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Abstract:

This deliverable will document the activities that have been performed in the implementation of the pilots and the use cases, and the description of the final results.

Keywords:

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

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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 deliverable consists on the final version of the software applications developed in the pilots, including change-set, final list of features and user documentation.

The purpose of this document is to describe the final state of the pilots on M39, with a description of what has been done, from the final use case descriptions to the step-by-step demonstration. With that view in mind, this document splits the content in two different kind of progress reports.

On one hand it contains descriptions of the activities that have been performed by many involved partners, how the functionalities of the platform are demonstrated in the scenarios, and how the components and other outcomes of the project (i.e., data models) are present in the use cases.

On the other hand, the final description of the use cases is presented, including the activities that have been carried out, from the allocation of physical resources to the implementation of new applications. Each scenario will include its own description of how the pilot has been implemented and the user documentation of the applications involved.



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.
- D2.4 Platform architecture and specifications: it describes the functionalities and the components that are demonstrated in the pilots.
- D5.1 Integration, software quality assurance and deployment plan: it describes the plan of activities for the pilots' implementation.
- D5.3 Use case oriented pilot initial version: The status of the pilots and the applications at the beginning of the integration.

Primary Dependant documents:

• 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 activities performed for the implementation of the pilot, the required infrastructure, the deployment of the applications and services, and the use of the platform. They are included also the final version of the use cases and the references to the applications' user manuals.
- Section 4 Port of Thessaloniki: It describes the activities performed for the implementation of the pilot, the required infrastructure, the deployment of the applications and services, and the use of the platform. They are included also the final version of the use cases and the references to the applications' user manuals.
- Section 5 Smart containers: It describes the activities performed for the implementation of the pilot, the required infrastructure, the deployment of the applications and services, and the use of the platform. They are included also the final version of the use cases and the references to the applications' user manuals.
- Section 6 Port management system integration: It describes the activities performed for the implementation of the pilot, the required infrastructure, the deployment of the applications and services, and the use of the platform. They are included also the final version of the use cases and the references to the applications' user manuals.
- Section 7 Conclusions: It resumes the final status of the demonstrations, the obtained experience and the lessons learned.



Annexes:

- Annex A: User manuals
- Annex B: Change logs

2 GENERAL

2.1 PROJECT OVERVIEW

A project overview considering the pilot's point of view was already described in D5.3 Use Case Oriented Pilots Initial Version (M24). In this section we will explain in a general way the progress of the project and the integration of the platform in the different pilots that have been implemented in the last year of the project.

In this document we will find the final use case description and status, and a new scenario that has been added to the Valencia pilot to showcase the integration of services provided by other data federation with data from DataPorts through IDS connectors.

First thing to mention is that the project had an initial planning for 36 months, starting in January 2019 and finishing in December 2022. Because of the COVID pandemic some of the tasks were delayed and some partners had difficulties to find the expected resources, so the consortium decided to ask for a 3 months extension of the project, that was accepted by the EC.

The Figure 1 depicts the activities performed from the M24 to M39, containing the main activities related with the pilot's implementation, the platform integration and the whole evaluation.



Figure 1 – Performed activities

As shown in the previous figure, the main deliverables of the WP5, including this one, have been moved to M39.

Along the last year of the project, in each of the pilots, the task leaders have provided all the required infrastructure, that is needed not only for the applications and the demonstrations but also for the deployment of DataPorts. Because the platform has a modular architecture, some of the components are present in every pilot to keep the data near the source following an edge computing approach and other are single instances shared among the scenarios. For this purpose, servers have been provided and access has been granted to stakeholders and involved parties, as the needed support to be able to work in the different environments.

Agents have been implemented for the acquisition of data and its transformation into the data models defined also in the scope of this project. The whole components of DataPorts have been integrated with the mechanisms defined for the security of the platform, building a secure environment for the exchange of information. All the agents have been also prepared to work with the different components required in each of the scenarios for the processing of the data, considering the conditions of the use cases. How to access the components of the platform and how they interact, the user rights to access these components and the permissions to the data, everything is ruled and protected through the Data Governance and other security components of the platform.

Furthermore, to meet the use case objectives, new applications have been implemented to demonstrate the benefits of using DataPorts. These applications are described along the document, as well as how users interact with them to validate the platform functionalities.

In addition, in the following sections of the document, all the activities performed by the consortium related with the implementation of the pilots to achieve the results are described.

2.2 COMPONENT DEFINITIONS

The Table 1 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 form of event logs (i.e., sequences of business process actions) to deliver predictive, prescriptive and explainable process monitoring capabilities.

Table 1 – DataPorts platform components

2.3 USE CASES AND PLATFORM FUNCTIONALITIES

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

The Table 2 shows the scenarios of the use cases with their short names.

Use case short name	Use case complete name
тто	Tracking of Transport Operations
DSS	Port Authority Data Sharing and Analytics Service
VGM	Sharing Verified Gross Mass
DCN	Digital Consignment Note



Use case short name	Use case complete name
CPU	Container Pick-up
AUC	Analytics Use Case for ThPA
SCO	Smart Containers
PNS	Posidonia Notifications

Table 2 – Scenarios of the pilots

Each scenario of the pilot implements or integrates the platform's components required to reach their objectives; functionalities are demonstrated depending on the use of these components. The Table 3 lists where the functionalities of the platform are showcased.

ID	Functionality	тто	DSS	VGM	DCN	CPU	AUC	SCO	PNS
F-2.1	The DataPorts platform provides various platform governance capabilities and interoperability among different platforms	S	S	9	S	S	S	S	⊘
F-2.2	The DataPorts platform sets a data driven ecosystem ready for a comprehensive exploitation of data, and virtual data repositories	0	0	0	0	0	0	0	0
F-2.3	The DataPorts platform introduces a novel, decentralized architecture, data and events can be recorded on a blockchain for transparency and credibility	0	0	0	0	0	0	⊘	⊘
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	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0
F-2.6	The DataPorts platform provides Orion Context Broker and Blockchain component, registering the description of the data	0	0	0	0	0	0	0	0
F-2.7	The DataPorts platform enables the data owners to exchange data	\bigcirc							
F-2.8	The DataPorts platform enables data sovereignty	\bigcirc							
F-3.1	The DataPorts platform enables connections with external sources of data supported by data agents manager	0	0				0	0	0
F-3.2	The platform will enable a real connection among current IT systems in ports environment, allowing them to share data and knowledge	0	0	0	0	0			⊘
F-3.3	The DataPorts platform provides data sanitization algorithm to guarantee data integrity		0				0		
F-3.4	The DataPorts platform establishes machine learning models		\bigcirc				\bigcirc		

F-3.5	The DataPorts platform enables the federation of data varying in syntax and semantics							\checkmark	\bigcirc
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		0				?	9	0
F-3.7	The DataPorts platform provides semantic stream processing	\bigcirc	\checkmark					\checkmark	\bigcirc
F-3.8	The DataPorts platform provides semantic data compression	\bigcirc	\bigcirc						
F-3.9	The DataPorts platform provides declarative, distributed data aggregation	\bigcirc	\bigcirc				\bigcirc		
F-3.10	DataPorts platform provides an innovative user interface to guide the user in specifying privacy and data access policies	0					0	0	0
F-3.11	The DataPorts platform provides the data owners data driven analytic services		\checkmark						\bigcirc
F-3.12	The DataPorts platform provides the consumers and end users new AI and cognitive applications		0				⊘		
F-3.13	The DataPorts platform provides tools to help decision processes		\bigcirc				\bigcirc		
F-3.14	The DataPorts platform provides smart API for cognitive services	\bigcirc	\checkmark				\checkmark		
F-3.15	The DataPorts platform processes streams of records and publish and subscribe to streams of data	Ø	0				⊘	⊘	0
F-3.16	The DataPorts Platform provides a framework for semantic interoperability from several sources	0	0				0	0	0
F-3.17	The DataPorts Platforms offers an ontology to guarantee semantic interoperability	\bigcirc	\bigcirc	\bigcirc	~	\bigcirc	\bigcirc	Ø	\bigcirc
F-3.18	The DataPorts Platform provides REST-style interaction with Linked Data	\bigcirc	\bigcirc						
F-3.19	The DataPorts Platform provides a data source metadata registry	\bigcirc	\checkmark						\bigcirc
F-3.20	The DataPorts Platform provides data from a federated database on demand	\bigcirc	\bigcirc					\checkmark	

F-3.21	The DataPorts Platform provides data from a federated database through publish and subscribe model	8						8	
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)	9					0	0	0
F-4.2	The DataPorts platform provides services to ensure security and protection of shared data	0	0	0	0	0	0	0	0
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	0	0				0		
F-4.4	The DataPorts platform provides clear rules on how data will be accessed	\bigcirc	\bigcirc				\bigcirc	\bigcirc	\bigcirc
F-4.5	The DataPorts platform provides flexibility of policies on data distribution	\bigcirc						\bigcirc	\bigcirc
F-4.6	The DataPorts platform provides end to end secure environment	\checkmark	\bigcirc	\bigcirc	\bigcirc	\bigcirc	~	\bigcirc	
F-4.7	The DataPorts platform ensures full compliance with General Data Protection Regulation (GDPR)	0	0	0	0	0	0	0	0
F-4.8	The DataPorts platform enables efficient processing over protected data while preventing (or limiting) access to actual data content by other parties	0	0	0	0	0	0	0	0

Table 3 – Functionalities of the platform

2.4 DATAPORTS COMPONENTS

From the previous Table 3 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.

Depending on the requirements of the scenarios because the functionalities of the platform are provided by components, the elements to include are not the same for all of them. The Table 4 lists the usage of the different components of the platform in the scenarios implemented in the project demonstration.

Component	тто	DSS	VGM	DCN	CPU	AUC	sco	PNS
Data Access Component		Ø				\bigcirc	\bigcirc	0
Semantic Interoperability Component						0	0	
Data Abstraction and Virtualization Component		0				0		
Data Governance Component		0				0	0	
Automatic Model Training Engine		\mathbf{b}						
Process-based Analytics Component (*)								
Blockchain infrastructure								

Table 4 – Components and scenarios

(*) Note concerning **process-based analytics component:** The functionalities of this component are fully implemented¹ and validated using extensive benchmark data sets from the research community². This

¹ The implementation of the components is available from:

- Prescriptive Analytics: <u>https://git.uni-due.de/abpm/isj</u>
- Explainable Predictive Analytics: <u>https://git.uni-due.de/adi645f/cf4bpm-artifacts</u>
- Explainable Prescriptive Analytics: <u>https://git.uni-due.de/rl4sas/xrl-dine</u>

See the following research papers:

- Prescriptive Analytics: <u>https://git.uni-due.de/abpm/isj</u>
- Explainable Predictive Analytics: <u>https://git.uni-due.de/adi645f/cf4bpm-artifacts</u>
- Explainable Prescriptive Analytics: <u>https://git.uni-due.de/rl4sas/xrl-dine</u>

² See the following research papers:

- **Prescriptive Analytics:** A. Metzger, T. Kley, and A. Palm, "Triggering proactive business process adaptations via online reinforcement learning," in 18th Int'l Conference on Business Process Management (BPM 2020), Sevilla, Spain (virtual), September 13-18, 2020, ser. LNCS, D. Fahland, C. Ghidini, J. Becker, and M. Dumas, Eds., vol. 12168. Springer, 2020;
- Explainable Predictive Analytics: T. Huang, A. Metzger, and K. Pohl, "Counterfactual Explanations for Predictive Business Process Monitoring," in 18th European Mediterranean & Middle Eastern Conference on Information Systems (EMCIS 2021), December 8-9, 2021, Online, Springer LNBIP 437, pp. 399-413 Best Theoretical Paper Award
- Explainable Prescriptive Analytics: F. Feit, A. Metzger, K. Pohl, "Explaining Online Reinforcement

demonstrates the innovation and progress from the state of the art brought about by the deep AI/ML techniques focused in this component.

The process-based analytics component addresses the following recommendation of PR1: "The focus of the development in data analytics services and cognitive applications is mainly on regression models of timeseries data, but tools for other type of analytics tasks or data might also be considered to make the components more generally applicable to possible (future) use cases.". The process-based analytics component works on event logs. An important difference event log data and time series data is the kind of data used for the AI/ML components. While time series data represent values of single or multiple variables at different points in time (such as number of containers or trucks), event log data represent sequences of process events. In addition to a timestamp, a process event typically includes an event label (uniquely identifying the process step) and additional attributes of the event. As such, there is an important semantic difference between a data point in a time series and a process event³.

By using benchmark data sets from research, the process-based analytics component addresses another recommendation of PR1: "Also, the components of data processing and data analytics services are currently restricted to and fine-tuned for the pilot use cases, the project might consider letting end-users build up their own data processing and analytics (including parameters) pipeline to provide more flexibility." We approached this recommendation from a research angle, meaning that by applying the process-based analytics component to benchmark data sets from research, we demonstrated the generalizability of results.

While the potential use of the component as part of the two indicated scenarios is described in the remainder of this deliverable, due to the limited volume and variety of the data that was collected via the DataPorts platform, it was not possible to assess and demonstrate the benefits of the component in the setting of the two concrete use scenarios.

2.5 SECURITY AND QUALITY ASSURANCE

The security and quality assurance process consisted in several tasks and activities performed along the project with the aim to secure the DataPorts platform.

The first task was 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 were identified and measures to address them were proposed.

The following task was 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 were identified. These vulnerabilities constituted a risk of attack on the platform, so they were analysed and assessed. Also, proper countermeasures were proposed.

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

Learning Decisions of Self-Adaptive Systems", in 3rd Int'l Conference on Autonomic Computing and Self-Organizing Systems (ACSOS 2022), Virtual, CA, USA, September 19-23, 2022, R. Casadei, E. Di Nitto, I. Gerostathopoulos, D. Pianini, I. Dusparic, T. Wood, P. R. Nelson, E. Pournaras, N. Bencomo, S. Götz, C. Krupitzer, and C. Raibulet (Eds.), IEEE, 2022, pp. 51-60 –Best Paper Nominee

³ A. Metzger, A. Neubauer, P. Bohn, and K. Pohl, "Proactive process adaptation using deep learning ensembles," in 31st Int'l Conference on Advanced Information Systems Engineering (CAiSE 2019), Rome, Italy, June 3-7, 2019, ser. LNCS, P. Giorgini and B. Weber, Eds., vol. 11483. Springer, 2019, pp. 547–562

The following task was a Security Revision, which is the process of testing the platform and to verify whether the security requirements defined for the platform and the components have been followed. Verifying the platform is compliance with the security requirements defined.

The following task was to deploy an Identity and access manager (IAM), which is responsible of the management of all the identities in the platform and provides an authentication system used internally by the components and in the front-end of the components to authenticate the users in a secure way.

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.

Time	Actors	Actions
M01-M06	EVR	System identification during the risk assessment.
M06-M12	EVR	Risk identification, analysis and evaluation of risks. Selection of treatment options and countermeasures for facing identified risks.
M06-M12	IBM, EVR and	Definition of approach for Blockchain for governance rules.
	CERTH	Selection of Fabric version and development language for chaincodes.
		Definition of a Minimum Viable Product (MVP) for VGM, CPU and data governance use cases
M06-M12	IBM, OTE, EVR, ICCS, CERTH	Definition of the environment and components necessary for traceability and secure sharing of data.
M12-M20	IBM, EVR 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
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.
M12-M20	EVR	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.
M20-M30	CERTH, EVR 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
M20-M30	CERTH, EVR and IBM	Monitoring and register of transactions in the logger chaincode (clearing house)
M20-M30	EVR	To carry out the pentest, the security code review and the testing of pilots. All the results are included in the deliverable.

The table below presents the actions done regarding the security and quality assurance tasks.

Time	Actors	Actions
M20-M30	EVR	Deployed an IAM system that integrates with the platform components as an authentication and access mechanism.

Table 5 – 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 followed in the DataPorts project involved 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, from M12 to M29, periodic meetings were 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 common Data Model is currently hosted in the DataPorts Git repository⁴, which contains the corresponding documents describing the syntax of the entities involved, as well as the documentation and examples. The DataPorts Data Model has been described in the software deliverable "D3.5 - Data processing services M27" ⁵ and has been adopted and validated in the use cases.

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 followed to define the Data Model comprises the steps listed in the Table 6.

Time	Actors	Actions	
M6 -15	UPV / TRX	Technology selection and methodology and steps definition.	
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. 	
M15-M22	WP5 partners	Analyse the ontologies and data models (if this happens) currently used in each of the scenarios described in the pilots.	
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 	
M22-M24	UPV	Git repository structure creation and collaboration guidelines.	

⁴ https://github.com/DataPortsProject

⁵ https://dataports-project.eu/deliverables/



Time	Actors	Actions
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.
M22-M25	WP2 / WP3 /WP5 partners	Data Model Version 1.0:Detailed specification of the Data Model.
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. Data Model Version 2.0. This version considers the improvements made during the initial integration in the pilots. This version of the Data Model also includes JSON-LD context documents and is compatible with NGSI-LD.
M30-M36	WP5 partners	Development and deployment in the pilots of the final versions of the agents.

Table 6 – Data Model Plan Reporting Table

The most relevant concepts from the common Data Model will be uploaded to GitHub⁶ to make them available to everyone interested in the mechanisms of interoperability of DataPorts. In addition, some concepts from the common Data Model that can be used for a wide community of open-source developers will be uploaded to the Smart Data Models initiative repository as a contribution from DataPorts. Currently, these classes are incubated in that location, waiting to pass the corresponding reviews to be adopted.

2.6.1 Data Models Matrix

The Table 7 – Data models and scenarios shows which data models are used in each scenario. This means that an agent will get the data from the source and transform it according to the schema definition.

Data Model	тто	DSS	VGM	DCN	CPU	AUC	SCO	PNS
Trackable Event				\mathbf{b}			\mathbf{b}	
Posidonia Event								$\mathbf{\Sigma}$
PortCall								
StoredItem				$\mathbf{>}$				
Shipment	0							
PortGateEntry	>							

⁶ https://github.com/DataPortsProject/datamodel

Data Model	TTO	DSS	VGM	DCN	CPU	AUC	SCO	PNS
PortGateExit	>							
Customs								
MobilityData								
CommercialShipCall						$\mathbf{>}$		
Booking						$\mathbf{>}$		
Parking						0		
ExpectedCruiseShipCall								
GateEvent								
TravelTime								
TrafficDetection								

Table 7 – Data models and scenarios

3 PORT OF VALENCIA

This section describes the five 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.

3.1 APPLICATIONS DEPLOYMENT

The port of Valencia pilot defined five different scenarios. Three of these scenarios are deployed in the same infrastructure, while two of them, the data sharing and analytics scenario and the IDS, are deployed in a different environment.

The three scenarios are in three virtual machines on cloud working in a cluster. In order to manage the cluster, there is an instance of Kubernetes called Rancher. Over Rancher there are all the needed components for the operation of the applications, including the blockchain infrastructure, the MongoDB database, and the front-end and back-end of the application. These components are replicated in the different pods, the replicas for the MongoDB database and two for the application code.

The blockchain network is based on Hyperledger Fabric 1.4.0. It includes the smart contracts necessary for the storage, access, modification, and deletion of the data in the ledger. In addition, blockchain client is included in the code. Finally, the blockchain credential are in several wallets stored in Mongo DB.



Figure 2 – Valencia port scenarios infrastructure 1

For the last scenario, one instance of the Automatic Model Training Engine has been deployed in a virtual infrastructure to enable the creation of an Artificial-Intelligence-based cognitive service to tackle a specific Ports' business KPI. To easy the deployment in any infrastructure, the component was dockerized. To carry out the services training phase, secure communications processes implemented in Dataports platform are performed, namely; communications with Data Governance to obtain permissions for a specific user of AMTE, information exchange with Data Abstraction and Virtualization to obtain metadata and pre-processed

datasets, and subscriptions with Semantic Interoperability. Finally, predictive results are provided through a secure API, so end user may make use of the predictions performed by the trained Cognitive Services.



Figure 3 – Valencia port scenario infrastructure 2

3.2 TRACKING OF TRANSPORT OPERATIONS

3.2.1 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 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 are 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 receives 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 provides 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 4 depicts the workflow and interactions of the scenario:



Figure 4 – Tracking of Transport Operations workflow

The Table 8 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
4	Alice uses the Tracking application to get the location of all her containers Bob uses the Tracking application to get the location of all his goods Charlie uses the Tracking application to get the transport operation status

Table 8 – Tracking of Transport Operations Scenario Description

Initially, three applications were defined in the deliverable D5.3. However, these applications share the same data, roles, users, etc. so finally they are three different views of the same application.

