is needed to have the capability to query the network for participating organizations, in order to assign sharing and governance rules at an organization level	11/29/2021	Minor rework	We are already able to assign sharing and governance rules at an organisational level. However, there is currently no view that shows all blockchain participant organisations. Nonetheless, this can be easily added

Table 61 - WP3 requirements evaluation

WP4 Data Governance And Security

WP4 has 10 requirements with Pass status, 6 requirements with Fail status, and 1 requirement with a Minor Rework status, with a pass percentage of 59%.

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
4.1	MUST	As a participating Blockchain organization, I would like to be able to develop and run agreed upon business	Deploy smart contracts executing pilot's business logic on the appropriate Blockchain network	11/28/2021	Pass	As part of the BC network setup and configuration chaincodes with the business logic

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		logic in a distributed manner and agree on results				appropriate to the solution were deployed on all 3 business networks
4.2	MUST	As a participating Blockchain organization, I would like to share data in a privacy preserving manner with selected organizations within the business network	Use Blockchain networks for each pilot with stakeholder organizations to share data in the network. Use channels between network participants who need to share data in a manner invisible to other participants	11/28/2021	Pass	Part of the network design and configuration includes setup of BC orgs, channels including peers of those orgs which are sharing the BC ledger
4.3	MUST	As a participating Blockchain organization, I would like to enrol my client applications and end users to access and share data in my Blockchain network in a secure manner using appropriate authentication	Certify end users, so they can be enrolled and registered as such to invoke Blockchain client applications. Use Fabric CA to provision the certificates and Fabric authentication mechanism for enrolling and registering those certificates	11/28/2021	Pass	For all 3 networks BC client applications were developed using Fabric SDK to enrol and register organizational users into BC. Those users can submit transactions on the network based on their roles
4.4	MUST	As a participating Blockchain organization, I would like to enrol my client applications and end users to	Use Blockchain authorization mechanisms (resource level ACLs, for managing which orgs/users can add	11/28/2021	Pass	Part of the BC networks setup includes setup of organizational CA's MSPs

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		access and share data in my Blockchain network in a secure manner using appropriate authorization mechanisms	organizations to network, which can access channel data), smartcode level authorization (such as role based authorization for users determining who can read/write what data) to determine access to on chain data			and certification of organizational and user roles to determine rights and access levels both to the network and the shared ledger
4.5	MUST	As a data provider, I would like to have an agreement with data consumer about data manipulation	Deploy smart contracts that store rules, obligation and prohibitions about data manipulation	11/29/2021	Pass	
4.6	MUST	As a data provider, I would like not only to grant access to data consumer, but also to revoke access	Deploy a Hyperledger Fabric application to overview datasets and assigned permissions	11/29/2021	Pass	
4.7	SHOULD	As a participant Blockchain organization, I want to set data governance rules, so that data access is specified	Create Blockchain data governance use case implementation network, which provides ability to add/query new data governance rules for off chain data. Ensure that on chain data for data sharing scenarios have policies and access roles in place to govern access to the data	11/29/2021	Minor rework	We already have access rights in place that govern access to data. However, we have not implemented the addition of new, generic access rights. Nonetheless, this can be easily added.
4.8	MUST	The DataPorts	Verify that personal	11/15/2021	Pass	

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		Platform must ensure the privacy of personal data required for authentication purposes	data is adequate, relevant and limited to what is necessary, in relation to the purposes for which they are processed if needed and that this data is not used for any other purpose			
4.9	COULD	The DataPorts Platform could ensure personal data minimization by authentication (stripping)	1. Verify that personal data must be adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed. Essentially, it means that data cannot be processed, unless it is needed to process them, in order to achieve the above-mentioned purposes 2. Identify platform process and information/data managed on each one, guaranteeing that only needed and minimal information is used for its purposes	11/15/2021	Pass	
4.10	MUST	The DataPorts Platform must control the usage of its services only to authorized subjects, guaranteeing the	1. Review that admin users or general only access to personal data considering specific process, and due to authorized and	11/15/2021	Pass	