The datasets shown on Table 9 are 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 9 – Tracking of Transport Operations Scenario Datasets

TradeLens has been removed from the list of data sources because the owners decided to stop the platform at the beginning of 2023. During the pilot demonstration TradeLens will not be available.

3.2.2 DataPorts roles

The Table 10 – Tracking of Transport Operations Roles shows 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, and develops the application
PRO	Prodevelop develops the agents to acquire the data at port premises and deploys the Data Access component
UPV	UPV is in charge to transform data to a common data model with the Semantic Interoperability component
EVR	Everis deploys the data governance component and manage the permissions
TRX	Traxens integrates the container position from its platform

Table 10 – Tracking of Transport Operations Roles

3.2.3 Activities carried out

The Table 11 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions
M20-M24	VPF	Provide the scenario specification with the support of all involved partners
M24-M32	VPF, PRO, UPV, EVR	Deploy the necessary infrastructure for the scenarios and the DataPorts Components
M32-M36	PRO, VPF, TRX	Development of the Agents for all the data sources
M28-M36	VPF	Develop the three applications

Table 11 – Tracking of Transport Operations Action Plan Reporting Table

3.2.4 Data Integration

The aforementioned data sources have been connected with the platform with the development of the corresponding agents. The complete list of the agents developed for this scenario is shown in the Table 12 - Agents implemented in this scenario:

Agent	Туре	Description
PCS Road		This agent imports historical data about interactions with deposits, indicating who is the depositary, and who is the cargo depositor, and also the date on which the action was carried out.
	On demand	Imported data is transformed into the <u>StoredItem</u> data model and split into two different objects (acceptance and release) which are stored in separate collections in Cygnus
Port Authority - Entry		This agent periodically imports (on a 5 minute basis) information regarding accesses through the entry gate by querying a REST endpoint at <u>https://greenp.digiport.com.es</u>
	Publish / Subscribe	Each entry event is transformed into two different data models, <u>PortGateEntry</u> and <u>TrackableEvent</u> , and stored in Cygnus

Agent	Туре	Description
Port Authority - Exit		Similar to Entry agent but importing events happening at the Port's exit gate.
	Publish / Subscribe	Events are also transformed into two different data models, <u>PortGateExit</u> and <u>TrackableEvent</u> , and stored in Cygnus
vForwarding		This agent exposes and endpoint that can be used by an external system to push shipments related data.
	Publish / Subscribe	The information is mapped using the <u>Shipment</u> data model and stored in Cygnus.
Posidonia Operations	Publish / Subscribe	This agent subscribes a RabbitMQ broker for Posidonia Operations events. These events are translated using the <u>TrackableEvent</u> data model.
Smart Containers Geolocation	Publish / Subscribe	This agent queries periodically (defaults to 15 minutes) and externalRESTendpointexposedathttps://ws.traxens.com/traxwsext/cxf/externalandimportsevents related to geolocation of a specific set of containers.Imported data is transformed using the TrackableEvent datamodel and stored in Orion
Smart Containers Geofencing	Publish / Subscribe	Similar to the Geolocation agent, but in this case the agent imports events related to containers entering or departing predefined georeferenced zones.
Smart Containers Door Opening	Publish / Subscribe	Similar to the two previous agents, but in this case the agent imports container door events (opening and close)

Table 12 – Agents implemented in this scenario

3.2.5 Applications

The Table 13 describes the applications that are part of the scenario that interact with the platform and should be modified or implemented:

Application	Action	Status			
Tracking Application	New application	100%			
A shipping line is interested in monitoring all its own containers. The application allows real-time location of the containers. An importer or exporter can access to the cargo tracking data that any data provider is sharing. A freight forwarder can monitor the status of all the transport operations that is managing. It includes location events, status, delays, etc.					
User documentation can be found in Annex A Section 9.1.1					

Table 13 – Tracking of Transport Operations Applications

This section shows the use of the application by the stakeholders participating in the transport process.

Shipments

The freight forwarder can see the list of all the shipments managed including all the all the messages received if we expand one of them.

Data Platform for Connection of Co	Dataports	Light ~	😹 🛃 Administr
Home			
Logistics	shipment.title		
Shipments	shipment.instructions items: 10 🔻 1-10 af 14 < > 🗭 Update 🖉 Synchronize		
Transports	-		
Transport Units	Q Search Contains C Ends 42 Under by V (0) Ascending Descending		
Deposits	Requested Accepted Planned Finished Rejected Cancelled		
Events			
Administration	shipment_newShipment		
VGM	A Status A Status A Shipment.req. A shipment.relat. A shipment.relat. A shipment.relat. A shipment.relat. A shipment.relat. A shipment.request A Status A Status A Status A Status A Status A Shipment.relat. A shipment.relat. A shipment.relat. A shipment.relat. A shipment.request A Status A Status A Status A Status A Shipment.relat. A shipment.relat. A shipment.relat. A shipment.request A Status A Status	orLa 関 shipment.dispatchPar EXPEDIDOR	shipment.carrierLabel TRANSPORTISTA
VIGIA	Shipment.consignee		
Masters	Valencia 0106/22 Madrid 0106/22		
Messages	shipment.totalGoods () is shipment.goods 15000 Kg. 2 pallet AZUEJOS 1		
ESS	> / O tatus ■ shipment.req. ■ shipment.shi ■ shipment.relat ■ shipment.order ■ shipment.order ■ shipment.order ■ shipment.order	orLa 🛱 shipment.dispatchPar	shipment.carrierLabel
Access Options	A shipment.consignee DESTINATARIO		
	Valencia 1106/22 Madrid 1106/22		
	shipment totalGoods		

Figure 5 – List of shipments



Figure 6 – Shipment individual messages

Transport

The freight forwarder can see the transports included in the previous shipments. If a shipment is divided in three different transport services (road, train, and maritime) these are showed separately.

Data Data Platform Connection of	Ports for the Cognitive Ports	Dataports							Light ~	<u>-</u> 業	Administrador
📌 Home											
a. Logistics	~	🔉 Transports									
Shipments		Transport query, pleas	e select the sea	arch criteria Items:	10 - 1-3	is < > 🐔	Update Ø Synchroniz	20			
≣ ≢ Transports		Q Search	0	aual 🔿 Start 🙆 I	Contains O Ends	나는 Order By	• Ascending O Desce	ending 🛱 From	🖆 🇰 Until	8	
📺 Transport Units		Requested	Accep	ted 🔲 🗣 Planned	Executing	🗌 🗣 Finished 🔲 🗣 Re	jected 🔲 🗣 Cancelled				
Deposits											
Events											
Administration	¢	• New transpor									
VGM	< C	SK 🔮 ⊘ 📏 🤇	Status Finished	Trip Number 0001	Identification ABC1234	Carrier TRANSPORTISTA	porter				
VIGIA	<					Valencia 01/06/22		Madrid 01/06/22			
Masters	<	> 🖉 🗟 🔊	Status	Trip Number	Identification	🛱 Carrier	🛱 porter				
Messages	<		Executing Chilches	002	BCD5464	TRANSPORTISTA Valencia 11/06/22	W55555555@46011	Madrid 11/06/22		Madrid 11/06/22	
ACCESS			C)		0		0			
Access Options	<	> 🧪 🗟 🖉 <	Status Finished	Trip Number	■ Identification ABC1234	Carrier TRANSPORTISTA	porter				
				١	/alencia 12/06/22		Chilches 12/06/22		Valencia 12/06/22		

Figure 7 – Shipment divided by transports

Transport Units

The freight forwarder or the shipping line can see the list of containers from the registered shipments.

Da Da	ta Ports atform for the tion of Cognitive Port	Dataports						Light ~	■ ※	Administrador
A Home										
Logistics	~	Transport Units								
Shipments		Consult transport units, please sel	ect the search criteria	a items: 10	▼ 1-3 of 3	< > 2 U	date Ø Synchronize			
📰 Transports		Q Search	Equal O Start	Contains O	ode J≞ Order By	× (0) A	cending O Descending	🖻 🗰 Until		
Transport Units		Requested Ac	cepted 🗖 🗣 Plann	ed 🗆 🗣 Exec	uting 🗖 🗣 Finish	ed 🗆 🗣 Rejected 🗖	Cancelled			
Deposits										
Events										
¢ _₽ Administration	<	New Transport Unit								
VGM	<	> ∕ ⊗ 🖿 ೫ 🎰 Unit/Cont. TRLU123456	shipment.shi S202206111	Type 20GP	Status Executing	Carrier CSLU	Provider CSLU			
VIGIA	<	> 2 ○ 10 २२ mm Unit/Cont. TLLU4058460	shipment.shi 6884410410W	Type 4510	Status Executing	Carrier COSCO Shipping L	Provider Cosco Shipping Li			
Masters	<	> 2 ○ 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	shipment.shi 6339846650W	Type 4310	Status Executing	Carrier COSCO Shipping L	Provider Cosco Shipping Li			
Messages	<							I	tems: 10 👻	1-3 of 3 < >
ACCESS										
Access Options	<									

Figure 8 – List of containers used in the shipments

Deposit

The freight forwarder can see the gate in and gate out orders from the registered shipments.



E Date Date Plat	a Ports	Dataports		[Light -> 🔚 🎇 🖨 Administrado
A Home					
Logistics	~	a Deposits			
Shipments		Inquiry for items in deposit, please select the search criteria Items: 10 - 1-8 of 8	< > 🔁 Update 🖉 Synchr	ronize	
Transports				🚔 Errora	≜ Uasi #
Transport Units		Contains O Ends Contains Contains O Ends Contains O Ends Contains	Ascending Descending		
Deposits					
Events					
Op Administration	¢	New Stored Item			
VGM	¢	> ♪ ◇ > Status ■ ID ■ Depositor Finished S202206111.1 CSLU	Agent AGENTE MARÍTIMO	storedItem.depositary TERMINAL	Request date 11/06/22
VIGIA	¢	■ GateOut #1 ● Status ■ Requested ■ Valid From ■ Ex S202206111.1 Finished 12/06/22 15/06 #* Transport m Unit	irres in 🗰 Planned 🗰 Performed /22	Confirmed ↓ Place ↓ 12/06/22 ↓ VALENCIA	Storeditem.authorised FORWARDER TRANSITA
Masters	<	006 ABC1234 ✓ TRLU123456 > 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2	🛱 Agent	storeditem.depositary	Request date
Messages	¢	Finished S202206111.2 CSLU ■ GateIn #1	AGENTE MARÍTIMO pires in 🗰 Planned 🇰 Performed	TERMINAL Confirmed Place	11/06/22 storeditem.authorised
ACCESS		Scuzcup111.2 Finished 12/06/22 15/06	122	12/00/22 VALENCIA	FURWARDER TRANSITA
Access Options	¢		Pepositor I Agent COSCO Shipping Lines Cosco Sh Jires in I Planned Performed	Ipping Lines Spain S.A DOCKS Confirmed ♀ Place Ribarroja del Ti	ditem.depositary ■ Request date LOGISTICS SPAINS.A. 09/07/21 ■ storeditem.authorised J

Figure 9 – Gate in and gate out orders in the shipments

Events

The "Events" section shows the individual operations of each shipment. In addition, it also includes events from other data sources such as vessel location from Posidonia, container location from Traxens, and truck entering and leaving the port.

	form for the n of Cognitive Ports	Dataports						(Light 🗸		Administrador
A Home											
🚠 Logistics	~	Events									
Shipments		Event query, please select sear	rch criteria Items: 10 👻	1 - 10 of 5877	< > 2	Update 🖉 S	ynchronize				
∃ [≜] Transports						_	_			-	
🚠 Transport Units		Q, Search	🔘 Equal 🔘 Start 🖲 Ci	ontains O Ends 41 0	rder By	 Ascendir 	ng 🔘 Descending	From	Until		
Deposits											
Events		New Event									
0 Administration	<	> 🖊 🖥 🖉 🖞 🕻	Type Shipment Requested Ad	Publisher G97360325@46024	Participants	Date 23/06/22 12:13	• Place	References Shipment: R2022060833			
VGM	<	> 🖍 🖥 👘 🔨 🤇	Type Shipment Planned Modifi	Publisher W4444444@46024	Participants	Date 23/06/22 12:13	• Place	References Shipment: 2022060801 Transport: 0001			
VIGIA	<	> 🖍 🖥 🖉 🖬 🖉	Shipment Picked Up	Publisher W4444444@46024	Participants	Date 01/06/22 12:08	Place Valencia	References Transport:			
Masters	<	> ∖ ∎ ≈ ° ° <i>}k</i>	© Type Shipment Dispatched	Publisher Y2222222@46024	Participants	Date 01/06/22 12:08	Place Valencia	References Transport:			
Messages	<	> 🖍 🖥 🖉 🛄 🌪	O Type Shipment Received	Publisher X33333333@28922	Participants	Date 01/06/22 20:19	Place Alcorcon	References Transport:			
ACCESS		> 🖍 🖥 🖉 👘	Type Shipment Delivered	Publisher W4444444@46024	Participants	Date 01/06/22 20:19	Place Alcorcon				
 Access Options 	¢	> / = b × U to	 Type Shipment Requested Ad 	Publisher Z1111111@46024	Participants	Date 23/06/22 12:13	• Place	References Shipment: R202206082 Transport:			
		> / = b × u to	 Type Shipment Requested Ad 	Publisher Z1111111@46024	Participants	Date 23/06/22 12:13	• Place	References Shipment: R202206083 Transport:			
		> /	Type Shipment Requested Ad	Publisher 22222222@46024	Participants	Date 23/06/22 12:13	• Place	References Shipment: X202206081			

Figure 10 – List of events integrated with other sources

3.3 PORT AUTHORITY DATA SHARING AND ANALYTICS SERVICES

3.3.1 Scenario Description

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

As an example, for this scenario, we gather data related with the vessel calls. Using such data, it is feasible to forecast 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 is made available to rest of the port stakeholders using the DataPorts platform's interoperability and governance mechanisms.



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



The Table 14 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 training data
6	The resulting data is sent to the subscribed application through the common API

7

Alice uses the Predictive Process Monitoring application to get the predictions

Table 14 – Port Authority Data Sharing Scenario Description

The datasets shown on Table 15 are 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 15 – Port Authority Data Sharing Scenario Datasets

3.3.2 DataPorts roles

The Table 16 Table 10 – 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
PRO	Prodevelop deploys the Data Access component and create the agents
UPV	UPV is in charge to transform data to a common data model with the Semantic Interoperability component
ITI	ITI deploys the Automatic Models Training Engine component to allow the creation and use of AI cognitive services based on the data available in DataPorts platform
ICCS	ICCS deploys and configure the Data Abstraction and Virtualization component
UDE	UDE deploys and configure the Process-based Analytics component

Table 16 – Port Authority Data Sharing Roles

3.3.3 Activities carried out

The Table 17 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions
M20-M24	VPF	Provide the scenario specification with the support of all involved partners
M24-M26	VPF, PRO, UPV, ITI, ICCS, UDE	Deploy the necessary infrastructure for the scenarios and the DataPorts Components
M25-M28	PRO	Development of the Agents for all the data sources
M20-M28	ITI	Implement the data pipelines to generate the cognitive services based on Port Authorities needs
M28-M34	ITI	Develop the application
Table 17 – Port Authority Data Sharing Acton Plan Reporting Table

3.3.4 Data Integration

The aforementioned data sources have been connected with the platform with the development of the corresponding agents. The complete list of the agents developed for this scenario is shown in the Table 18 - Agents implemented in this scenario:

Agent	Туре	Description
PCS Port Calls	Publish / Subscribe	This agent imports port calls (a vessel's visit to the port for a period of time, in order to perform some kind of useful function, like the loading or unloading of goods) by querying periodically (by default, every minute) to a REST endpoint exposed at https://www.valenciaportpcs.net/portcalls/search/ExportBerths Imported data are transformed to PortCall data model and stored in Orion
PCS Port Calls	On demand	Similar to the "Publish/Subscribe" flavour, this agent imports historical port calls with a granularity of 1 month. Imported data is stored in Cygnus.
PCS Trade	On demand	This agent imports trade data generated by the Port systems and available as CSV files. The agent transforms source entities into the <u>Customs</u> data model and stores the data in Cygnus
Customs	Publish / Subscribe	Due to the large volumes of data from the source datasets at the AEAT's website, this agent has been decommissioned in favour of the "on demand" one.
Customs	On demand	This agent imports detailed information on aggregated statistics of the external commerce recorded in the Spanish customs provided by the Spanish Tax Agency (AEAT) and publicly available at the AEAT's website.
		The agent can be run with a granularity of one month and the imported data is stored in Cygnus using the <u>Customs</u> data model

Table 18 – Agents implemented in this scenario

3.3.5 Applications

The Table 19 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	100%				
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.						
User documentation can be found in Annex A Section 9.1.2						

Table 19 – Port Authority Data Sharing Applications

The illustration of the Predictive Process Monitoring Application is described below.



Cognitive Services List:

The following figure shows the main screen of the web user interface, which presents a list of the created cognitive services along with their status, namely running, stopped, deployed... Additionally, a selectable menu is provided on the left-hand side (see Figure 12):

aPorts /	AUTOMATIC MODELS TRAINING ENGINE						amte@dataport
:S							
s	Name	Task	Туре	Description	Last trained date	Status	
5	Vessels ETD estimator	Time Series Forecasting	Vessel Time of Departure Estimator	Forecast of the estimated Time of Departure of an arriving vessel in all ports of Valencia	16/11/2022 16:21:28	RUNNING	Stop
	Vessels Port Calls Calculator	Time Series Forecasting	Vessels Port Calls Calculator	Number of port calls that will be expected to occur in all ports and terminals in the next 2 months	18/11/2022 11:12:37	STOPPED	Deploy ***
	Average Vessel Berth Time	Time Series Forecasting	Average Vessel Berth Time	Saturation of the port of Valencia in the next 3 weeks	18/11/2022 11:14:23	RUNNING	Stop ***
	Customs Trade Volume	Time Series Forecasting	Customs Trade Volume	Estimation of the tons of animal products imported to Valencia in the next 3 months	18/11/2022 11:17:12	RUNNING	Stop ***
	Missing Origin/Destination Identification	Values Imputation	Missing Origin/Destination Identification	Prediction of the unknown district from the historical data of PCS traceability	18/11/2022 11:20:23	RUNNING	Stop ***
	Vessels Port Calls Calculator 5 months	Time Series Forecasting	Vessels Port Calls Calculator	Number of vessels in all ports and terminals in the next 5 weeks	18/11/2022 11:26:32	STOPPED	Deploy
	Machinery forcasting 7 days	Time Series Forecasting	Container Goods Volume	Number of TEUS of machinery imported to Valencia in the next 7 days	18/11/2022 11:30:52	RUNNING	Stop ***
	Plastics imported to Valencia in 2 months	Time Series Forecasting	Container Goods Volume	Number of TEUS that are expected to arrive to the Port of Valencia in the next 2 months	17/01/2023 10:08:10	TRAINING	

Figure 12 – Predictive Process Monitoring Application: Cognitive services list

Cognitive services creation wizard:

The creation wizard leads the user through the creation process of a new cognitive service in an easy manner. The wizard provides several cognitive services to achieve a specific type of prediction, such as the forecast of the ETD of a vessel or the calculation of the received tons of a specific good for the next months.

3	Task Dataset Configuration Strategy Confirmation		
:	Service description ()		
s			
s	Name Description Plastics imported to Valencia in 2 monts Image: Comparison of the comparison of th	US that are expected to arrive to the Port of Valencia in the next 2 months	✓ ₽
	Please select a type of service		
	Container Goods Volume	Missing Origin/Destination Identification	Customs Trade Volume
	Quantity of TEUs of a good from/to a specific district	Expected volume of a good (in tons) from/to a district	Expected volume of a good (in tons) from/to a district
	More Info	More Info	More Info
	Average Vessel Berth Time	Vessels Port Calls Calculator	Vessel Time of Departure Estimator
	Averaged berthing time of a vessel in a terminal / port	Expected volume of vessels in a terminal / port	Time of departure of a vessel from a terminal / port
	More Info	More Info	More Info

Figure 13 – Predictive Process Monitoring Application: Creation wizard

Machine Learning models tracking and analysis:

To investigate the collection of machine learning models trained for each cognitive service, the tab "Models" shows a list of the services along with some associated statistics. Additionally, to delve into each of the services, a deeper analysis option is provided by clicking the button "More Info".



r DataPorts	AUTOMAT	TIC MODELS TRAIN	ING ENGINE								mbravo@vpf.com	
E Services		ml <i>fl</i> ow		Models Tracking								
, In Results				Cognitive Services				Best Mod	lel Trained			
		ld	Name	Туре	Training Date- Time	Models Trained	Name	Туре	Quality Metric	Training Time		
		0	Vessels Time of Departure Estimator	Vessel Time of Departure Estimator	16/03/2023 09:52:32	11	DTree	Regression	5.56	0 hours, 0 min, 1 sec	More info	
		1	CTV STANDARD	Customs Trade Volume	21/03/2023 14:48:10	10	RF	Regression	8.61	0 hours, 0 min, 2 sec	More Info	
		2	CTV fast	Customs Trade Volume	21/03/2023 15:10:25	4	DTree	Regression	9.69	0 hours, 0 min, 0 sec	More Info	
		3	ctv optiimum	Customs Trade Volume	22/03/2023 09:02:18	408	ExTrees	Regression	7.31	0 hours, 0 min, 1 sec	More Info	
		4	avbt	Average Vessel Berth Time	22/03/2023 09:22:06	10	SARIMAX	Statistical	31.72	0 hours, 0 min, 0 sec	More Info	
		5	vpcc	Vessels Port Calls Calculator	22/03/2023 10:08:25	408	NN	Regression	76.99	0 hours, 0 min, 2 sec	More Info	

Figure 14 – Predictive Process Monitoring Application: Models tracking

Analysis of the results of a cognitive service:

Once the cognitive services have been trained, their outcomes can be visualized on the option 'Results' of the left panel. The results section is divided into 3 types of cognitive services:

(I) Results of "Port Services"

The data showed is a small extract of the real data extracted from the Port of Valencia in Real Time (to analyse the whole table of vessels, click the button **"View Full table"**), whereas the last column is calculated by the best predictive model trained in the cognitive service, and represents the expected time of departure of a vessel as illustrated in the next picture:

T DataPorts	PREDICTIVE PROCESS MONITORING APPLICATION							amte@dataports.org 🎧
E Services	Port Services	Product	Services	Missing Values Services				
Models In Results		fort of Valencia		Port of	Sagunto		Port of Gandia	
	Sec. Annu	Harristow					I	
	Estimated Time of Departure	Prediction in Real Time					Ju View Full Table	
	Vesset Ship Name	Voyage Code	Port	Terminal	Regular Line	Status	Arrival	Departure(")
	NORTHERN MAGNUM	1202206102	Valencia	CSP IBERIAN VALENCIA TMNAL SAU	MEDGULF MAERSK	e Estimated	2022/12/31 19500	2023/01/04 11:00
	UNAYZAH EXPRESS	1202206557	Valencia	APM TERMINALS VALENCIA, S.A.	HAPAG - MD1 ALLIANCE	• Estimated	2022/12/31 18:00	2023/01/04 10:00
	CMA CGM HOPE	1202206342	Valencia	CSP IBERIAN VALENCIA TMNAL SAU	CMA-CGM/OOCL CMA	Estimated	2022/12/31 12:00	2023/01/03 18:00
	GEMLIK EXPRESS	1202206443	Valencia	APM TERMINALS VALENCIA, S.A.	MPS-MED PACIFIC SERVICE HAPAG	e Estimated	2022/12/10 06:00	2023/01/02 12:00
	MAERSK NAJROBI	1202206326	Valencia	APM TERMENALS VALENCIA, S.A.	MAERSK-SEAGO / SLZ	e Estimated	2022/12/30 06:00	2023/01/02 12:00
	APLANTWERP	1202206162	Valencia	APM TERMINALS VALENCIA, S.A.	IMEX-MEDEX CMA	Estimated	2022/12/28 23:00	2023/01/01 05:00
	CELSIUS LIVERPOOL	1202206575	Valencia	CSP IBERIAN VALENCIA TMNAL SAU	MEDWAX	Estimated	2022/12/28 17:00	2022/12/31 23:00
	BARCELONA EXPRESS	3202201252	Sagunto	INTERSAGUNTO TERMINALES, S.A.	MCA MEDITERRANEAN-CANADA	e Estimated	2022/12/27 19:00	2022/12/31 01:00

Figure 15 – Predictive Process Monitoring Application: Results – Port Services I

In Figure 17, the graph on the bottom-left represents the estimated occupation of ports/terminales based on the selected trained service of type Vessels Port Calls Calculator, whereas the graph on the bottom-right shows the expected average berthing time based on the selected trained service of type Average Vessel Berth Time, as illustrated in the next picture:

r DataPorts	Ports Forecasting	
E Services ⋺ Create	Cognitive Services related to the future expected state of the desired portu/terminals Vessels Port Calls Calculator 5 months	Average Vessel Berth Time \checkmark
鑗 Models 。In Results	5 weeks ALL PORTS ALL TERMINALS	3 weeks ESVLC ALL TERMINALS
	Lestimated Occupation of All ports and All terminals in the next 5 weeks	Exercise 2022/01/2022/00/200/202/00/202/00/202/00/200/202/00/200/202/00/202/00/200/202/00/200/202/00/2
I 🔹 II ITI RVESTARE		

Figure 16 – Predictive Process Monitoring Application: Results – Port Services II

(II) Results of "Product Services"

In Figure 17, the graph on the top-left represents the expected values in Tons of the selected trained service of type Customs Trade Volume, whereas the graph on the top-right shows the forecasted values in TEUS of the selected trained service of type Container Goods Volume, as illustrated in the next picture:



Figure 17 – Predictive Process Monitoring Application: Results – Product Services I

In Figure 18, the graph on the bottom-left represents the countries ranking based on the selected trained service of type Customs Trade Volume, whereas the graph on the bottom-right shows a ranking of all the products, based on the selected trained service of type Container Goods Volume, as displayed in the picture below:



Figure 18 – Predictive Process Monitoring Application: Results – Product Services II

(III) Results of "Missing Values Services"

In Figure 19, the graph on the left represents the accuracy of the best predictive model trained for the service of type Missing Origin/Destination Identification. The graph on the right, displays the percentage of missing values filled up for each of the possible categories.



Figure 19 – Predictive Process Monitoring Application: Results – Missing Values Services

3.4 SHARING VERIFIED GROSS MASS

3.4.1 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 20 depicts the workflow and interactions of the scenario:

Figure 20 – Sharing Verified Gross Mass Workflow

The Table 20 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 20 – Sharing Verified Gross Mass Scenario Description

The data providers of the scenario are included on Table 21:

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 21 – Sharing Verified Gross Mass Scenario Datasets

3.4.2 DataPorts roles

The Table 22 Table 10 – 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 22 – Sharing Verified Gross Mass Roles

3.4.3 Activities carried out

The Table 23 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions
M10-M12	VPF	Provide the scenario specification with the support of all involved
		partners
M12-M13	VPF, IBM	Deploy the local infrastructure
M12-M15	VPF	Develop first version of front-end and back-end
M14-M15	IBM	Develop the chaincode for interacting with Hyperledger
M16-M17	VPF, IBM	First MVP
M21-M24	VPF, IBM	Deploy the Blockchain infrastructure in virtual servers
M24-M30	VPF	Enhance development of front-end and back-end with extended
		functionalities

Table 23 – Sharing Verified Gross Mass Action Plan Reporting Table

3.4.4 Applications

The Table 24 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	100%				
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						
User documentation can be found in Annex A Section 9.1.3						

Table 24 – Sharing Verified Gross Mass Applications

This section shows a typical flow of information with the participation of the different actors involved.

Vehicle registration

Before any weight request, the vehicles and the trailers should be registered by the haulier company in order to calculate the VGM.

Date Pla	taPorts atform for the tion of Cognitive Ports	Dataport	S						Light v	• *	Administrador
A Home											
🚠 Logistics	¢	Vehicles									
¢ _₽ Administration	¢	Enter search a	nd sort criteria litems: 1	10 🔻 1-10	l of 9287 🔍	> 2 ^e Upd	late 🖉 Synchronize				
VGM	~	Q Search		ual () Start 间 C	Contains 🔿 Ends	나는 Order By	 Ascending O D 	escending			
Requests				0	0						
🔜 Vehicles											
	<	New Vi	ehicle 💕 Downlos	ad Excel							
Masters	<	e 🖉 🦉 🖉	Registration 0010DDC	• Type Truck	Weig 7,127 Kg	🖹 Tank 1,299 l	Registration company GESTRANS - A40549990	Road haulier TRANSESTE LOGÍSTICA, S. L	Remarks SALGAR, S.L.		
Messages	<	२७ 👁 📄 	Registration 0061HZT	Type Truck	Weig 7,248 Kg	🖹 Tank 1,500 l	Registration company GESTRANS - A40549990	Road haulier	Remarks BOXTRANS		
Access Options	¢	≈⊙ ≣	Registration 0078HDF	• Type Truck	Weig 5,884 Kg	🖹 Tank 1,100 l	Registration company GESTRANS - A40549990	Road haulier			
		∕ ≣ © ≫	Registration 0095BBF	Type Trailer	Weig 5,570 Kg	🖹 Tank	Registration company GESTRANS - A40549990	Road haulier	Remarks BOXTRANS		
		N 🗨	Registration 0115HZV	Type Truck	Weig 6,799 Kg	🕑 Tank 880 l	Registration company GESTRANS - A40549990	💭 Road haulier -	Remarks BOXTRANS		
		🖋 🖻 🔍	Registration 0117FLL	• Type Truck	Weig 7,436 Kg	🔊 Tank 1,400 l	Registration company GESTRANS - A40549990	Road haulier	Remarks Salgar		
		∥ ∎∞&	Registration 0135DVT	• Type Truck	Weig 4,792 Kg	🖹 Tank 850 l	Registration company GESTRANS - A40549990	Road haulier			
		/ <mark> </mark> © X	Registration	Type Truck	Weig 7,567 Kg	🖹 Tank 1,160 l	Registration company GESTRANS - A40549990	Road haulier	Remarks		

Figure 21 - List of registered vehicles and trailers

VGM request

The shipper or the freight forwarder can see the list of VGM request and the current status.

E Dal Data Pla Connecti	ta Ports torm for the on of Cognitive Ports	Dataports									Light 🗸	■ 畿	Administrat
Home													
Logistics	¢	VGM Requests	S										
Administration	¢	Enter search and sort cri	teria Iterno 1	0 🔻 1-5of5		Update 🔗	Synchronize						
VGM	v	Q Locator Admit		O VGM Locator	O Cost	ainer		O Booking					
Requests		Q Search	O Four	I O Start Contains	4% Order By	ate .	O Ascer	ving Descending	₿ From 16/1/2023	-	曲 Until 15/2/2023	8	
Vehicles		Requested [→ Weighte	d 🗆 🗣 Sent 🗖 🗣 Finis	shed \square • Errors	Cancelled	0 4400	und of peacenting	12				
VIGIA	¢												
Masters	κ			100000	~								
Messages	<	Create express V	/GM requests	New VGM request									
ESS		> / 🛛 🖥 🖉 🚊	Status REQUESTED	Booking 53550324	Request date 02/02/23	Loc.VGM 83377	Shippin HLCU - HAP	g Line AG-LLOYD	Container SEGU576976	≤ VGM 24,254			
Access Options	¢	> 🖉 🙆 🖉 👟	Status WEIGHTED	Booking book1	Request date 01/02/23	Loc.VGM 95245	Admit admit1	BORU - BORCHARD	LINES LIMI	Container cont1	VGM 123	Weighing date 01/02/23 16:40	
		> / 🛛 🛇 🗎 🕅 🚊	Status WEIGHTED	Booking bo1	Request date 01/02/23	Loc.VGM 21039	Admit ad1	Shipping Line BORU - BORCHARD	LINES LIMI	col	VGM 123	Weighing date 01/02/23 15:45	
		> / 🖓 🛇 🔓 🖉 🏯	Status WEIGHTED	Booking	Request date 01/02/23	Loc.VGM 48547	Admit 34324	BORU - BORCHARD	LINES LIMI	Container 34	2 VGM 12,345	Weighing date 01/02/23 15:42	
		> 🖋 🔛 🛇 🗮 Ø 🚊	Status WEIGHTED	Booking 2323	Request date 01/02/23	Loc.VGM 77258	Admit 1232	Shipping Line BORU - BORCHARD	LINES LIMI	Container 2312	Q VGM 2,323	Weighing date 01/02/23 15:21	
												Items: 10 👻	1-5 of 5 < >

Figure 22 - List of VGM request

By clicking to "New VGM request" a new request can be created.



Edit VGM Request					
O VGM Info O JS	SON View				
Reference Q43074810035 48547	Weighing d WEIGHTED	otified			
i Remarks fdsfdsds					
S Admit	Method	🖬 VGM	and the		
34324	CALCULATED () HEAVY	12345	Kgm		
# Booking * 12	iii Container * 34 IIII	C.Bars	BORCHARD LINES LIMITED	BORU	
BSHIPPER FUNDACIÓN VALENCIAPOR	रा			開 CIF G97360325	
2 Contact					
VGM REPRESENTATIVE	रा			間 CIF G97360325	

Figure 23 - Create a new VGM request

VGM certificate

Once the truck is weighted the scale operator can include the value by editing the VGM request. The VGM certificate is automatically generated and sent to the PCS.

3.5 DIGITAL CONSIGNMENT NOTE

3.5.1 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 24 depicts the workflow and interactions of the scenario:



Figure 24 – Digital Consignment Note Workflow

The Table 25 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 the consignment note PDF/A document and check the integrity and traceability through the DataPorts platform

Table 25 – Digital Consignment Note Scenario Description

The data providers of the scenario are included on Table 26:

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 26 – Digital Consignment Note Scenario Datasets

3.5.2 DataPorts roles

The Table 27 Table 10 – 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 27 – Digital Consignment Note Roles

3.5.3 Activities carried out

The Table 28 contains the tasks involved in the implementation of the scenario:



Time	Actors	Actions
M30-M31	VPF	Deploy the Blockchain infrastructure in virtual servers
M34-M37	VPF	Develop the front-end
M34-M36	VPF	Develop the back-end

Table 28 – Digital Consignment Note Action Plan Reporting Table

3.5.4 Applications

The Table 29 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	100%				
Freight forwarder and road haulier need to access the last version consignment note for their transport operations						
User documentation can be found in Annex A Section 9.1.4						

Table 29 – Digital Consignment Note Applications

The application is integrated into the tracking application because the data needed for creating the digital consignment note is managed in that application.

Shipment

The freight forwarder can see the list of shipments managed by them. There is a pdf icon which allows to generate the Digital Consignment Note with all the available data.



Figure 25 - List of shipments

Figure 26 - Digital Consignment Note generated

3.6 DATA EXCHANGE THROUGH IDS CONNECTOR

3.6.1 Scenario Description

This scenario has been built as a proof of concept. The rest of the project scenarios assume communication and data exchange between entities inside the DataPorts data space. According to the DataPorts architecture, the IDS framework is the most suitable solution to data sharing among participants of external dataspaces. For that purpose, Dataports has used an IDS connector developed by Fraunhofer ISST and validated by IDSA, the Dataspace Connector, to become a participant of the EUHubs4Data (EUH4D) Federation (https://euhubs4data.eu/).

The scenario makes use of sovereign and trusted data sharing between two participants within the EUH4D Federation:

- Valencia Port wants to get some advanced analytics based on their data, but the services they want to use are inside the EUH4D federation **Fuente especificada no válida.** and are not reachable through the DataPorts data space.
- A technology provider inside EUH4D offers an AI model that will suit Valencia Ports' needs and provide valuable predictions.

This scenario assumes that some exchange of data has already taken place. So, the technology provider has built models capable of predicting vessel departures based on data from Valencia Port.

The data transactions pipeline carried out to perform the scenario is divided into three steps (see Figure 27):



Figure 27 – Scenario description

Each of the data transaction steps are described in detail below:

Data Transaction 1: Dataports registers a dataset into IDS connector and EUH4D consumes it to create an AI cognitive service capable of making predictions.



Figure 28 – Data transaction through IDS connector workflow. Data transaction 1

Step	Description				
1	DATAPORTS registers a dataset (*) through Data Access component				
2	DATAPORTS registers the dataset into IDS connector				
3	EUH4D requires the available information in DATAPORTS' IDS connector				
4	EUH4D downloads the dataset from the IDS connector				

Table 30 – Data transaction through IDS connector Description

(*) In this concrete scenario, the dataset *PCS Calls* was used, which represents the series of historical vessel calls of the ports of Valencia.

Data transaction 2: Dataports registers a new incoming vessel into IDS connector and EUH4D consumes it to make a prediction.



Figure 29 – Data transaction through IDS connector workflow. Data transaction 2

Step	Description				
1	DATAPORTS registers a new arriving vessel into IDS connector				
2	EUH4D requires the available information in DATAPORTS' IDS connector				
3	EUH4D downloads the new arriving vessel information from the IDS connector				

Table 31 – Data transaction through IDS connector Description

Data Transaction 3: EUH4D registers a prediction into IDS connector and DATAPORTS consumes it.



Figure 30 – Data transaction through IDS connector workflow. Data transaction 3

Step	Description				
1	EUH4D registers a prediction into IDS connector				
2	DATAPORTS requires the available information in EUH4D's IDS connector				
3	DATAPORTS downloads the prediction information from the IDS connector				

Table 32 – Data transaction through IDS connector Description



3.6.2 DataPorts roles

Table 10 Table 10 – Tracking of Transport Operations Roles shows the organizations that take part in the scenario implementation and their roles:

Role	Description of the role	
DATAPORTS (VPF)	Data provider and consumer	
EUH4D (ITI)	Technology provider	

Table 33 – Data exchange through IDS connector Roles

3.6.3 Activities carried out

Table 11 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions
M24-M30	ITI	Assessment of different possibles solutions for the IDS connector. Implication for DataPorts platform.
M30-M36	ITI	Deployment of IDS connector backend
M30-M36	ITI	Integration between IDS connector and cognitive application
M34-M36	ITI	Deployment of IDS connector front end
M34-M36	ITI	Testing of the operation of IDS connector
M34-M36	ITI	Use case development and validation

Table 34 – Data exchange through IDS connector Action Plan Reporting Table

3.6.4 Data Integration

The aforementioned data sources have been connected with the platform with the development of the corresponding agents. The complete list of the agents developed for this scenario is shown in Table 35.

Agent	Туре	Description
PCS Port Calls	Publish / Subscribe	This agent imports port calls (a vessel's visit to the port for a period of time, in order to perform some kind of useful function, like the loading or unloading of goods) by querying periodically (by default, every minute) to a REST endpoint exposed at https://www.valenciaportpcs.net/portcalls/search/ExportBerths Imported data are transformed to PortCall data model and stored in Orion
PCS Port Calls	On demand	Similar to the "Publish/Subscribe" flavour, this agent imports historical port calls with a granularity of 1 month. Imported data is stored in Cygnus.

Table 35 – Agents implemented in Data exchange through IDS connector scenario

3.6.5 Applications

The application used in this scenario is the same as in section 3.3.5.

Apart from this, the following figures show a series of screenshots of the IDS connector and how this was configured to work out together between DataPorts and EUH4D platforms.

Dataports IDS connector entry:

The following figure shows the Data Offering wizard to create new entries into the IDS connector of Dataports.

1	DataPorts	E Dataspace Connector Data#vrts/D5 connector	
		Data Offering > Offering > New Offering	
	Dashboard	META DATA POLICY REPRESENTATION CATALOGS BROKERS	
∋	Data Offering	Title	
		Description	
	Policy Templates	Publisher	
₽	Data Consumption	Keywords	
æ	IDS Ecosystem	Standard License	
		Endpoint Documentation Language Payment Modality Undefined	

Figure 31 – Dataports IDS connector – Create new entry

Once the wizard has been completed successfully, the entries can be visualized in the offerings section, see Figure 32.

Ŀ	DataPorts		Dataspace DataPorts IDS of	e Connector							
	Dashboard		Data Offering > Offerings Data Offerings Overview of all currently offered IDS resources.								
∋	Data Offering	^	ADD OFFERING								
			Filter by catalog Show all resources	S	- Search		Q				
	Policy Templates		Creation date \downarrow	Title		Keywords		Brokers		Agreem.	
Ð	Data Consumption	~	2023-03-17 10:57:17	New Vessel Arrival		NewVesselArrival				0	• / 2 î
ŵ	IDS Ecosystem	~	2023-03-14 12:42:42	PCSCalls		PCSCalls				16	• / 🗈 🗎
									Rows per page:	5 👻 1-2 of	2 < >

Figure 32 – Dataports IDS connector – Offerings list

EUH4D IDS connector entry:

Likewise, in EUH4D IDS connector, the entries can be analysed in the offerings section see Figure 33.