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		separation of roles and functions	controlled activities, and only can modify data considering different privileges 2. Test access to services, using a) admin account with privileges b) user account with no privileges			
4.11	SHOULD	The DataPorts Platform should provide the users the ability to manage and control their requirements concerning personal data	Login to manager portal with user credentials; Check the type of user logged; Test with different types of users based on privileges; Each user has privileges based on the range given once created; On the panel of the portal navigate to personal data; Check all the personal ata that is stored; Different type of data is stored in personal profile; Check the possibility to change personal data; Test with all personal data fields; Check that personal data is successfully changed; Cancel the user account; Check that all personal data of the user have been removed	11/15/2021	Pass	
4.12	MUST	The DataPorts Platform must	1. Review the existence of a	11/15/2021	Fail	In order to ensure full

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		support the security and governance recommendations from the IDS reference architecture in order to share and transfer data securely	service identity provider; 2. If available, review the DAPS, who must ensure that data governance rules are deployed and working; 3. Verify, when transferring any type of information, which security protocol is in use and assess its secureness; 4. Identify point-to-point encryption (between connectors), using an encrypted tunnel; 5. Verify end-to-end authorization (authenticity and authorization based on actual communication endpoints; i.e., data Blockchain connectors); 6. Verify, regarding the trustiness between security domains, PKI structure to ensure identity, by reviewing the security protocols and processes within smart contracts			compliance, we need to carry out the audit of the platform. We will have the results of the audit in month 30.
4.13	MUST	Implementation of a solution for IAM, fully aligned with the scope of the DataPorts Platform and	Once the IAM solution is implemented; Log in to the platform as SA; Go to Manage System ->	11/15/2021	Fail	In order to ensure full compliance, we need to carry out the audit of the

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		future challenges	User Roles; Check if the user has logged in the application as role previously selected (System Administrator)			platform. We will have the results of the audit in month 30.
4.14	MUST	An existing account may be deleted, and this deletion must be adequately performed, aligned with the IAM solution	Once the IAM solution is implemented; Log in to the platform as SA; Go to Manage User Accounts ->-User roles; Click in account or user to be deleted; Go to delete; Check in list of user access if selected user does not appear anymore	11/15/2021	Fail	In order to ensure full compliance, we need to carry out the audit of the platform. We will have the results of the audit in month 30.
4.15	SHOULD	The DataPorts Platform should have the capacity to create roles, and (de)assign roles to an existing account	Once the IAM solution is implemented; Log in to the platform as SA; Go to Manage User Accounts -> User roles; Click in account or user to be modified; Add roles, or delete them, and submit; Check in list of user access if selected user has new role, or has been deleted; Go to Manage Roles -> User roles; Click in new role; Configure the role and submit; Check in list if the new role appears	11/15/2021	Fail	In order to ensure full compliance, we need to carry out the audit of the platform. We will have the results of the audit in month 30.

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
4.16	MUST	The DataPorts Platform must not reveal any sensitive information when a user fails to login into the platform	Access to the platform; Insert username or password wrong; Check if "Bad Credentials" message appears, not specifying if username or password is wrong; Click in "Forgot your password" button and check if new password or instructions are submitted	11/15/2021	Fail	In order to ensure full compliance, we need to carry out the audit of the platform. We will have the results of the audit in month 30.
4.17	MUST	The DataPorts Platform must be secured	Run platform pentesting and security analysis process	11/15/2021	Fail	The pentest and security analysis results will be available on month 27

Table 62 - WP4 requirements evaluation

WP5 – Deployment, Piloting and Evaluation

WP5 has 21 Fail requirements and 2 Minor Rework requirements, with a pass status of 9%.