	ATE .	Dataspace IDS Connector I	e Connector hosted by the ITI							
		Data Offering → 01 Data Offerin	fferings GS							
∋		ADD OFFERING	rrentiy offered IDS resources	6.						
		Filter by catalog Show all resources	5	- Search		٩				
		Creation date ↓ 2023-03-16 14:36:07	Title New Prediction		Keywords Prediction		Brokers		Agreem.	
÷								Rows per page:	5 💌 1-1 of 1 < >	

Figure 33 – EUH4D IDS connector – Offerings list

4 PORT OF THESSALONIKI

This section describes the two scenarios defined for the Thessaloniki pilot including a description, flow of information, data sources, action plans, applications, etc. The first scenario concerns the Container Pick-Up use case, while the second comprises of the four analytics use cases.

As already explained in the document D5.3 Use case oriented pilots initial version⁷, the initial proposed scenarios have been merged and combined to build the current two of them.

For each of the scenarios, there is a description of the DataPorts components that are used, as well as their interactions. Two types of Blockchain solutions were developed for these scenarios; the first, is one of the main Dataports platform building blocks for trusted sharing of information concerning ports operations, i.e., the Data Governance component, while the second was implemented so as to build a custom solution for the Container Pick-up use case.

4.1 APPLICATIONS DEPLOYMENT

Two main scenarios for the Port of Thessaloniki have been implemented in the framework of DataPorts; the first regarding one of the port's core activities, the lifecycle management of containers and one regarding key analytics that will assist the port in bettering its operations. This last scenario includes four uses cases the **Analytics for the Port of Thessaloniki** and **Queues predictions**, while the remaining two case, utilize the available mobility data, for the **facilitation of all stakeholders visiting the** port or its surrounding area and **provide information for social distancing**, due to Covid.

The application for the container pick-up scenario is blockchain-based backend, reachable by the frontend, deployed and set up in ThPA network. It includes the smart contracts that control the Container Pick-Up process, invoking the transactions and queries of the designed solution.

In the analytics scenario a Visual analytics platform for analysis and metrics, customized for the Thessaloniki port authority was implemented. In this framework, AI driven algorithms, libraries and methodologies were set, to address the data and visual analytics at Thessaloniki pilot.

All applications developed as part of the ThPA pilot have been deployed on a VM within a ThPA VPN. This can be seen in Figure 34. The Container Pick-Up (CPU) concerns one of the port's core activities, the lifecycle management of containers. The rest of the applications are statistics and analytics based and employ a strong visual analytics component. ThPA statistics and Queues predictions applications are all accessible as part of a credentials-based web application. On the other hand, passenger facilitation and Covid-19 statistics are accessible through an open website available to the general public.

The Figure 34 depicts the components involved in both use cases.

⁷ https://dataports-project.eu/deliverables/



Figure 34 - CPU and analytics deployment in ThPA

In the diagram we see, in orange colour, two instances of a blockchain solution being used: the first is indirect usage and concerns the Data Governance component – a part of the Dataports platform – used to facilitate dataset sharing between DataPorts partners. The second is a direct use of a blockchain network, implemented so as to build a custom solution for the Container Pick-up use case, utilising blockchain technology to support a port operation involving the port itself and two other port ecosystem stakeholders.

4.1.1 Credentials-based web application

This web application combines both the CPU application and two of the analytics applications under one credentials-based web frontend. To deploy the CPU part of the web application, an instance of a Hyperledger Fabric network has been deployed on the VM. This includes the smart contracts that control the Container Pick-Up process, invoking the transactions and queries of the designed solution. Fabric acts both as an identity manager for the entire web application, on which the authentication mechanism is based, and as a common ledger for the stakeholders using the CPU application, i.e. shipping agents, trucking companies and the port authority. Furthermore, the application Node.js API middleware is installed on the same VM, through which the frontend communicates with the smart contracts. To deploy ThPA statistics and Queues Predictions, their python code is deployed on VM, together with their respective API, running with Flask. Finally, the frontend, hosting both CPU and analytics, is deployed in the same VM.

The CPU application interfaces with the ThPA computing systems through a purpose-built API, in order to pass on COREOR requests and receive permit IDs, COREOR acceptances and rejections, new bookings and their respective acceptances and rejections. The analytics applications ask the local deployment of the DataPorts platform – situated on a separate VM – for data. The local DataPorts platform consults with the single instance of the Data Governance component – situated at the VPF deployment of the platform – to verify the user's permissions for using the requested dataset.

4.1.2 Public web application

This publicly available web application, comprising both the Passenger Facilitation and the Covid Statistics applications, is deployed on the same ThPA VM. The deployment again comprises the python code, together with the respective API, running with Flask. Finally, the public frontend, hosting both Passenger Facilitation and Covid Statistics, is deployed in the same VM.

As with the previous analytics cases, the public analytics applications ask the local deployment of the DataPorts platform for data and the local DataPorts platform, in turn, consults with Data Governance at VPF to verify the user's permissions for using the requested dataset.

4.2 CONTAINER PICK-UP

The Container Pick-Up (CPU) use case has arisen from the merging of two initially (D5.1 Integration, software quality assurance and deployment plan) 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 since they are two procedures in line and, therefore, better understood as one use case.

4.2.1 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 within 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 under some conditions 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 35 – 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 in Figure 35. Table 36 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 ⁸ , 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 36 – CPU Scenario Description

As can be understood from Table 36Table 30, at the end of the use case both COREOR and booking information is saved on-chain in the local ThPA Fabric network. Figure 36 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 37.

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.

⁸ 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
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.
THPA Freezone system	Application that provides the QR code.



Table 37 – CPU Scenario Data Sources

Figure 36 – Sequence diagram for the main scenario of the CPU use case

4.2.2 DataPorts roles

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

Organisation	Role
ThPA	THPA is the scenario leader, providing the infrastructure and knowledge to successfully implement the application.
CERTH	CERTH has defined the blockchain configuration and deployed the blockchain infrastructure. Moreover, it developed and deployed the chaincode, developed the backend API and the frontend for the application.

Table 38 – CPU Use Case Roles

4.2.3 Activities carried out

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

Time	Actors	Actions
M10-M12	ThPA	Provide the scenario specification with the support of all involved partners
M11-M12	CERTH	Deploy test infrastructure
M11-M16	CERTH	Develop first version of front-end and back-end
M11-M15	CERTH	Develop the chaincode for interacting with Hyperledger
M16-M17	CERTH	First MVP
M19 M26	СЕРТЦ	Continuous development of frontend and backend with extended
10110-10130	CERIN	functionalities; continuous improvement/bug fixing of frontend/backend
M24-M36	CERTH, ThPA	CPU integration with ThPA infrastructure
M34-M37	CERTH, ThPA	CERTH deploys the blockchain infrastructure on ThPA premises

Table 39 – CPU Use Case 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 have been updated or implemented, along with the links to the documentation.

TOS (FRETIS)	Modification	100%				
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.						
User documentation can be found in Annex A: 9.2.1 Container pick-up						
Change log can be found in Annex B: 0 TOS						

Table 40 – CPU Use Case Applications

4.3 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.



4.3.1 General Workflow and Scenario Description



The interconnection of different systems in the analytics use cases is depicted in Figure 37. The analytics solutions are split between those that are used only by ThPA analytics users of the local infrastructure frontend (Statistics for ThPA, Queues predictions) and those that are used by the general public through a public web application (Facilitation of passengers, Statistics for Covid-19). Nonetheless, 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.) needs an input dataset, it looks to see whether this dataset has already been retrieved in the past. If not, the relevant source dataset is requested through the DataPorts platform API gateway. Since all datasets used by the analytics use cases are on-demand datasets, the requested dataset is provided by the Data Abstraction and Virtualisation (DAV) component. However, for this to happen, Semantic Interoperability first checks with Data Governance whether there are sufficient access rights on this dataset. If access is legitimate, DAV informs analytics of the availability of the dataset. The analytics application then proceeds to download it from DAV.

Table 41 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 DataPorts platform (steps 1b, 2b).

Step		Description				
1	а	A ThPA analytics logs in to the local DataPorts frontend.				
-	b	A member of the general public accesses the public analytics web application				
a The user selects either the "Statistics for ThPA" or the "(application.		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 checks whether it has already received said dataset.				
4		For each of the missing source datasets, the application asks the DataPorts platform, through its API gateway, for that dataset.				
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, DAV informs the application of the availability of the dataset.				
7		The application proceeds to download the dataset from DAV.				
8 The application proceeds to do the same for all source datasets it requires.		The application proceeds to do the same for all source datasets it requires.				
9		The application produces an analytics output, which is then visualised in the user's dashboard.				

Table 41 – Analytics for ThPA Scenario Description

The datasets shown in Table 42 will be used in the analytics scenarios.

Data source	Description of data		
OTE mobility data	Data from OTE mobile phone network		
Commercial vessel calls	Various operational data, including vessels arrivals, loading/unloading times, containers loaded/unloaded, etc, taken from the ThPA statistics application		
Bookings	Details of truck bookings for container pick-up, taken from ThPA's Truck Appointment System (TAS)		
Gate Events	Information of vehicles passing through THPA gates, taken from ThPA's Gate Access System (GAS)		
Parking data	Data from two commercial parking lots situated at the port		
HIT traffic data	Thessaloniki traffic data provided by the Hellenic Institute of Transport (HIT) (part of CERTH)		

Table 42 – Analytics for ThPA Scenario Datasets

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

4.3.1.1 Statistics for THPA Prediction

ThPA collects operational data from several internal applications. Statistics for THPA Prediction (ThPA statistics, for short) uses the ThPA statistics application, the Truck Appointment System (TAS) and the Gate Access System (GAS). What this analytics application offers is a 'fusion' of all this data to get more meaningful

information. Through this application, these data can be combined to produce statistics, while the metrics and KPIs calculated can provide valuable insight of operations performance to a ThPA analytics user. The user can then decide on any corrective measures, if necessary.



Figure 38 – Vessel visualisation – part of the ThPA statistics visual analytics

Figure 38 shows the "Vessel visualisation" tab within the Analytics menu, which is part of the ThPA Statistics use case. Here, the "Commercial vessel calls" dataset from the ThPA statistics application is used. We have marked separate regions on this screenshot using coloured rectangles, which are not present in the actual frontend.

- The purple rectangle at the bottom contains a line plot showing the total number of vessels at the port at each day, during a large period of time (e.g. a year). By clicking on the line bar of the purple rectangle and dragging the mouse, we can select a sub-interval on the line graph. This selection affects the contents of the graph within the yellow rectangle.
- Within the yellow rectangle we can see each vessel that arrives at the port as a horizontal bar. The time span that this graph covers is the same as the time span selection in the line graph of the purple rectangle. 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 port.
- Within the red rectangle, textual details for each vessel are shown, upon clicking on a vessel bar in the yellow rectangle.
- The bar charts in the light green rectangle show the distribution of the number of vessels operated at the port, with respect to the type of ship and the type of cargo. The bar charts are automatically updated when a new timespan is selected in the line plot of the purple rectangle.
- The bar charts in the dark green rectangle show the distribution of the average cargo weight of the vessels operated at the port, with respect to the type of ship and the type of cargo. The bar charts are automatically updated when a new timespan is selected in the line plot of the purple rectangle.

- For each vessel, we compute the work-time ratio, which is the ratio of the time the vessel was working at the port over the total time from arrival to departure (t_{work}/t_{total}) . This takes values from 0 (idle ship) to 1 (efficient ship). We display the distribution of work-time ratios across the selected timespan in the blue rectangle graph. We can select a range to filter the vessels in the other plots.
- We can focus on outliers, i.e. relatively idle vessels, by clicking the "Select outliers" button in the blue rectangle, which automatically selects ships with work-time ratio lower than 0.2.



Figure 39 - Vehicle traffic – part of the ThPA statistics visual analytics

The second part of the ThPA statistics application can be found in the "Vehicle traffic" tab of the Analytics menu, as can be seen in Figure 39. Here, the "Commercial vessel calls", "Bookings" and "Gate Events" datasets from the ThPA statistics, TAS and GAS systems are used.

- In the red rectangle, we can see a map showing the positions of the port gates as blue circles, along with the total number of trucks that passed through them. Next to the map there is a set of 7 bar charts showing the average number of trucks passing through the gates per hour of the day, for each of the 7 days of the week.
- In the yellow rectangle we can see the maximum number of trucks inside the port per day, for a long period of time (several months), in a line plot (thick blue line). We also see the number of bookings per day, for the same period of time (light blue line).



Figure 40 - Vehicle time at port – part of the ThPA statistics visual analytics

The final part of the ThPA statistics application can be found in the "Vehicle time at port" tab of the Analytics menu, as can be seen in Figure 40. Here, the "Gate Events" dataset from the GAS system is used.

The bar chart of the blue rectangle shows the number of vehicles per duration of stay at the port premises. Each bar represents one stay duration category. There are 16 different duration categories: less than 1 minute, between 1-5m, between 5-10m, between 10-30m, between 30-60m, between 1-5 hours, between 5-10h, between 10-24h, between 1-5 days, between 5-10d, between 10-30d, between 1-3 months, between 3-6M, between 6-12M, more than 1 year and unknown time. Clicking on a specific bar opens up the bar chart in the yellow rectangle.

The bar chart in the yellow rectangle shows splits up the number of vehicles, corresponding to the selected bar from the blue rectangle chart, to number of vehicles per vehicle type. So, in the example shown in Figure 40, of the, on average, 7417 vehicles staying between 30-60 min in the port during the month of March, 3159 of them are TIR trucks, 3736 are container trucks, 459 are Taxi vans etc.

4.3.1.2 Queues Predictions

As with ThPA Statistics, the Queues Predictions use case utilises data from the ThPA statistics application, the Truck Appointment System (TAS) and the Gate Access System (GAS). These data are used to predict ship turnaround times, as well as estimate the traffic at the port premises. Again, such predictions can provide valuable insight into traffic load, as well as workload at the docks, to a ThPA analytics user.

T DataPorts	=					thpa_admin 🌲 🛓 💥
Home COREOR Requests Booking Requests Analytics Organization Users Profile	Vesel Visualization Prediction Custom prediction Vehicle time it port Real-time vessel data					
Notifications	Ship Name ↑↓	Ship Type ↑↓ Ca	argo î↓	Arrival î↓	Mooring ↑↓	Work ↑↓
	AEGEAN NOBILITY	OIL TANKER FU	JEL	Wed Jan 25 2023 06:40:00	Fri Jan 27 2023 09:14:00	Fri Jan 27 2023 09:14:00
	SEMINOLE	BULK CARRIER AG	GRICULTURAL	Fri Jan 27 2023 03:25:00	Fri Jan 27 2023 08:28:00	Fri Jan 27 2023 11:10:00
	ENERGEIA	LG TANKER FU	JEL	Fri Jan 27 2023 17:45:00	Mon Jan 30 2023 08:52:00	Mon Jan 30 2023 08:52:00
	ΠΡΟΒΙΝΤΕΝΣ	OIL TANKER FU	JEL	Fri Jan 27 2023 19:24:00	Mon Jan 30 2023 13:17:00	Mon Jan 30 2023 13:17:00
	πανορμιτής	BULK CARRIER M	IATERIAL	Sat Jan 28 2023 19:50:00	Sat Jan 28 2023 19:50:00	Mon Jan 30 2023 08:00:00
	Cargo Predictions for AEGEAN NOBILITY					
	Empty ↑↓ Non-emp	ty ↑↓ Bulk tγpe ↑↓ Weigh	nt †↓ Type	Average	Min - Max	End Date
	0 0	UNLEADED GASOLINE 889370	000 Turnaround	2d 10h 24m	2d 10h 24m - 2d 10h 24m	Fri Jan 27 2023 17:04:00
	~~ ~	1 > >>	Mooring	1d 22h 1m	1d 22h 1m - 1d 22h 1m	Sun Jan 29 2023 07:15:00
			Work	1d 17h 25m	1d 17h 25m - 1d 17h 25m	Sun Jan 29 2023 02:39:00

Figure 41 - Prediction – part of the Queues Predictions analytics

Figure 41 shows the "Prediction" tab within the Analytics menu, which is part of the Queues Predictions use case. Here, the "Commercial vessel calls" dataset from the ThPA statistics application is used. The view consists of a date picker field and three tables: Results, Cargo, Predictions for <ship_name>.

- When a datetime is selected in the date picker and the Submit button is pressed, the Results table is filled with ships that were in the port at that exact datetime, along with information like ship name, ship type, its cargo, and three dates regarding the arrival and the start date of mooring and work respectively.
- Clicking on a ship in the Results fills the Cargo table with the number of empty and non-empty containers, the type of bulk cargo and the weight of the cargo. If the ship is carrying bulk cargo, the number of containers will be zero and the weight will refer to the bulk cargo. If the ship is carrying containers, their numbers will be shown and weight will refer to container weight.
- The predictions table takes a few seconds to load. Once it does, it contains predictions for the three stages of the ship's stay at the port (turnaround time, mooring time, work time), given both as a prediction on the average time and as a min-max range. There is also the 'End date' column that provides the prediction as an absolute datetime for the given stage of the ship's stay at the port.

Figure 42 shows the "Custom prediction" tab within the Analytics menu, which is part of the Queues Predictions use case. Again, only the "Commercial vessel calls" dataset from the ThPA statistics application is used. The view consists of a series of fields describing a ship and its arrival, mooring and work times (if known), and a Predictions table.

The mandatory fields are the ship's name, the arrival time, ship type, cargo, number of empty and non-empty containers, and weight. Once we input all the necessary information, we click on the Submit button and the Predictions table is filled with estimates for turnaround, work and mooring times. This table is identical to the Predictions table in the Prediction tab. Once we are done inspecting the given predictions, we can click the 'Clear' button so as to reset the fields and proceed with another custom prediction.

🗖 DataPorts	≡						thp	a_admin 🌲 🙎 🗮
🔒 Home	Vessel visualization	Prediction	Custom prediction	Vehicle traffic	Vehicle time at	t port	Real-time vessel data	
COREOR Requests								
Booking Requests	Ship Name *	-						
Analytics	ALLEGRI							
A Organization		Pr	edictions					
# Users	24/02/2023 20:42	т	ype	Average		Min - N	Aax	End Date
L Profile	Mooring start	т	urparound	1d 2h 41m		1d 2h 4	1m - 1d 2b 41m	Sat Eab 25 2023 23:23:54
Notifications		-	unaround	id zir 4 mi		10 2114	- 10 21 - 10	581160 25 2025 25.25.54
	Mooring end	N	fooring	1d 0h 1m		1d 0h 1i	m - 1d 0h 1m	
		v	Vork	0d 19h 32m		0d 19h 3	32m - 0d 19h 32m	
	Work start							
	Work end							
	Ship Type *							
	FULL CONTAINER V							
	Cargo *							
	40 FULL 🗸							
	Empty Containers *							
	0]						
	Non-empty Containers *							
	150]						
	Weight *	-						
	3500000							
	Clear							
	Submit							

Figure 42 - Custom prediction – part of the Queues Predictions analytics



Figure 43 - Vehicle traffic – part of the Queues Predictions analytics

The final part of the Queues predictions application can be found in the "Vehicle traffic" tab of the Analytics menu, as can be seen in Figure 43. Here, the "Commercial vessel calls", "Bookings" and "Gate Events" datasets from the ThPA statistics, TAS and GAS systems are used. The line chart in the green rectangle shows the forecasted number of trucks in port for the next 10 days.

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

DataPorts

The analytics developed for this and the Covid use cases are made available to the general public through a public web portal. Prior to visiting the port, professionals and general public alike can visit this portal to evaluate local traffic conditions, as well as the density of commuters, around the port. A visitor's needs vary according to the purpose of the visit. A professional having a business meeting in or around the port will want to assess the traffic conditions and parking spots in the area, to avoid hours of peak traffic and commuting. On the other hand, a street vendor that wants to set an outdoor stand, will want to "exploit" a high concentration of people around the port. The platform also "returns" information such as traffic and time required to reach the port premises per route. Through the application, the user has also the possibility to access the average number of visitors for both parking lots that ThPA S.A. handles. The use case solution is based on the OTE mobility data, parking data from the parking lots and traffic data provided by CERTH-HIT.



Figure 44 - Mobility monitoring – part of the Passenger Facilitation analytics

The first functionality that comes up when opening the public frontend is Mobility monitoring (Figure 44). Information comes up on a map of Thessaloniki, where numbered nodes are shown, each roughly corresponding to a mobile network cell. The number accompanying each node is the *absolute* number of people caught using their cell phones in that cell, on a specific hour, day, month and year. Alternatively, the user can opt for *relative* numbers by clicking on the appropriate radio button. In this case, the numbers in each node show how much higher or lower the mobility is on a specific hour, day, month and year, compared to the average value for that node. The final option of COVID is in essence the implementation of the Covid-19 statistics use case and will be presented in the next section.

Using the dropdown menus, the user can select a different month and/or year. By moving the slider, the user can select a specific hour and day, and the data inside the map change accordingly.



Figure 45 - Mobility statistics – part of the Passenger Facilitation analytics

The next functionality is Mobility statistics. This shows the same map view, but in this case what we see in each node is the average number of people during the selected hour, day, month and year. The user can select the desired month, day and year from the drop-down lists, and the hour by clicking on any of the bars in the bar chart, right below the main map. Each bar corresponds to an hour within the day and shows the average users throughout the city for that hour. The default hour is hour zero (00:00-00:59 in the morning). Clicking on one of the other bars updates the map to show the average values in all nodes for the newly selected hour. There are two options for colouring the nodes: i) by municipality, or ii) by COVID thresholds based on average.



Figure 46 - Traffic statistics – part of the Passenger Facilitation analytics

The third available functionality is Traffic statistics. Again, we see the map of Thessaloniki, in which nodes now represent traffic detector sensors. Inside each node we have the average traffic detected by the sensor

for every hour, day and month, which changes when selecting a different bar from the bar chart, as with mobility statistics. We can change the month and day through the drop-down lists on the right of the map.





Next is the Traffic travel times functionality. On the map we see various paths throughout the city streets as lines, connected at various points. All paths appear as green, with only the currently selected path being red. The user can choose the current path from a drop-down list above the map. Below the map we have a bar chart, showing the average travel duration for traversing the selected path during the selected hour, day and month. We can change the month and day through the drop-down lists at the top-right of the map.



Figure 48 - Parking spots - part of the Passenger Facilitation analytics

Finally, we have statistics for Parking spots, relating to the two commercial parking lots situated at the port. We can select whether we are interested in one of the two parking lots, or both, through a drop-down list at the top-left. Right next to that is the total vehicle capacity for our selection.

The main line chart shows how the number of occupied parking spots changes during the day. We can see that usually, peak hour is at 9:00am with a local low at around 3:00pm, then a new peak at 6:00pm and then gradually emptying throughout the evening. The user can adjust the small chart under the main one, in order to isolate just one period of time and hence have better resolution in the main chart.

The bar charts to the right of the main chart show average parking spot occupancy, per hour and day of week.

4.3.1.4 Statistics for Passengers/Visitors - Covid-19

Due to the unforeseen impacts of Covid-19, 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.



Figure 49 - Mobility monitoring - Covid

The first Covid-related functionality can be found in the Mobility monitoring option of the Mobility menu. Once the Covid thresholds radio button is selected, information comes up on a map of Thessaloniki, where numbered nodes are shown, each roughly corresponding to a mobile network cell (Figure 49). The number accompanying each node is the *absolute* number of people caught using their cell phones in that cell, on a specific hour, day, month and year. In contrast to the absolute numbers option, Covid thresholds display a different colour scheme, where the colours represent different danger levels: green is for low-risk areas, orange for medium-risk and red for high-risk areas. Attributing a colour to a node is not based on just the absolute amount of mobility for that node, but on the difference between the absolute and average values for that node. This way, nodes where big spaces exist and which, therefore, frequently attract large crowds, will not necessarily be considered high-risk.

The second Covid-related functionality can be found in the Mobility statistics option of the Mobility menu. This shows the same map view, but in this case what we see in each node is the average number of people during the selected hour, day, month and year (Figure 50). The user can select the desired month, day and year from the drop-down lists, and the hour by clicking on any of the bars in the bar chart, right below the main map. Each bar corresponds to an hour within the day and shows the average users throughout the city for that hour. The default hour is hour zero (00:00-00:59 in the morning). Clicking on one of the other bars updates the map to show the average values in all nodes for the newly selected hour. Selecting the Covid thresholds radio button displays the same data as in the Colour by municipality option, but in the green-orange-red scheme.



Figure 50 - Mobility statistics - Covid

4.3.2 DataPorts roles

Table 43 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
ΟΤΕ	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.
CERTH	CERTH has provided the local application frontends 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 43 – Analytics for ThPA Roles

4.3.3 Activities carried out

Table 44 contains the tasks involved in the implementation of the scenario.

Time	Actors	Actions
M21-M22	OTE	Provided the mobility data
M22-M24	CERTH, ThPA,	CERTH, ThPA and OTE decided on the initial tentative scenario
	OTE	specifications
M22-M28	CERTH	Create the models to generate the services based on Port Authorities
		needs
M25-M37	ThPA, CERTH,	Deploy the necessary infrastructure for the scenarios and the DataPorts

Time	Actors	Actions		
	PRO, UPV, EVR	Components		
M25-M37	PRO	Development of the Agents for all the data sources		
M26-M30	CERTH, ThPA	CERTH and ThPA decided on the final scenario specifications		
M26-M37	CERTH	Develop the applications		
M26-M37	CERTH, ThPA	Develop the corresponding frontend		

Table 44 – Analytics for ThPA Action Plan Reporting Table

4.3.4 Data Integration

The aforementioned data sources have been connected with the platform with the development of the corresponding agents. The complete list of the agents developed for this scenario is shown in the Table 51.

Agent	Туре	Description
OTE	On demand	The agent reads Mobility Data from a CSV file.
Commercial Ship Call	On demand	The agent calls an API for retrieving the vessel calls from the ThPA statistics application.
Booking	On demand	This agent uses an API to get the truck bookings for container pick-up
Parking	On demand	This agent retrieves the parking status calling an existing API.
Traffic – Travel Time	On demand	The agent reads Traffic Data from a CSV file.
Traffic – Traffic Detection	On demand	The agent reads Traffic Data from a CSV file.
Expected Cruise Ship Call	On demand	This agent uses calls an API to get the list of container ships that will call THPA in the near future.
Gate Event	On demand	The agent gets the status of the gates using a provided API.
Posidonia Operations	Publish / Subscribe	This agent subscribes a RabbitMQ broker for Posidonia Operations events. These events are translated into the platform's ontology.
Smart Containers Geolocation	Publish / Subscribe	Agent to integrate containers' positions
Smart Containers Geofencing	Publish / Subscribe	Agent to integrate containers' events for entering or departing zones
Smart Containers Door Opening	Publish / Subscribe	Agent to integration door opening containers' events

Table 45 – Agents implemented in this scenario

4.3.5 Applications

Table 46 describes the applications that are part of the scenario that interact with the platform and have been updated or implemented, along with the links to the documentation.
Application	Action	Status			
Statistics for THPA Prediction	New application	100%			
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.					
User documentation can be found in Annex A	A:				
9.2.2.1 Vessel visualization					
9.2.2.4 Vehicle traffic					
9.2.2.5 Vehicle time at port					
Application	Action	Progress			
Queues Predictions	New application	100%			
The application will combine input datasets t relation to its operations. Through the DataP predictions.	o estimate traffic in and around the por orts solution, the Terminal Operator car	t premises, in n get queues			
User documentation can be found in Annex A	A:				
9.2.2.2 Prediction					
9.2.2.3 Custom prediction					
9.2.2.4 Vehicle traffic					
Application	Action	Progress			
Facilitation of Passengers, Professionals, and Visitors of the Port	New application	100%			
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.					
User documentation can be found in Annex A:					
9.2.2.6 Mobility					
9.2.2.7 Traffic					
Application	Action	Progress			
Statistics for Passengers/Visitors Covid-19	New application	100%			
The application provides indicators for social	The application provides indicators for social distancing, based on mobile phone network data.				
User documentation can be found in Annex A	A:				
9.2.2.6 Mobility					
Table 46 – A	nalytics for ThPA Applications				

5 GLOBAL USE CASE: SMART CONTAINERS

5.1 APPLICATIONS DEPLOYMENT

The three scenarios selected for the smart container pilot were implemented as planned within the Valencia Port Pilot (refer to section 3 of this document) in the same environment.

The first one concerns the "Raw container location information". The implementation has been carried out on the raw data: the main benefit is an improvement of the visibility by providing in quasi real time the position of the container and thus the visibility of the tracking of the booking. Other services can be developed based on this data and on Machine Learning algorithms, the benefits will be further developed in the following sections.

The two other scenarios concern notifications for two different use cases: the door opening and the geofencing (or also Gate in / Gate out) notifications. The implementation for these two services was also implemented at the Valencia Port pilot.

To collect and exploit this data, Traxens has installed 40 devices with a departure from the two ports involving into this project: 24 devices was installed in the Valencia port and 16 devices in Thessaloniki port. The Figure 51 and Figure 52 shows the geolocation of the devices installed for the pilot as of the 6th of February 2023.



Figure 51 : Valencia Smart Containers pilot geolocation



Figure 52 : Thessaloniki Smart Containers pilot geolocation

The geolocation data, used as a row data bring us visibility on the position of the container in a near real time, we can also follow the trajectory of the cargo at any time. The Figure 53 and Figure 54 shows examples of container trajectory.



Figure 53 : Container trajectory Example 1



Figure 54 : Container trajectory Example 2

From the date of installation of the pilot until this date, these devices generated more than 80 000 geolocation event, 1500 door opening event and 6000 geofencing events.

The three use cases can be visualised on the "events" section of the Dataports platform. The Figure 55, Figure 56 and Figure 57 bellow shows the different events available on the platform in the event section.

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Figure 55 : Door Opening Events

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Figure 56 : Geofencing Events

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Figure 57 : Geolocation Events

5.2 SMART CONTAINERS

During any given container trip, many transport operators are involved, and no single one has total door-todoor 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 58 - 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.



5.2.1 Scenario Description

In this use case, regular containers have been fitted with permanent IoT devices provided by Traxens. These IoT devices periodically generated and communicated 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 data 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 59 depicts the workflow and interactions of the scenario:

Figure 59 – Smart container workflow

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 47 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 47 – Smart Containers Scenario Description

The datasets shown on Table 48 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) IoT devices data for Raw container location (Service 3)	Container ID, timestamp, door opening status (OPEN/CLOSED) Container ID, timestamp, GPS

Table 48 – 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 **DataPorts**

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.

5.2.2 DataPorts 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 agents 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.

The Table 49 shows the organizations that take part in the scenario implementation and their roles:

Table 49 – Smart Containers Roles

5.2.3 Activities carried out

The Table 50 contains the tasks involved in the implementation of the scenario:

Time	Actors	Actions
M10-	TRX	Provide a scenario for the use case review by all partners
M15		
M15-	TRX, VPF and	Deploy the necessary infrastructure of IoT devices on containers
M18,	ThPA	
delayed		
to M24		
M15-	TRX and UPV	TRX and UPV integrate Smart containers data model requirements into
M25		DataPorts model

Time	Actors	Actions
M25-	PRO and TRX	PRO develops the agents following TRX data sources specifications and
M28		requirements
M25-	TRX, VPF and	Integrate the use case in tracking application and evaluate Smart
M34,	ThPA	Containers benefits for the ports
delayed		
to M38		

Table 50 – Smart Containers Action Plan Reporting Table

5.2.4 Data Integration

The aforementioned data sources have been connected with the platform with the development of the corresponding agents. The complete list of the agents developed for this scenario is shown in the Table 51:

Agent	Туре	Description
Smart Containers Geolocation	Publish / Subscribe	Agent to integrate containers' positions
Smart Containers Geofencing	Publish / Subscribe	Agent to integrate containers' events for entering or departing zones
Smart Containers Door Opening	Publish / Subscribe	Agent to integration door opening containers' events

Table 51 – Agents implemented in this scenario

6 GLOBAL USE CASE: PORT MANAGEMENT SYSTEM INTEGRATION

6.1 APPLICATIONS DEPLOYMENT

This use case is built from two different phases. The first one consists in providing useful data to current pilot users from the ports of Valencia and Thessaloniki. For that purpose, an instance of the vessel flow monitoring application Posidonia Operations has been created and configured for each of the ports, as shown in Figure 60:



Figure 60 – Posidonia Operations for Valencia and Thessaloniki

Two instances of Posidonia Operations have been deployed and set up in the network of Prodevelop. The application has been modified to enable data from the AISHUB platform **Fuente especificada no válida.** An instance of the Data Access Component of DataPorts gathers data from Posidonia Operations when a vessel event is processed and sends it to the Semantic Interoperability Component of the corresponding port. Because the data is shared between different networks the communication is done using the security components of DataPorts. This environment is used in the **Tracking of Transport Operations in the port of Valencia** and the **Analytics for the Port of Thessaloniki** scenarios.

On the other hand, there is a second phase in the use case where the platform is deployed for a third port where Posidonia applications are currently in use: the Balearic Port Authority. The Figure 61 depicts the complete services that build this scenario.



Figure 61 – Port management applications in the Port of Baleares

The applications for the Port Community System (Posidonia PCS) and the port management (Posidonia Management) have been improved to enable the sending of events on given user interactions. These messages are listened by the Data Access Component. In addition, there is an agent that subscribes a RabbitMQ queue for retrieving events generated by Posidonia Operations. Using the DataPorts subscription service provided by the Semantic Interoperability Component these messages are sent to the new alerting application, Posidonia Notifications that exposes and endpoint as the call-back for the subscription. This environment is used in the **Posidonia Notifications** scenario.

6.2 POSIDONIA NOTIFICATIONS

6.2.1 Scenario Description

In this scenario there are integrated up to three different Posidonia Port Solution **Fuente especificada no válida.** applications with DataPorts. Thanks to this integration, the platform is 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 retrieves these events and manages an alerting system that informs the users that are interested in the message's subject. The applications that generate or detect the events are Posidonia Management**Fuente especificada no válida.**, Posidonia Operations**Fuente especificada no válida.**

The Figure 62 depicts the workflow and interactions of the scenario:



Figure 62 – Posidonia Notifications Workflow

The Table 52 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 is transformed using the data models of the platform and stored for processing.
3	An agent from the Data Access Component creates an endpoint to receive management events of Posidonia Management.
4	When a user of Posidonia Management generates an event using the application, this event is sent to DataPorts using the endpoint provided by the agent. For example, when the user changes the ETA of a port call. This data is transformed using the data models of the platform and stored for processing.
5	An agent from the Data Access Component creates and endpoint to receive management events of Posidonia PCS.
6	When a user of Posidonia PCS generates an event using the application, this event is sent to DataPorts using the endpoint provided by the agent. For example, when a consignee creates a water supply request. This data is transformed using the data models of the platform and stored for processing.
7	Subscriptions are created through the platform's API setting the Posidonia Notifications application endpoint as target.
8	When any of the subscribed events happen, the Semantic Interoperability Component sends 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.
10	When Posidonia Notifications gets a message of ETA change it alerts the user of the Port Authority, for example by email.

Step	Description
11	A vessel consignee registers into the Posidonia Notifications application and configures its preferred settings for alerts. It also subscribes for water supply requests being accepted or denied.
12	When a request is accepted or declined in Posidonia PCS it creates and event that will be sent to Posidonia Notifications, that notifies the vessel consignee by email.

Table 52 – Posidonia Notifications Scenario Description

The datasets shown on Table 53 are 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, including:
	Vessel reaches waypoint
	Entering to port
	Leaving port
	Berthing started
	Berthing finished
	Anchoring started
	Anchoring finished
Posidonia PCS	JSON messages with events for the management of:
	Water supply requests
	Electricity supply requests
	 Port surface occupation requests
	Waste removal requests
	Access to port requests

Table 53 – Posidonia Notifications Scenario Datasets

As result of the integration, users of the Posidonia applications will have the tools to change and improve the way they manage they operations. How to use the new functionalities is usually similar: a stakeholder subscribes for notifications about the topics of interest in Posidonia Notifications, configures how they want to be alerted and then he is able to react in consequence when messages arrive.

6.2.1.1 Posidonia Management

As a vessel consignee, terminal operator or port authority, I want to be aware of changes in the ETA of incoming vessels. This data can be modified through the Posidonia Management application.

The first thing the user needs to do is to log in Posidonia Notifications and subscribe for the Change of ETA topic. In this example, the user subscribes for all the ETA changes of Port Calls at the same port authority (Organization). All events received of this type will be sent to the given email direction.



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Figure 63 – Subscribing to ETA changes

Once the subscription is completed, the user will start receiving notifications when this event happens.

For this action to happen a user of Posidonia Management will access the application and change the ETA of a visit. For doing this the user will access the Port Call list in the application.

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Figure 64 – Port Call list

For running the actions that will send the events to DataPorts, the user will select a Port Call and look into the Actions drop-down list for Edit ETA.

DataPorts

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Vessel suitability requests	Edit Maritime Service counter	dia	AVEIRO	2.451	Solicitada	24/01/2023 00:00	25/01/2023 00:00		
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Figure 65 – List of Port Call actions

After selecting the Edit ETA action, a new window will be shown where the user will pick the new date and time.

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Figure 66 – ETA change of a Port Call

Once it is done, a new notification will be created and sent to all users subscribed to the event that meet the conditions. The alert will be shown both in the notifications panel in Posidonia Notifications and the destination where it was sent.





Figure 67 – Notification created



Figure 68 – Inbox of the Port Authority user

When a notification is received, the user can react immediately to the event.

6.2.1.2 Posidonia PCS

In this application the Port Authority can manage some types of professional service requests done by the vessel consignees. Some of the services provided are water and electricity resources, access to port, waste removal and surface occupation. The interaction between users and the required steps are the same. In this example we are showing how will the users take advantage of the new tools to improve the process.

The Port Authority is the responsible of accepting or denying the services, so it is interested in the arrival of new requests. Using Posidonia Notifications, it will subscribe for water requests done for the Baleares Port Authority.



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Figure 69 – Subscribing for new water requests

On the other hand, the vessel consignee is the user that creates the request, and wants to be alerted when their requests are accepter of denied. With this objective, it will subscribe in Posidonia Notifications for when their own requests (Stakeholder) have changed their status.

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Figure 70 – Subscriptions to water request changes

Now both the vessel consignee and the port authority have everything set up to start receiving alerts. As aforementioned, the vessel consignee will start the process creating a new request. It will navigate to the management of water and electricity section of Posidonia PCS and create a new water request.

DataPorts

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Figure 71 – Water and electricity requests list

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Request date Register date D2/03/2023 10:29 Port of call Port of call ESALD202300008 Ship Entry date Depart date 9237644 MILENIUMDOS 25/01/2023 00:00 26/01/2023 00:00 Departion/dock zone 21, MUELLE DE RIBERA Request of Quantity (Im/Kw) Supply line Terrestre Request data Request atrt Request end Request en	Requested by considbudueall	Organization R5220633A	Consignaciones But	que SA	
Port of call Port of call Port of call ESALD202300008 MO Ship Entry date Depart date 25/01/2023 00:00 26/01/2023 00:00 26/01/2023 00:00 Coperation/dock zone 21, MUELLE DE RIBERA Request of Quantity (Im/Kw) Supply line Request start Reque	Request date 02/03/2023 10:29	Register date 02/03/2023 10:29			
Operation/dock zone 21, MUELLE DE RIBERA Requested data Request of Quantity (Tm/Kw) Supply line 50 Terrestre Request start Request end 02/03/2023 10:30	Port of call ESALD202300008 MO 9237644	Ship MILENIUMDOS		Depart date 26/01/2023 00:00	
Requested data Supply line Request of Quantity (Tin/Kw) Supply line Water 50 Terrestre Request start Request end Requested time (h) 02/03/2023 10:30 Image: Supply line Image: Supply line	Dperation/dock zone 21, MUELLE DE RIBERA	MILENIONDOS	× ×	2010112023-00.00	
Request start Request end Requested time (h) 02/03/2023 10:30 Notes	Requested data Request of Water	Quantity (im/)	Kw)	Supply line Terrestre	v
Notes	Request start 02/03/2023 10:30	Request end		Requested time (h)	
	Notes				

Figure 72 – Water supply request



Once the request is done, a new notification will be created in Posidonia Notifications for the Port Authority.



Figure 73 – Notification for new water supply request

And also, the message will arrive to the destination email.