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
5.1	MUST	DataPorts must collect metrics about the pilots (requirements satisfied, end-user satisfaction, data collected and processed etc.) to establish a benchmarking of the KPIs achieved by the project	Given a pilot of the DataPorts project, when I require to report the Evaluation Plan, then the use cases must provide the established metrics in the Evaluation Plan	29/10/2021	Fail	There are no pilots yet
5.2	MUST	As a data	The DataPorts	11/29/2021	Fail	No IoT devices

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		provider, I want to be ensured for data privacy, so that there is no data leakage	Platform ensures that connected IoT devices are not vulnerable malware and DoS/DDoS attack. Data transfer is achieved according to GDPR compliance. It is about ThPA use cases. Use case 1: Data driven application for strategic and real time decisions			are being used in Use Case 1. However, data privacy will, in general, be guaranteed through the IDS connector or an equivalent means of connection.
5.3	MUST	As a data prosumer, I want to have interoperable data models for my use case scenarios, so that they can be portable with an interconnected platform	Ensure all the functionalities which will be tested according to the pilots' needs that are suitable for the available infrastructures. In addition, global use case is a PoC to interconnected ports. For example, the DataPorts Platform should be efficient in case it has to be implemented in other ports with similar infrastructures. It is about ThPA use case 1: Data driven application for strategic and real time decisions	11/29/2021	Fail	It has been discussed and decided amongst partners that the ThPA Use case 1: "Data driven application for strategic and real time decisions", which has been evolved into Use case 1: "Container Pick-Up", will not be sharing its data within the DataPorts. Therefore, there is no need for interoperable data in Use Case 1.
5.4	SHOULD	As a data prosumer, I want intervention-mediation, in order to solve	This is the necessary intervention-mediation for the successful completion of the	11/29/2021	Fail	At the time of writing this requirement, there were only 2 use

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
		mobility issues	scenario regarding the mobility queues. More specifically, it is about ThPA use case 2: Improve mobility of passengers, professional and visitors of the port			cases specified for ThPA. Later on, the second use case was split into 4 different use cases, one of which is "Use Case 3: Queues predictions", and another is "Use case 5: Facilitation of passengers...". These use cases fulfil this requirement. However, they are in the process of being implemented.
5.5	COULD	The data elements processed correspond to the common eFTI data set and subsets, and can be processed in any of the official languages of the Union	Given the pilots of DataPorts project, when involved entities share or subscribe to transport data, then the data have to be based on the eFTI standard when applicable	11/9/2021	Minor Rework	The data model for the logistics and transportation scenarios has been defined to make it easier to comply with the common eFTI data set and subsets when defined
5.6	SHOULD	DataPorts should involve clients to get real data from different platforms	Given the pilots of DataPorts project, when I require data to test the functionalities, then the data owners should allow the	11/9/2021	Minor Rework	The scenarios are using real data from public and non-confidential

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			data sharing even if they are not partners			data sources
5.7	MUST	The DataPorts Platform must provide template agents for the Posidonia Operations data	Given the pilots of DataPorts project, when a Posidonia Operations application is going to be integrated with the platform, then a template agent will be provided	11/17/2021	Fail	The template is not available yet
5.8	MUST	The DataPorts Platform must provide template agents for the Posidonia Management data	Given the pilots of DataPorts project, when a Posidonia Management application is going to be integrated with the platform, then a template agent will be provided	11/17/2021	Fail	The template is not available yet
5.9	COULD	The DataPorts Platform could provide template agents for the Posidonia PCS data	Given the pilots of DataPorts project, when a Posidonia PCS application is going to be integrated with the platform, then a template agent will be provided	11/17/2021	Fail	The template is not available yet
5.10	MUST	As a data prosumer, I want to exploit the capabilities of Big Data analytics	Given ThPA pilot, when data from different databases will be available to the DataPorts Platform, then the set of data to be produced will facilitate the long and short term decision making and planning. It can be related to patterns regarding a) the	11/10/2021	Fail	requires further integration to complete the requirement