	Outlook	, P Buscar		43	₽	٥	0	6 ³ (B
	Inicio Vista Ayuda								
e	🗏 🗹 Correo nuevo 🗸 🗸	🗊 Eliminar -> 🖻 Archivar 🍈 Informar -> 🚿 L	impiar 😘 Mover a 🗸 🕤 🌾 🥱 v 🦻 Pasos rápidos v 🗠 Leído / No leido 🖉 v 🛱 v 🖉 🕥 v 👼 v 🦻 🗄 🔹						~
88	 Favoritos 	⊘ Prioritarios Otros = Filtrar	Water Requested				@, ∨	<u>م</u>	
D	🖂 Bandeja de 1	[DATAPORTS] posidonia_notifications	[DATAPORTS] posidonia_notifications			5 4	6 0		
	➢ Elementos en	The consignee Consignaciones Buque	Para: [Piloto DataPorts] baleares_port_authority			Jue 0	2/03/202	3 10:29	
	🔊 Borradores		The consignee Consignation Buque SA has requested water supply: Vessel: MILENIUMDOS						
	Agregar favorito		Quantity: 50.0 Tm						
	~ Carpetas		6 Responder A Reenviar						
	🕞 Bandeja de 1								



The Port Authority can now manage the request as soon as it is received, thanks to the real time alerting. The user will access to Posidonia PCS application and accept the request from the vessel consignee.

AT CALLS MANAGEMENT						Wat	er ar	nd Energy	Supply		
IPS MANAGEMENT NGEROUS GOODS	Group	~	English	♥ Quick search			Ø	Actions •		All ports	~
ER TABLES MANAGEMENT	Port of call =	Ship =	Requested dock	Request date =	Id Service =	Status :	Org	Register	ily type =		
ESSIONAL SERVICES	ESALD202300008	MILENIUMDOS	MUELLE DE RIBERA	02/03/2023 10:29		NOTIFIED	Cons	Cancel			
inergy Supply	ESALD202300009	A, GAUDI	AMPLIACION M. PONIENTE 2 ALINEACION	02/03/2023 10:19	133	APPROVED	Cons	Authorite Deny			
igabarras	ESALD202300001	ADA D	PANTALAN REPSOL SA	01/03/2023 16:00	132	NOTIFIED	Cons	Audit			
ASTER TAILES	ESALD202300001	ADA D	PANTALAN REPSOL SA	01/03/2023 15:54	131	NOTIFIED	Cons	gnaciones Buque SA	Agua		
MOOSCOMERCIALES	ESALD202300001	ADA D	PANTALAN REPSOL SA	01/03/2023 15:47	130	NOTIFIED	Cons	gnaciones Buque SA	Agua		
INU.GESLSP	ESALD202300001	ADA D	PANTALAN REPSOL SA	01/03/2023 15:44	129	NOTIFIED	Cons	gnaciones Buque SA	Agua		
MENU.VUA	ESALD202300001	ADA D	PANTALAN REPSOL SA	01/03/2023 15:40	128	NOTIFIED	Cons	gnaciones Buque SA	Agua		
QBORRADOR ROOT	ESALD202300001	ADA D	PANTALAN REPSOL SA	01/03/2023 15:33	127	NOTIFIED	Cons	gnaciones Buque SA	Agua		
ACIOSBASICOS	ESALD202300001	ADA D	PANTALAN REPSOL SA	01/03/2023 15:26	126	NOTIFIED	Cons	gnaciones Buque SA	Agua		
ANCÍAS/PASAJE	ESALD202300001	ADA D	PANTALAN REPSOL SA	01/03/2023 15:25	125	NOTIFIED	Cons	gnaciones Buque SA	Agua		

Figure 75 – Managing water supply requests

When the request is accepted, a new notification is created for the vessel consignee in Posidonia Notifications.

ø	DataPorts	Notifications Notifications								
(C)	Dashboard Search	Actions 🗸 🖪	° C'		Filters 🗸	T	47 1 4	⊞ + ×	Q- Search	
ø	Administration	Created	Topic	Message The Ralearic Port Authority has accested the water supply request: Consignee: Consignationes Buoue SA Vessel: M	ILENIUMDOS Our	writity: 50.0 Ti	0	Channel (Destination	Notification status
-84	User destinations									
œ	Subscriptions									
2	Notifications									

Figure 76 – Notification of a water request accepted

And a message will be sent to the destination email of the subscription.



Figure 77 – Inbox of the vessel consignee with the request accepted

Now the vessel consignee is aware of the status as it is changed. Imagine the scenario where the request is denied by the Port Authority. The vessel consignee will be able to make a new request solving the possible issues immediately.

6.2.1.3 Posidonia Operations

This application provides vessel events processed from the AIS messages and the cartography of the port. Thanks to these events users can know when a vessel is near the port, when it arrives, when it started berthing, when it is leaving...and other events. There are many potential stakeholders for this information, like the Port Authority, the vessel consignee, the terminal operators, the shipping line, pilots, stevedores and dock workers, or logistic companies involved.

For start receiving these notifications, the user will subscribe for the desired topics in Posidonia Notifications. In this example, the Port Authority of Baleares subscribes for any arrival of a vessel to any of the ports they manage.

ø	DataPorts	Subscription			
ଜ	Dashboard	Subscription			
Q	Search	Topic *			
٢	Administration	Vessel port arrival			
•& :	User destinations	Muted Disabled			
92	Subscriptions	Filters			
	Notifications	Available	Selected		
		E Division +	II Organization	×	
		II Stakeholder +-			
		Add all		1 item selected Empty	
		Destinations			
		II baleares_port_authority@prodevelop.es	×	Channel * Email	*
				Destination	
				baleares_port_authority@prodevelop.es	
^	No. 16 - 19 - 19				
÷ @	Helo				
å	Balearic Port Author.	Add Destination			

Figure 78 – Subscribing for vessels arrivals

Users can subscribe to all topics they have access to. For each topic they can set how and where to be notified.



0	DataPorts	Subscriptions Subscriptions			
ଙ୍ଗ ପ	Dashboard Search	Actions 🗸 🕒 😧 📵 💼 😋		Disabled fields are hidden Filters 🗸 🍸 I 👻 🔢 I 👻	Q - Search
\$	Administration	Time created	Topic Vessel port arrival	No. of destinations	Muted
-& ;	User destinations	21/03/2023 13:46	Vessel port departure	1	No
21	Subscriptions	21/03/2023 13:46	Vessel reaches waypoint	1	No
1	Notifications	21/03/2023 13:46	Vessel dock arrival	1	No

Figure 79 – Subscriptions to vessel events

When the events are sent from Posidonia Operations and received in Posidonia Notifications, alerts will be created and sent to the setup directions.

6.2.2 DataPorts roles

The Table 54 shows the organizations that take part in the scenario implementation and their roles:

Organisation	Role
PRO	Has leaded 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	Has participated in the data model definition for the data sources of this scenario

Table 54 – Posidonia Notifications Roles

6.2.3 Activities carried out

The Table 55 contains the tasks involved in the implementation of the scenario.

Time	Actors	Actions
M12-	PRO	PRO provides a scenario specification and it is revised by all participant
M15		partners
M12-	PRO	PRO involves the Baleares Port Authority in the project in order to use its
M18		environment, data and events in the pilots
M18-	PRO and UPV	PRO and UPV analyse the requirements for the semantic transformation
M27		and representation of the data
M23-	PRO	PRO develops the Agents for the integration of the data sources following
M34		the specifications and requirements. The agents are listed on the section
		6.2.4 Data Integration.
M25-	PRO	PRO modifies the Posidonia Operations application to being able to
M27		process data from the AISHUB platform.
		Change log: OPE.1
M25-	PRO	PRO extends the current Posidonia Management application so when the
M36		events that need to be shared happen, it gathers all the needed
		information, builds a JSON message and sends it to a DataPorts endpoint.
		Change log: MNG.1, MNG.2, MNG.3, MNG.4, MNG.5
M25-	PRO	PRO extends the current Posidonia PCS application so when the events
M35		that need to be shared happen, it gathers all the needed information,
		builds a JSON message and sends it to a DataPorts endpoint.
		Change log: PCS.1, PCS.2, PCS.3, PCS.4, PCS.5, PCS.6
M23-	PRO	PRO develops an alert application, making the analysis, design,
M36		implementation and integration with DataPorts.
M30-	PRO	PRO deploys all the required components and applications for the

Time	Actors	Actions
M36		scenario demonstration.
M36-	PRO	PRO creates the user manuals, application change logs
M39		

Table 55 – Posidonia Notifications Action Plan Reporting Table

6.2.4 Data Integration

The aforementioned data sources have been connected with the platform with the development of the corresponding agents. The complete list of the agents developed for this scenario is shown in Table 56.

Agent	Туре	Description
Posidonia Management	Publish / Subscribe	This agent exposes an endpoint and translates data from Posidonia Management events into the platform's ontology.
Posidonia PCS	Publish / Subscribe	This agent exposes an endpoint and translates data from Posidonia PCS events into the platform's ontology.
Posidonia Operations	Publish / Subscribe	This agent subscribes a RabbitMQ broker for Posidonia Operations events. These events are translated into the platform's ontology.

Table 56 – Agents implemented for this scenario

6.2.5 Applications

The Table 57 describes the applications that are part of the scenario that interact with the platform and have been updated or implemented, along with the links to the documentation.

Application	Action	Status				
Posidonia Management	Modification	100%				
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 Fuente especificada no válida. message broker from where the agent of the platform will get it. This will be repeated for each of the events.						
User documentation can be found in Annex /	A: 9.3 Posidonia Management					
Change log can be found in Annex B: 10.5						
Application	Action	Progress				
Posidonia PCS	Modification	100%				
The Posidonia PCS application will build and the events that will publish in DataPorts.	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 relevent published in DataPorts and publish it into a R	vant information about the event that is RabbitMQ message broker from where t	going to be he agent of the				

platform will get it. This will be repeated for each of the events.

User documentation can be found in Annex A: 9.4 Posidonia PCS							
Change log can be found in Annex B: 0							
Application	Action	Progress					
Posidonia Operations	Modification	100%					
The application Posidonia Operations has been updated to support messages not only from AIS stations but also for consuming events from AISHUB Fuente especificada no válida . Thanks to this upgrade, the application is able to process messages without any additional local							
Thessaloniki.	their data in the platform, like for the pc						
Change log can be found in Annex B: 10.6							
Application	Action	Progress					
Posidonia Notifications	New application	100%					
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	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.						
User documentation can be found in Annex A: 9.5 Posidonia Notifications							

Table 57 – Posidonia Notifications Applications

7 CONCLUSIONS

For more than three years, partners from different parts of Europe have collaborated to build the DataPorts platform and demonstrate the benefits of its use through pilots in two major European ports, Valencia and Thessaloniki, and two global use cases involving major maritime technology companies such as Traxens and Prodevelop.

This document gathers the work carried out and the final status of the integration of DataPorts in each of the ports and more specifically in the different scenarios that have been proposed as part of the final demonstration of the project.

In each of the pilots, numerous tasks ranging from infrastructure provisioning to application development have been carried out. The objectives of each of the pilots have been successfully met, demonstrating that the platform enables the sharing of information from multiple sources, regardless of the owner, technology or type of data it contains, in a secure, transparent and controlled manner, while ensuring that only permitted users have access to it. In addition, the platform provides cognitive data analytics and machine learning services, providing the ports with powerful decision-making tools. All of the above takes these ports to a new level of data management and use, paving the way for the digitisation of new processes related to both service provision and freight logistics.

As a result of the project, not only solutions have been developed to improve efficiency in the ports, reducing the time needed to manage operations and other derived benefits, but also the necessary knowledge and methodologies have been acquired to continue improving new scenarios in the future. In addition, the deployment of DataPorts in different environments and the diversity of connectors required to access the data sources has been a challenge we have overcome not without effort. As part of the actions carried out during the integration of the platform and the development of the pilots, we can highlight the following acquired know-how:

- Definition, building and management of data models.
- Acquisition and processing of data from heterogeneous sources, both technologically and semantically.
- Data filtering, cleaning and preparation.
- Security in federated systems, with IAM integration and a single point of access interface.
- Implementation of services for training models and predictions through Machine Learning.

As future lines of work, it is suggested to those responsible for the different components and applications involved to continue integrating new data sources, building new agents and completing the corresponding data models, thus extending the semantics of the platform. More organisations can also be involved, both data providers and stakeholders, in order to enrich the catalogue of available data. With these actions, new scenarios could be improved, meaning the optimisation of the management processes carried out in ports as well as the positive effects these activities may have on external elements.

DataPorts

8 ACRONYMS

8.1 ACRONYMS

Acronym List	
API	Application Programming Interface
COREOR	Container Release Order
СР	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
HIT	Hellenic Institute of Transport (part of CERTH)
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
ТМ	Technical Manager
TOS	Terminal Operating System
VGM	Verified Gross Mass
WPL	Work Packages Leaders
ZOI	Zones of Interest

Table 58 – Acronyms

DataPorts

9 ANNEX A: USER MANUALS

9.1 PORT OF VALENCIA

9.1.1 Tracking of transport operations

The tracking application allow the user to different data related to transport operations and tracking.

The "Shipments" section shows the list of all the shipments including all the all the messages received if we expand one of them.

Doto Pla Doto Pla	ta Ports atform for the tion of Cognitive Ports	Dataports						(Light ~	<u>-</u> 業	e Adr	iminis
Home												
Logistics	~	a Deposits										
Shipments		Inquiry for items in deposit, please sel	ect the search criteria litems: 10 💌	1-8 of 8 🗸	> 🤁 Updat	e 🛷 Synch	ironize					
Transports						_	# 5					
Transport Units		Q Search O E	qual 🔿 Start 💿 Contains 🔿 Ends 🕂	Urder By	Ascending	Descending	From	E	Until			
Deposits		☐ ● Requested ☐ ● Accept	ed [] ♥ Planned [] ♥ Executing []	Finished	Rejected 📋 🛡 Can	celled						
Events												
Administration	<	New Stored Item										
/GM	¢	> ∕ ⊗ 🖥 २२ ⊘ Status 📕 I Finished S20	D Popositor 2206111.1 CSLU		Agent AGENTE MARÍTIMO		storeditem.depo TERMINAL	sitary	Request date 11/06/22			
VIGIA	¢	GateOut #1 Stat S202206111.1 Finishe T	us 🗰 Requested 🛑 Valid From d 12/06/22	Expires in 15/06/22	Planned	Performed	Confirmed 12/06/22	Place VALENCIA	storeditem	.authorised TRANSITA		
Masters	¢	#= Transport mm Unit 006 ABC1234 ✓ TRLU123456										
Messages	¢	Costelo #1 Costelo #1 Costelo #1	D Epositor 12206111.2 CSLU	# Evoiree in	Agent AGENTE MARÍTIMO	# Derformed	Storeditem.depo TERMINAL	Diace	 Request date 11/06/22 storeditem 	authorized		
ESS		S202206111.2 Finishe	d 12/06/22	15/06/22			12/06/22	VALENCIA	FORWARDER	TRANSITA		
Access Options	<	006 ABC1234 ✓ TRLU123456 > ♪ ◇ ⑤ 酚 ⋈ O Status Accepted Gatein #1 ♀ Stat	D Ashipment.ship 3-ACP-2021-380709-1 6884410410W us Arquested Valid From	mentID 🖪 Deposi COSCO SI 🛱 Expires in	itor hipping Lines Planned	Cosco Si Performed	t hipping Lines Spain S./ Confirmed	Sto DOCK	reditem.depositary S LOGISTICS SPAIN,S storeditem	8.A. 09/07	equest date 7/21	
lome	son of Cognitive Ports	✓ ♥ ♥ ■ 次 ■ 0001 ABC1234	Status shipment. Finished R202206081	req 📕 shipment.shi 2022060801	📕 shipment.relat	💼 shipment 09/06/22	.order 🖪 shipment. CARGADOR	requestorLa	Shipment.dispate	chPar 🖪 shipm TRANSP	ient.carrierLabel ORTISTA	I
ogistics	~	shipment.consignee DESTINATARIO										
Shipments				Valencia 01/06/22			Madrid 01/06/22					_
Transports		👪 shipment.totalGoods 🛛 🕻	shipment.goods									
Transport Units		15000 Kg. 2 pallet A2	ULEJOS 1									
Deposits			Shipment Delivered	01/06/22	👬 🏚	Shipment R	eceived 01/06/2	2	💼 🌉 Sh	nipment Pick	ed Up 01/06	6/22
Events			© 28922 Madrid		9 289 9 289	22 Madrid	korran		9 46024 9 472222	Valencia	cia	
dministration	· C		 shipment.s 2022060801 		1 si 2022	hipment.s 060801			3 ship 2022060	ment.s 1801		
GM	~		R Carrier W4444444@46024		Rec	ipient X333333333	@28922		🖪 Carrier	r W4444444@460	24	
Requests		01/06/22 🔶										
Vehicles			Shipment Dispatche	d 01/06/22								
IGIA	¢		 \$46024 Valencia \$Y22222222@46024 Valencia 									
lasters	<		shipment.re R202206081									
lessages	۰.		Dispatcher Y2222222@46024									
SS												
Access Options	¢		Shipment Planned 2: 12:13 Shipment: 2022060801 Transport: 0001	3/06/22								
		23/06/22 🔶	➢ shipment.s ■ shipment.re 2022060801 R202206081									



Figure 81 – Shipment details

The "Transports" section shows the transports included in the shipments presented before. If a shipment is divided in three different transport services (road, train, and maritime) these are showed separately.



Figure 82 – Transport units list

The "Transport Units" section shows all the containers from the registered shipments.

=	DataPol Data Platform for the Connection of Cognitive	ts Dataports						Light v	三 畿	Administrador
A Home										
Logistics	~	🗳 Transport l	Inits							
Shipment	ts	Consult transport units, pl	ase select the search crite	ria items: 10	▼ 1-3 of 3	< > 😅 U	odate 🖉 Synchronize			
💷 Transport	ts	0 current			In Order By		E C a c m 🛱 From	前 萧 Lintil		
Transport	t Units	C Search	Accepted Pla	● Contains () nned □ ● Exe	cuting	ed 🗌 🗣 Rejected 🗍	Cancelled			
Deposits										
Events										
ିନ୍ଧୁ Administrati	ion <	New Transport Un	t							
VGM	<	> 2 🚫 🔮 次 📠 Unit/ TRLU123	Cont. Sipment.shi. S202206111	20GP	Status Executing	Carrier CSLU	Provider CSLU			
	<	> 🖉 🔂 🛣 Unit/ TLLU405	Cont. 📕 shipment.shi. 1460 6884410410W	. 📕 Type 4510	Status Executing	Carrier COSCO Shipping L	Provider Cosco Shipping Li			
Masters	<	> ∕ 🚫 🛅 🕅 📠 Unit/ CCLU471	Cont. Shipment.shi.	4310	Status Executing	Carrier COSCO Shipping L	Provider Cosco Shipping Li			
Messages	<								items: 10 👻	1-3 of 3 < >
ACCESS										
🔒 Access Optio	ons <									

Figure 83 – Transport units list

The "Deposits" section shows the gate in and gate out orders from the registered shipments.



Figure 84 – Gate in and gate out orders list

The "Events" section shows the individual operations of each shipment. In addition, it also includes events from other data sources such as vessel location from Posidonia, container location from Traxens, and truck entering and leaving the port.

🗗 DataPorts	AUTOMATIC MODELS TRAINING ENGINE						amte@dataports.or
 Services Create 					Last trained		
β Models	Name	Task	Туре	Description	date	Status	
Results	Vessels ETD estimator	Time Series Forecasting	Vessel Time of Departure Estimator	Forecast of the estimated Time of Departure of an arriving vessel in all ports of Valencia	16/11/2022 16:21:28	RUNNING	Stop
	Vessels Port Calls Calculator	Time Series Forecasting	Vessels Port Calls Calculator	Number of port calls that will be expected to occur in all ports and terminals in the next 2 months	18/11/2022 11:12:37	STOPPED	Deploy
	Average Vessel Berth Time	Time Series Forecasting	Average Vessel Berth Time	Saturation of the port of Valencia in the next 3 weeks	18/11/2022 11:14:23	RUNNING	Stop
	Customs Trade Volume	Time Series Forecasting	Customs Trade Volume	Estimation of the tons of animal products imported to Valencia in the next 3 months	18/11/2022 11:17:12	RUNNING	Stop
	Missing Origin/Destination Identification	Values Imputation	Missing Origin/Destination Identification	Prediction of the unknown district from the historical data of PCS traceability	18/11/2022 11:20:23	RUNNING	Stop
	Vessels Port Calls Calculator 5 months	Time Series Forecasting	Vessels Port Calls Calculator	Number of vessels in all ports and terminals in the next 5 weeks	18/11/2022 11:26:32	STOPPED	Deploy
	Machinery forcasting 7 days	Time Series Forecasting	Container Goods Volume	Number of TEUS of machinery imported to Valencia in the next 7 days	18/11/2022 11:30:52	RUNNING	Stop ***
	Plastics imported to Valencia in 2 months	Time Series Forecasting	Container Goods Volume	Number of TEUS that are expected to arrive to the Port of Valencia in the next 2 months	17/01/2023 10:08:10	TRAINING	***

Figure 85 – Events list

9.1.2 Port authority data sharing and analytics services

To create a new cognitive service, select the tab "**Create**" available on the selectable menu on the left-hand side.

In the first step of the wizard, "**Task**", define a service name and its description. Then, the wizard provides several cognitive services to fulfil a specific type of prediction, thereby select "**Vessel Time of Departure Estimator**"

🗗 DataPorts	AUTOMATIC MODELS TRAINING ENGINE amtu
E Services ➡ Create ✿ Models	Task Dataset Configuration Strategy Confirmation Service description ①
📊 Results	Name Description ETD Estimator Image: Comparison of the departing time of each vessel
	Please select a type of service Container Goods Volume Ontainer Goods Volume Missing Origin/Destination Identification Customs Trade Volume
	Quantity of TEUs of a good from/to a specific district Expected volume of a good (in tons) from/to a district Expected volume of a good (in tons) from/to a district More info More info More info
	Average Vessel Berth Time Vessels Port Calls Calculator Vessel Time of Departure Estimator
	Averaged berthing time of a vessel in a terminal / port Expected volume of vessels in a terminal / port Time of departure of a vessel from a terminal / port More Info More Info More Info

Figure 86 – Predictive Process Monitoring Application: Creation wizard

The second step of the wizard is named "Dataset".

In this step, a searchable list of available datasets in DataPorts' platform is presented, which provides the data required to create the service. In this case, only datasets with historical records of the arrival and departure of vessels are shown. Select the dataset shown in the picture below.

Servic	e "ETD Estimate	or"					
Task: Ve	essel Time of Depart	ure Estimator					
Task	Dataset Configurati						
Data	set selection ()		٩				
	Provider	Name	Description	Variables	Row count	Size (in MB)	Last Update
0	Portsdebalears	Vessel calls of Balear's Ports	Vessel calls information of the ports of Palmma, Alcudia, Ibiza, Mahon and La Savina. Historical data from 2018 to 2021	13	115.331	7,9	25/07/2021
	MarineTraffic	Vessel calls of Algeciras Port	Vessel calls information of the port of Algeciras. Historical data from 2013 to 2021	8	65.890	3,5	30/07/2021
	MarineTraffic	Vessel calls of Barcelona Port	Vessel calls information of the port of Barcelona. Historical data from 2013 to 2021	8	152.344	8,2	02/08/2021
0	ValenciaPort	Vessel calls of Valencia's Ports	Vessel calls information of the ports of Valencia. Sagunto and Gandia. Historical data from 2015 to 2021	8	46.444	2,5	10/07/2021
			Showing 1 to 4 of 4 aptrice (1 1				

Figure 87 – Dataset selection

The third step, called "Configuration" (see figure below), and it's specific for each service. In this screen,

the user can choose additional information or options to be considered to train the underlying models. A proper configuration of such options could greatly impact the model's accuracy. In the case of the configuration of Cognitive Services associated with a time variable, the option "Consider only last year of data for training" will be available. Hence, more accurate models may be trained as the training data is closer to the time of the prediction. It is worth to mention, that only options relevant to the end-user expertise are available, avoiding options related with the underlying ML training process.

🖪 DataPorts	AUTOMATIC MODELS TRAINING ENGINE		am	ite@dataports.org	
E Services Create Models It Results	Service "ETD Estimator" Task: Vessel Time of Departure Estimator Task Departure Estimator Task Desset Configuration				
	Configure training ① Service Parameters Select a port ALL PORIS ~	Select a terminal ALL TERMINALS	Select a regular line		
	Temporal Forecast Parameters Consider only last year of data for training				
	Previous		Next		
	This project has received funding from the Euro	pean Union's Horizon 2020 research and innovation programm	e under grant agreement No 871493		

Figure 88 – Cognitive service configuration

The fourth step is named "Strategy".

This screen shows a list of the different training strategies. The end-user must select any of them depending on its time availability and performance requirements. Depending on the strategy selected, a specific set of algorithms and associated parameters will be automatically chosen by the training engine.

In this case, select the strategy "Standard".

DataPorts

Service "ETD Estimator" Task: Vessel Time of Departure Estimator			
Select strategy ①			
🔗 Fast	d Standard	垚 Optimum	℃ Deep training
A quick forecasting process will be carried out to obtain the forecasting outcome as fist as possible. Hence, some non essential processing and optimization steps will be avoided. The whole forecasting time will vary from 5 - 10 minutes.	A common forecasting process will be performed. Therefore, the most important input variables and the best machine learning algorithm will be selected. The whole forecasting sime will vary from 20 - 30 minutes.	A highly thorough forecasting process will be performed by adding extra optimization steps into the pipeline in order to outcome the best possible forecast. The whole forecasting time will vary from 60–120 minutes.	A forecasting process will be performed by utilizing deep learning algorithms, which are able to find very complex patterns, within the data, at a high computational cost. The whole forecasting time will vary from 120 - 180 minutes.
~ 5 - 10 minutes.	~ 20 - 30 minutes.	~ 60 - 120 minutes.	~ 120 - 180 minutes.
Provinus			Next
- 5 - 10 minutes.	~ 20 - 30 minutes.	~ 60 - 120 minutes.	~ 120 - 180 minutes.

Figure 89 – Training strategy selection

The final step is named "Confirmation".

In this step, the detailed information of all the choices and selections made during the wizard are presented for reviewing. Once confirmed, the button Train Service starts the distributed training process of a ML model that implements the required service.

Click the button "Train Service".

🗗 DataPorts	AUTOMATIC MODELS TRAINING ENGINE	mte@dataports.org	r 🎧
E Services ➡ Create	Service "ETD Estimator" Task: Vessel Time of Departure Estimator		
Models	Task Dataset Configuration Strategy Confirmation		
,1 Results	Internet Leader Unsigned on Wang Continuation Confirm training SERVICE NAME ETD Estimator Predicts the departing time of each vessel DATASET TAX Include only lastyper false Vessel Time of Departure Estimator Une ALL LINES Time of departure of a vessel from a terminal / port A comon forecasting process will be performed. Therefore, the most important icous variables and the best machine learning agric most machine learn		
III 🛃 III IVISTOATS			

Figure 90 – Training confirmation

Automatically, the tab "Services" is shown and you will see the new created cognitive Service appended in the list and being trained.



vices								
lels	Name	Task	Туре	Description	Last trained date	Status		
its	Average Vessel Berth Time	Time Series Forecasting	Average Vessel Berth Time	Saturation of the port of Valencia in the next 3 weeks	18/11/2022 11:14:23	RUNNING	Stop	
	Customs Trade Volume	Time Series Forecasting	Customs Trade Volume	Estimation of the tons of animal products imported to Valencia in the next 3 months	18/11/2022 11:17:12	RUNNING	Stop	
	Missing Origin/Destination Identification	Values Imputation	Missing Origin/Destinati on Identification	Prediction of the unknown district from the historical data of PCS traceability	18/11/2022 11:20:23	RUNNING	Stop	
	Machinery forcasting 7 days	Time Series Forecasting	Container Goods Volume	Number of TEUS of machinery imported to Valencia in the next 7 days	18/11/2022 11:30:52	RUNNING	Stop	
	Glass products imported to Valencia in 3 months.	Time Series Forecasting	Container Goods Volume	Amount of TEUs of glass products expected to arrive to Valencia in the next 3 months.	23/01/2023 10:56:19	RUNNING	Stop	
	test_nodered	Time Series Forecasting	Vessels Port Calls Calculator	test_nodered	01/02/2023 15:11:19	RUNNING	Stop	
	ETD Estimator	Time Series Forecasting	Vessel Time of Departure Estimator	Predicts the departing time of each vessel	20/02/2023 14:07:50	TRAINING		

Figure 91 - Predictive Process Monitoring Application: Cognitive services list

Wait until its status changes to "Ready" in yellow color, and then click on the button "Deploy".

🗗 DataPorts	AUTOMATIC MODELS TR	AINING ENGINE							amt
E Services									
😴 Create		Name	Task	Туре	Description	Last trained	Status		
						date			
.II Results		Average Vessel Berth Time	Time Series Forecasting	Average Vessel Berth Time	Saturation of the port of Valencia in the next 3 weeks	18/11/2022 11:14:23	RUNNING	Stop	
		Customs Trade Volume	Time Series Forecasting	Customs Trade Volume	Estimation of the tons of animal products imported to Valencia in the next 3 months	18/11/2022 11:17:12	RUNNING	Stop	•••
		Missing Origin/Destination Identification	Values Imputation	Missing Origin/Destinati on Identification	Prediction of the unknown district from the historical data of PCS traceability	18/11/2022 11:20:23	RUNNING	Stop	
		Machinery forcasting 7 days	Time Series Forecasting	Container Goods Volume	Number of TEUS of machinery imported to Valencia in the next 7 days	18/11/2022 11:30:52	RUNNING	Stop	
		Glass products imported to Valencia in 3 months.	Time Series Forecasting	Container Goods Volume	Amount of TEUs of glass products expected to arrive to Valencia in the next 3 months.	23/01/2023 10:56:19	RUNNING	Stop	
		test_nodered	Time Series Forecasting	Vessels Port Calls Calculator	test_nodered	01/02/2023 15:11:19	RUNNING	Stop	
		ETD Estimator	Time Series Forecasting	Vessel Time of Departure Estimator	Predicts the departing time of each vessel	20/02/2023 14:07:50	READY	Deploy	

Figure 92 – Service ready to deploy

Then, the status should change to "Running" in green color.



🖪 DataPorts	AUTOMATIC MODELS TR	AINING ENGINE							amte@d
⊨ Services ★ Create									
🏚 Models		Name	Task	Туре	Description	Last trained date	Status		
, Results		Average Vessel Berth Time	Time Series Forecasting	Average Vessel Berth Time	Saturation of the port of Valencia in the next 3 weeks	18/11/2022 11:14:23	RUNNING	Stop	
		Customs Trade Volume	Time Series Forecasting	Customs Trade Volume	Estimation of the tons of animal products imported to Valencia in the next 3 months	18/11/2022 11:17:12	RUNNING	Stop	
		Missing Origin/Destination Identification	Values Imputation	Missing Origin/Destinati on Identification	Prediction of the unknown district from the historical data of PCS traceability	18/11/2022 11:20:23	RUNNING	Stop	
		Machinery forcasting 7 days	Time Series Forecasting	Container Goods Volume	Number of TEUS of machinery imported to Valencia in the next 7 days	18/11/2022 11:30:52	RUNNING	Stop	
		Glass products imported to Valencia in 3 months.	Time Series Forecasting	Container Goods Volume	Amount of TEUs of glass products expected to arrive to Valencia in the next 3 months.	23/01/2023 10:56:19	RUNNING	Stop	
		test_nodered	Time Series Forecasting	Vessels Port Calls Calculator	test_nodered	01/02/2023 15:11:19	RUNNING	Stop	
		ETD Estimator	Time Series Forecasting	Vessel Time of Departure Estimator	Predicts the departing time of each vessel	20/02/2023 14:07:50	RUNNING	Stop	

Figure 93 – Service running

Then, go to "**Results**" tab and click on the button "**View full table**" attached to the cognitive service just created.

	Port Services	Product Services		Sissing Values Services				
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		adiction in Post Time						
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	stimated Time of Departure Pr Vessel Ship Name PARIS EXPRESS	Voyage Code 1202300410	Port Vialencia	Teminal APM TERMINALS VALENCIA, S.A.	Regular Line HARAG - MD1 ALLIANCE	Status Operational	Arrival 2023/02/21 04:26	Departus 2023/02/23
	stimated Time of Departure Pr Vessel Ship Name PARIS EXPRESS METHONI	Voyaga Code 1202300410 1202300043	Porti Valencia Valencia	Reminal APM TERMINALS VALENCIA, S.A. CSP IEERAN VALENCIA TIMNAL SAU	Regular Line HARRG - MOT ALLIANCE MEDGULF MAERSK	Strikes Operational Operational	Arrival 2023/02/21 04:26 2023/02/21 02:51	Departu 2021/02/2 2023/03/22
	stimated Time of Departure Pr Vessi Ship Nami PARS EXPRESS METHON BURGUNOY	Voyaga Coda 1202300410 1202300043 1202300556	Port Valencia Valencia Valencia	Terminal APM TERMINALS VALENCIA, S.A. CSP IEERAN VALENCIA TAMAL SAU CSP IEERAN VALENCIA TAMAL SAU	Regular Line HARAG - MD1 ALLANCE MEDGULF MARKK CEMA CEM - BLACK SEA	Status © Operational © Operational © Operational	Arrival Arrival 2023/02/21 04:26 2023/02/21 02:51 2023/02/21 00:10	Departa 2023/02/21 2023/02/22 2023/02/22
	ttimated Time of Departure Pr Vessi Ship Name RAIS EXPRES METHONI BURGUNOY ALEXANDRA	Vojuga Code 1202300410 120230043 120230043 1202300556 1202300540	Port Valencia Valencia Valencia Valencia	Terminal Admitteminals Valencia, s.a. Cer Iternan Valencia Tainal Sau Cer Iternan Valencia Tainal Sau Cer Iternan Valencia Tainal Sau	Regular Line HARNIG - MOT ALLIANCE MEDGULF MARRIX CMA COM - BLACK SEA CMA COM - MEDCARIBE	Strins © Operational © Operational © Operational © Operational	At Verw Yar 1 Jake Arrival 2023/02/21 04:26 2023/02/21 06:31 2023/02/21 06:10 2023/02/21 06:10 2023/02/21 06:10	Departur 2023/02/21 2023/02/22 2023/02/22 2023/02/22
	Stimated Time of Departure Pr Vensil Skip Name PAUS EXPRES METHORS BURGUNOY ALEXANDRA KERRY	Voyage Cade 1222306410 122230043 122230043 1222300540 1222301540 1222301540	Port Valencia Valencia Valencia Valencia Valencia	Territor APM TERMINALS VALENCE, S.A. CEP IEEEAN VALENCE TAVALL SAU CEP IEEEAN VALENCE TAVALL SAU CEP IEEEAN VALENCE TAVALL SAU ELENCENEES MARTINAS S.A.	Regular Lines Halving - Mori ALLIANCE MILDOLUF MARTISK CMA COM - MELOCATION CMA COM - MELOCATION ERLLARIA SERVICO ROMAK MALMA	String © Operational © Operational © Operational © Operational © Operational	All Verey Fair 1 Julie Archval 2023/02/196/26 2023/02/196/26 2023/02/196/26 2023/02/196/26 2023/02/196/26 2023/02/196/26 2023/02/196/26	Departu 2023/02/23 2023/02/23 2023/02/21 2023/02/23 2023/02/23

Figure 94 - Predictive Process Monitoring Application: Results – Port Services

Finally, the results of the cognitive service are visualized. The data showed is a list of the real data extracted from the PCS Calls in Real Time, whereas the last column is calculated by the best predictive model trained in the cognitive service and represents the expected time of departure of a vessel as illustrated in the next picture:



🗗 DataPorts	PREDICTIVE PROCESS MONITORING APPLICATION			mbravo@vpf.com 🌎
≣ Services ⊕ Create	Port Services	Product Services	Missing Values Services	
🄹 Models	modi V	+≓ Import		
	Predictive Model Quality Level of prediction obtained by the best trained more	del for mutating missing values	Missing Districts Identification Information of the missing districts imputated	
	Mode	el Accuracy	Percentage of missing dist identified by the mode	ricts 21
	7	9.1	EBROENT (%)	
			and the state of the state of the state of the state	which we get all

Figure 95 - Predictive Process Monitoring Application: Results – Product Services

9.1.3 Sharing Verified Gross Mass

Before any weight request, the vehicle and the trailer should be registered in the "Vehicles" section.

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A Home										
Logistics	<	Vehicles								
©⊕ Administration	<	Enter search and so	ort criteria items: 10	0 ▼ 1-10 o	f 9287 🔍	> 🖓 Upda	te 🔗 Synchronize			
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Requests										
De Vehicles										
VIGIA	<	New Vehicle	e 🔊 Downloa	d Excel						
Masters	<	/ 🗖 👁 🖉 🚃 00	Registration 10DDC	• Type Truck	Weig 7,127 Kg	Tank 1,299 l	Registration company GESTRANS - A40549990	Road haulier TRANSESTE LOGÍSTICA, S. L	Remarks SALGAR, S.L.	
Messages	٢	/ 🗐 👁 🗷 🚃 00	Registration 61HZT	• Type Truck	Weig 7,248 Kg	🖹 Tank 1,500 l	Registration company GESTRANS - A40549990	Road haulier	Remarks BOXTRANS	
Access Options	<	/ 🖉 👁 🖉 🚃 00	Registration 78HDF	Type Truck	Weig 5,884 Kg	🖹 Tank 1,100 l	Registration company GESTRANS - A40549990	Road haulier		
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		<mark>/</mark> 膏の※ 🚃 01	Registration 15HZV	Type Truck	Weig 6,799 Kg	🕒 Tank 880 l	Registration company GESTRANS - A40549990	Road haulier	Remarks BOXTRANS	
		🥒 🔊 👕 🧪 📄	Registration 17FLL	Type Truck	Weig 7,436 Kg	🖹 Tank 1,400 l	Registration company GESTRANS - A40549990	Road haulier	Remarks Remarks	
		🥒 💿 🖉 🥒 🥒 🥒 🥒 🦉	Registration 35DVT	Type Truck	Weig 4,792 Kg	🖹 Tank 850 l	Registration company GESTRANS - A40549990	Road haulier		
		🖉 🗖 🗖 🖉 🦕 🖉	Registration 41KVC	Type Truck	Weig 7,567 Kg	🕄 Tank 1,160 l	Registration company GESTRANS - A40549990	Road haulier	Remarks ALX LOGISTICA	

Figure 96 – Registered vehicles

The "Request" section shows the list of VGM request and the current status.


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	> 🖉 🙆 🖉 🚊	Status WEIGHTED	Booking 2323	Request date 01/02/23	Loc.VGM 77258	Admit 1232	Shipping Line BORU - BORCHARD	LINES LIMI	Container 2312	2,323	Weighing date 01/02/23 15:21	
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Figure 97 – VGM requests list

By clicking to "New VGM request" a new request can be created.

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isages		shipment.totalGoods					
sages		container					

Figure 98 – Create new VGM request

9.1.4 Digital Consignment Note

In each of the shipments listed in the "Shipments" section there is a pdf icon which allows to generate the Digital Consignment Note with all the available data.

DataPorts



Figure 99 – Shipment list with the Digital Consignment Note button

Remitente (nombre, domicilio, pais) / Expediteur (nom, adresse, p	ays) / Sender (name, address,	37 Date transports ou	nda sorre	05)	07/2013) Este transporte	e queda ~	metido, no 🐟	lastr
[≜] country)		don a toda clivurula co Contrato de Trans Mercancias por Ca	traria, al orte inter retera (C)	Convenio nacional de MR.).	sobre el	Contrato de Tro E O.E. 07/07/2 DOCU	MENTO	al Convenio soli según la norm DM/2861/2012 DE CONTR	•
REF. REMITENTE: 2022325213		Ce transport est si clause contraire, à contrait de transpo merchandises par	amili, nor la Conver t internat route (CM	i obstant t vition relati konal de R).	oute ve au	This carriage is clause to the o Contract for the by road (CMR)	s subject, s contrary, to se internati	otwithstanding o the Conventio ional Carriage o	n on t f good
2Consignatario (nombre, domicilio, pais) / Destinataire (nom, adress address, country)	e, pays) / Consignee (name,	16 ^{Porteador (nombre, d} country)	amidilo, p	ais) / Trare	iporteur (rom, adresse, j	pays) / Ca	irrier (name, ad	dress,
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- ywys / rawn o seren y o'r ar yous (para, cunny) Valencia									
ADMITASE: VACÍO EN									
SOLICITADO PARA: PIN: aLugar y fecha de carga de la mercanda (lugar, país, fecha) / Lieu e	it date de la prise en charge de la	Dis Referencia transpo	tista				MATRI		
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CHONGQING JIANGBEI INT APT		El transportista no mercancía por exc incorrecto, siendo exceso de peso	se res eso de respon	ponsabi carga, sabilida	liza de mal ac d del c	los prejuic ondicionan argador as	ios sufr niento c sí como	ridos en la o embalaje las multas	por
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Figure 100 – Digital Consignment Note

9.2 PORT OF THESSALONIKI

9.2.1 Container pick-up

The functionality of the Container Pick-Up (CPU) application comprises three different frontends, which share common features: the shipping agent frontend, the port authority frontend and the trucking company frontend. All shipping agent and trucking company users automatically get the corresponding functionality in their frontends. Port authority users, on the other hand, are able to access the CPU functionality only if they have the coreor-user role. In order to access the functionality, all users must first login to the frontend. Once login has taken place, all CPU functionality is accessed through two items in the frontend's main menu: COREOR Requests and Booking Requests (orange rectangle in Figure 101).