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			performance of ThPA community (e.g. the pattern that the containers of a specific company/ship leave the terminal) b) the performance of ThPA itself (e.g. the pattern of containers delivery/pick up (quantities, days, months) from a specific company/ship to better plan and manage my yard, my personnel (shifts) and equipment) and c) data from other ports that participate in DataPorts			
5.11	MUST	As terminal operator, I want to have a user friendly Dashboard for the presentation of results	Given ThPA pilot, when the data will be processed and analysed by the DataPorts Platform, then it will be presented in a user friendly Dashboard with filters and selection criteria that will facilitate the user to work on. It will be organized by thematic sections for easy access	11/10/2021	Fail	requires further integration to complete the requirement
5.12	MUST	As terminal operator, I want to have a model that can predict queues	Given ThPA pilot, when the prediction model for creation of queues at land gate will be available, then the DataPorts Platform will support the optimization of	11/10/2021	Fail	requires further integration to complete the requirement

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			Truck Appointment System by better exploiting the available slots and reducing the waiting time to be served			
5.13	MUST	As terminal operator, I want to have real time information about the progress of the appointment systems in place	Given ThPA pilot, when the DataPorts Platform collects data about land gates operation, then will process them and provide real time (or almost real time) information about the status of the land gates	11/10/2021	Fail	requires further integration to complete the requirement
5.14	MUST	As a system administrator, I want to have access to all logs of the internal platform components	Given the pilots of DataPorts project, when any action is performed by a component, then it is recorded in the logs	11/10/2021	Fail	requires further integration to complete the requirement
5.15	MUST	As data prosumer, I want to ensure that the data provided to/from the DataPorts will be accessible by only authorized users	Given that ThPA will define the rules of "which user has access to what information" for its pilot, when the smart contracts will be implemented, then ThPA will check and ensure the validity	11/10/2021	Fail	requires further integration to complete the requirement
5.16	MUST	As data prosumer, I want to have records of the business activities took place	Given the Blockchain component, when data exchange will take place between collaborators in ThPA pilot, then a full record of transactions will be	11/10/2021	Fail	requires further integration to complete the requirement

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
			available for business and legal purposes			
5.17	MUST	As data provider, I want to be able to easily provide data	Given the interoperability capabilities, when data must be provided for ThPA pilot, then a template agent will be provided	11/10/2021	Fail	requires further integration to complete the requirement
5.18	MUST	As data consumer, I want to be able to easily get data	Given the interoperability capabilities, when data must be provided to ThPA pilot, then APIs will be provided	11/10/2021	Fail	requires further integration to complete the requirement
5.19	MUST	As terminal operator, the technical requirements to use the platform must be simple (storage requirements, servers, network etc.)	Easy adaptation of the DataPorts Platform to existing infrastructures	11/10/2021	Fail	requires further integration to complete the requirement
5.20	COULD	As terminal operator, parametrization is important to provide flexibility to users	Changes and additions to existing use cases and business models should be easily made	11/10/2021	Fail	requires further integration to complete the requirement
5.21	SHOULD	As a data consumer, I want to access statistics and predictions that include mobility or visitors	The required statistics/predictions should be defined for each use-case in particular, and implemented in smart contracts as required	11/29/2021	Fail	Use cases will NOT be implemented through smart contracts

Req ID	Priority	Description	Test Case / Acceptance Criteria	Evaluation Date	Evaluation Status	Comment
5.22	MUST	The DataPorts Platform must provide an agent to get Smart Containers data through Traxens API	Given the pilots of DataPorts project, when smart container produces data, then it must be available in DataPorts	11/19/2021	Fail	No devices deployed yet. Agents not developed.
5.23	MUST	The DataPorts Platform must provide an agent to provide Smart Containers data through DataPorts	Given the pilots of DataPorts project, when smart container data is available for a customer in DataPorts, then it must be notified and accessible to the customer	11/19/2021	Fail	No devices deployed yet. Agents not developed.

Table 63 - WP5 requirements evaluation