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Figure 101 - COREOR Requests view

9.2.1.1 COREOR Requests menu

The COREOR Requests menu is visible to only shipping agent and port authority users. Selecting the COREOR Requests item shows a sortable and searchable table of COREOR requests in the main view (red rectangle in Figure 101). The table contains the most important COREOR attributes, like Registration Date, RequestID, Permit ID (if it has been issued), Status etc. Status is especially helpful, since, by looking at it, we can quickly have an understanding about the condition of the COREOR. The different statuses are: pending, rejected, accepted, booked, completed (see Table 59).

	COREOR	Booking
Pending	Waiting to be evaluated by the port	Waiting to be evaluated by the port
Accepted	Accepted by the port, but no booking exists for it	Accepted by the port

Rejected	Rejected by the port. No booking can be created for it	Rejected by the port. New booking must be created for COREOR
Booked	Accepted, with corresponding booking created	N/A
Completed	Corresponding booking has been completed	Designated truck has left the port with the container
Failed	N/A	The date of the booking has passed and the designated truck never came to the port

Table 59 - COREOR and Booking statuses explained

Clicking on a line in the table displays the selected COREOR's details in the main view.

There is also a button, specifically for shipping agents, for creating new COREOR requests (green rectangle in Figure 101). Port authority users do not see such a button.

Clicking on the "New COREOR Request" button presents the user with a form, which contains UI elemets (text fields, lists etc) for all fields present in a COREOR request. These are contained in two tabs named "Step 1" and "Step 2". The user needs to fill in the required information from both steps and click on "Submit". As soon as the new request is submitted, it is saved in the blockchain and also forwarded to the port's systems. It is worth noting that each COREOR contains the name of the trucking company charged with removing the container from the Port.

The significance of the "COREOR Requests" menu for shipping agents is that through it they can create new COREORs and view the status of previously created COREORs. The port authority, on the other hand, can view all COREORs created for it by all shipping agents dealing with the port. Accepting a COREOR is done through the port's systems and the COREOR application is notified through its API.

9.2.1.2 Booking Requests menu

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Figure 102 - Booking Requests view

The Booking Requests menu is available to the users of all the organisations involved, i.e. shipping agents, port authority and trucking companies (Figure 102). Shipping agents can use this menu to view the bookings made for their COREORs and thus be better informed about the progress of their COREOR request. Trucking companies can inspect their own bookings and their status. It is worth noting that the actual bookings are done using the TAS port system, however the COREOR frontend provides notification functionality to the trucking company user, as described in 9.2.1.3. Finally, port authority users can view all bookings made by all trucking companies. Accepting a booking, however, is done through the port's systems and the COREOR application is notified through its API.

Clicking on a row in the booking requests table switches the view to show its details. For a booking that has been accepted, "Booking details" tab contains the QR code necessary for the truck driver to enter the Port (Figure 103).



Figure 103 - QR code in accepted booking request

9.2.1.3 Notifications

The trucking company user receives notifications for accepted COREORs that refer to their company for removing the container from the Port. These notifications are shown on the bell icon in the upper right corner and also in the Notifications view accessible through the main menu (Figure 104). Such a notification prompts the trucking company user to enter a new booking through the TAS port system.

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	1017376239371481	7M3XA9VLHDF1WSK6	shippingAgent1	ThPA	5000	Fri Feb 24 2023 15:06:00 GMT+0200	accepted
	302710527576589100	UKZ1UY5LTD6SGE9	shippingAgent1	ThPA	334	Fri Feb 24 2023 14:04:00 GMT+0200	completed
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	219664377232144260	VAWHYJ1IN2MTESRP	shippingAgent1	ThPA	2121	Fri Feb 24 2023 13:55:00 GMT+0200	accepted
	488856756633110140	27T9A4O5CK1VNEMY	shippingAgent1	ThPA	2343	Fri Feb 24 2023 13:48:00 GMT+0200	accepted
	13897623616961008	5UWJQH1XSECD2Y06	shippingAgent1	ThPA	44	Fri Feb 24 2023 13:43:00 GMT+0200	accepted
	664710135500646700	FK8U1JTD3SXOH4EL	shippingAgent1	ThPA	22	Fri Feb 24 2023 13:36:00 GMT+0200	completed
	328703398895507000	FS8B3JOEV10TQNM6	shippingAgent1	ThPA	33	Fri Feb 24 2023 13:31:00 GMT+0200	accepted
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Figure 104 - Notifications for trucking company user

9.2.2 ThPA Analytics Applications

All analytics applications have been specifically created for the Port Authority. Therefore, they are available to only port authority users. However, access to analytics is restricted to only those port authority users that have the analytics-user role. In order to access the functionality, all such users must first login to the frontend. Once login has taken place, all analytics functionality is accessed through the Analytics menu item in the frontend's main menu (Figure 105).



Figure 105 - Analytics menu

9.2.2.1 Vessel visualization

In the "Vessel visualization" tab the user can see a scatterplot of vessels at the top left (largest panel in the screen), with a special icon per vessel; by clicking on a vessel, an information panel at the top right is presented, showing details for the selected vessel.

In addition, in the dashboard the user is able to see an area plot at the bottom left, showing the number of vessels at the port each day, four bar charts at the middle right, showing the number and average weight of vessels per vessel type and cargo type and an area plot at the bottom right, showing the distribution of the work time ratio, while a button "Select outliers" above the work time ratio plot is also available for the user.

In the vessel number per day plot (bottom left), the user can select with the mouse a date range, clicking at a point and dragging to the right or left. Consequently, the selected date range is highlighted on top of the area plot, while the rest of the plots are updated, presenting only the selected period. More specifically, the date limits of the main scatterplot (horizontal axis) are limited to the selected range, while the bar plots at the middle right and work time area plot at the bottom right, are updated to cover only vessels handled within the selected date range, as presented below.

If the user then moves the selected date range to the left or right, by clicking and dragging it with the mouse, the rest of the plot are updated accordingly. Finally, by clicking outside the selected date range, the previously selected date range is un-highlighted and the views of the scatterplot, bar charts and work time plot are reset to cover all available data.

Finally, as in the vessel number per day plot, in the work time ratio plot (bottom right), the user can select a horizontal range, by clicking with the mouse and dragging to the right or left, so that the selected value range is highlighted; consequently, the rest of the plots are updated based on the selected value range. For them to be restored, the user simply clicks outside the selected value range. In the work time ratio plot, the user may also utilize the "Select outliers" button above it, which highlights the range from 0 to 0.2, that is the idle vessels. The scatterplot and bar chart views are updated accordingly, to cover only the vessels with a work time ratio less than 0.2.

9.2.2.2 Prediction

Next to the Vessel visualization tab, the user can find the Prediction tab, where he can explore the vessel prediction capabilities of the platform.

By selecting the preferred date, the results table that contains all the ships in port in the selected date is presented, along with information like Ship Name, Ship Type, Cargo, Arrival, Mooring and Work. If then the user selects a vessel from the table, he is presented with the following screen.

Two tables are presented under the main one, with information about containers of the selected ship and another with the time predictions for three procedures in port. The left side table named "Containers", is filled with data on the number of empty and non-empty containers along with their cargo and weight, for the selected vessel. The table on the right side called 'Predictions for "Ship Name", contains time predictions for turnaround, mooring, and work procedures of the vessel in average with a min-max range, and an estimated date if the start date of the procedure is known, based on historical data of the vessel from past port calls. It must be noted that if a procedure in the selected date is already done, predictions will not take place.

Finally, when the user selects a tab number from the 'Containers' table to see the rest cargos of the vessel, the 'Container' table turns page with the rest information of the cargos.

9.2.2.3 Custom prediction

For the prediction of vessels, the user may also utilize the next tab, called "Custom prediction", where a form is displayed in the left side with eleven fields to be filled in and in the right side an empty table called 'Predictions', for the results to be presented.

The user can then fill the form data, with at least the predefined ones as necessary to proceed (those with an '*', 6 in total) and then clicks submit below the form. The predictions table is consequently filled with time predictions for the procedures of turnaround, mooring, and work procedures of the ship, in average with a min-max range, and an estimated date if the start date of the procedure is known.

Finally, when selecting the 'Clear' button below the form, the form is cleared. The custom prediction tab, is presented below.

9.2.2.4 Vehicle traffic

In the Analytics page, when the user clicks on the "vehicle traffic tab", is presented with the following screen.

The vehicle traffic tab, contains a map view (top left part) showing the positions of the port gates as circular marks, with embedded numbers of the total number of trucks that entered through each gate, a set of 7 bar charts showing the temporal patterns of truck arrivals (top right). There is one bar chart per day of week. Each bar chart shows the number of trucks entering the port through all gates at the considered time period and a timeline plot (bottom). In X-axis there are the days in this timeframe and in Y-axis there is the number of trucks where actually each day in port. Another capability the user has, is that by clicking on a node of the plot graph, which is a specific day, a red line is presented, depicting the prediction regarding the number of trucks that will be in the port in the next 10 days. A separate chart below shows this prediction line in more detail.

In the map view (top left), when the user clicks on one of the circular marks (gate positions), the bar charts (top right) are updated to show statistics for only the trucks that passed through the selected gate. In the case that the user wants to see both gates, he can then hold Ctrl and click on another of the circular marks.



9.2.2.5 Vehicle time at port

In the Analytics page, when the user selects the "Vehicle time at port" tab from the menu, he is presented with the following screen, depicting the number of vehicles parked in the port premises grouped, according to the duration of their stay.

Then, when the user selects month, day or hour, the vehicles for that given duration are presented. In addition, when selecting a time category bar, he is presented with a new graph under the main, presenting each type of vehicle i.e. car, motorcycle etc... that stayed in that period.

Finally, when the user selects the "no specific month/day/time chosen" button, the process is reset and the starting interface is presented.

9.2.2.6 Mobility

A visitor interested in visiting the port can access the DataPorts platform, the following screen is presented, containing dropdown options "mobility" and "traffic", and Covid-related statistics. The following visualizations are presented, updated in real-time, according to user input.

When selecting "mobility" dropdown option, two more clickable options appear, "Mobility monitoring" & "Mobility Statistics". When selecting the "Mobility monitoring" option, the user can see a map interface of mobility in Thessaloniki created with historical data. Visitor can choose to see mobility with absolute or relative numbers and is also capable of seeing COVID thresholds. By changing timeline slider, in graph of active users, visitor is able to see mobility per hour of day.

In the "Mobility statistics" option a new map interface of Thessaloniki shows up. Visitor can choose to see the map by average numbers or by COVID thresholds colours i.e. red = too much users, orange = medium mobility, green = safe places. Visitor can also choose month and day to see average mobility in bar plot, where he can also choose a specific hour to see in the map average mobility, for every cell individually, and decide whether or not visit a specific area.

9.2.2.7 Traffic

In the "Traffic" dropdown option, three more clickable options appear: "Traffic statistics", "travel times" and "parking spots". When selecting the "Traffic statistics" option the following screen is presented.

The user can then select through the month or day dropdown, to see the average traffic in the map and in a bar plot of 24 hours of day. If the visitor clicks a bar from the average users Bar Plot, he can see the average traffic for a specific hour of day into the map and decide whether or not to visit an area.

Through the "travel times" option, the visitor can select a route from a dropdown option and the selected path with red colour is presented and the average duration to traverse it, is presented in a bar plot. If then the visitor selects a month or day from the dropdown options, average travel time for every hour during the selected month and day is presented for the selected path.

Finally, in the "parking spots" option, the average number of visitors for the two parking lots that ThPA handles, for each day of the week and each hour of day, are presented. The user may choose from a dropdown menu, to see the parking lot he is interested in. The main chart shows visitors that stayed parked in the port's parking lots and the small chart under it, can be used to adjust the main chart for a better analysis, by cropping or moving it. The "parking spots" screen is presented below.

9.3 POSIDONIA MANAGEMENT

9.3.1 Access to the application

The first page that appears when a user accesses the application is the login window. The user will fill the user and password fields for being authenticated and the applications will grant the access and available functionalities depending on the user privileges and access rights.



Figure 106 – Posidonia Management login interface

9.3.2 Initial page

Once we login the main page of the application is shown. On top right we can find data about the user. On the left there is the main menu and, in the centre, there is the main work area.



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Figure 107 – Posidonia Management welcome page

9.3.3 Port call modification

For managing the Port Calls there is an option "Port Calls" in the main menu, that contains an option, called again "Port Calls" that opens the list of the Port Calls of the current year by default.



Figure 108 – List of Port Calls in Posidonia Management

For running the actions that will send the events to DataPorts, we can select a Port Call and we will find in the Actions drop-down list the Edit ETA and Edit ETD options.



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Figure 109 – Executing actions in Posidonia Management

The Change ETA action will ask for the user confirmation and if granted, open a pop-up dialog where a new ETA can be introduced. This new value must be a before date than the ETD date.

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·&	User destinations	02/03/2023 10:31	Water supply denied	n).	1	No
81	Subscriptions					
1	Notifications					

Figure 110 – ETA change assistant in Posidonia Management

Once the date has been set the action can be finished pressing the Accept button. A confirmation message will tell us that the actions has been completed. If there is an error or the action cannot be done, this window will show a message error.



TEST	★Bookmarks	\mathbf{X}
★ 番		
Administration		
EDI services		
Port Calls		Operation performed successfully
rt Calls		
lapping Port Calls		Return to Return to
t Calls search		list record
things		
hing search		
End Audit Berthings via AIS		
vents		
operations		
Call planning		
l suitability requests		
Services <		
eries MARPOL		
ess rules		
Goods/Passage		
Property Management		
Fishing		
Marina		
Quay space use		
Supplies		

Figure 111 – Action result feedback in Posidonia Management

9.4 POSIDONIA PCS

9.4.1 Access to the application

The first page that appears when a user accesses the application is the login window. The user will fill the user and password fields for being authenticated and the applications will grant the access and available functionalities depending on the user privileges and access rights.





Figure 112 – Posidonia PCS login interface

9.4.2 Initial page

Once we login the main page of the application is shown. On top right we can find data about the user. On the left there is the main menu and, in the centre, there is the main work area that shows the list of Port Calls.

								Port ca	alls				
e notification and Passenger List ime Health Statement	Group		Quick search	ETA from	ETA	to	Ship	Transfer per	nd. T	ransfered Status	Actions	All ports	✓ Autorefre
Shir's MANAGEMENT DANGEROUS GOODS ISTER TABLES MANAGEMENT PROFESSIONAL SERVICES	Number ©	Status C	Vessel © MILENIUMDOS		ETA ÷	E1 3 00:00 26	(01/2023 00:0	ATA ≎	ATD ‡	Status Accepted	message 🌣	Consignee © Consignaciones Buque SA	Lists status
SERVICIOS DIVERSOS	Pending	Requested	CIUDAD DE CEUTA		12/11/202	2 00:00 16	/11/2022 00:0	D		For gene	rating	Consignaciones Buque SA	
	ESALD202200013	Accepted	CIUDAD DE CEUTA		29/06/202	2 04:00 29	/06/2022 09:0	з		Accepted		Consignaciones Buque SA	I DS R H DM PE PS TE I
	ESALD202200012	Accepted	AVEIRO		28/06/202	2 18:00 29	/06/2022 18:0	5		Accepted		Consignaciones Buque SA	I DS R H DM PE PS TE I
	Pending	Rejected	AMBER		16/06/202	2 00:00 17	/06/2022 00:0	٥		Rejected		Consignaciones Buque SA	I DS R H DM FE FS TE I
	Pending	Pending (draft)	AMBER		16/06/202	2 00:00 17	/06/2022 00:0	D		For gene	rating	Consignaciones Buque SA	I DS R H DM FE FS TE I
	Pending	Pending (draft)	AMBER		16/06/202	2 00:00 17	/06/2022 00:0	D		For gene	rating	Consignaciones Buque SA	I DS R H DM FE FS TE I
	Pending	Pending (draft)	AMBER		16/06/202	2 00:00 17	/06/2022 00:0	D		For gene	rating	Consignaciones Buque SA	I DS R H DM PE PS TE I
	Pending	Rejected	AMBER		16/06/202	2 00:00 17	/06/2022 00:0	D		Rejected		Consignaciones Buque SA	I DS R H DM FE FS TE T
	ESALD202200011	Accepted	AVEIRO		15/06/202	2 00:00 16	/06/2022 00:0	D		Accepted		Consignaciones Buque SA	I DS R H DM FE FS TE
	ESPMI202200002	Approved	AVEIRO		01/01/202	2 00:00 04	/01/2022 00:0	D		Accepted		Consignaciones Buque SA	I DS R H DM PE PS TE
	Pending	Rejected	AVEIRO		15/12/202	1 14:00 29	/12/2021 14:2	D		Rejected		Consignaciones Buque SA	I DS R H DM PE PS TE 1
	ESPMI202100179	Accepted	AVEIRO		14/12/202	1 00:00 16	/12/2021 00:0	0		Accepted		Consignaciones Buque SA	
	ESALD202100046	Accepted	AVEIRO		10/12/202	1 00:00 20	/12/2021 00:0	0		Accepted		Consignaciones Buque SA	
	ESALD202100038	Cancelled	AMBER		23/09/202	1 20:00 24	/09/2021 22:0	0		For gene	rating	Consignaciones Buque SA	I DS R H DM PE PS TE 1
	ESALD202100045	Accepted	AVEIRO		22/09/202	1 00:00 26	/09/2021 20:0	0		Accepted		Consignaciones Bugue SA	
							6	Page 1 of	200	20		~	

Figure 113 – Port Calls list in Posidonia PCS

9.4.3 New Requests

If the user is a vessel consignee there will be enabled the functionalities for creating new requests. For the requests of supplies or other services, we have to look for the Professional Services entry in the main menu of the application. In this menu we will find different kind of resources to request, for example water and energy.

+					Wate	er and Ene	rav Supply		
PORT CALLS MANAGEMENT					Wate		rgy supply		
SHIPS MANAGEMENT	Group	~	Quick search		\bigcirc \bigcirc \checkmark	Actions -			All ports 🗸
STER TABLES MANAGEMENT	Port of call 2	Shin :	Requested dock	Request date =	Id Service :	Status :	Organisation :	Supply type :	
PROFESSIONAL SERVICES	ESALD202200021	AMBER	MUELLE DE RIBERA	15/02/2023 08:13	93	NOTIFIED	Consignaciones Bugue SA	Aqua	
upply	55 AL D 20 22 00000	A CAUDI	AMPLIACION M	14/02/2022 10/40	02	NOTIFIED	Considentiation Rule un SA	Agus	
and Energy Supply sied Surface	23420202300003		PONIENTE 2	14,02,2023 13,40	26	NOTITED	consignation to baque se	Ayuu	
Access			ALINEACION						
MASTER TABLES	ESALD202300008	MILENIUMDOS	MUELLE DE RIBERA	14/02/2023 15:40	91	NOTIFIED	Consignaciones Buque SA	Agua	
SERVICIOS DIVERSOS	ESALD202200021	AMBER	MUELLE DE RIBERA	13/02/2023 10:27	90	NOTIFIED	Consignaciones Buque SA	Agua	
	ESALD202300008	MILENIUMDOS	MUELLE DE RIBERA	10/02/2023 17:04	89	NOTIFIED	Consignaciones Buque SA	Agua	
	ESALD202300008	MILENIUMDOS	MUELLE DE RIBERA	10/02/2023 17:03	88	NOTIFIED	Consignaciones Buque SA	Agua	
	ESALD202300001	ADA D	PANTALAN REPSOL SA	10/02/2023 13:37	87	NOTIFIED	Consignaciones Buque SA	Agua	
	ESALD202300001	ADA D	PANTALAN REPSOL SA	09/02/2023 17:40	86	NOTIFIED	Consignaciones Buque SA	Agua	
	ESALD202300001	ADA D	PANTALAN REPSOL SA	09/02/2023 17:33	85	NOTIFIED	Consignaciones Buque SA	Agua	
	ESALD202300001	ADA D	PANTALAN REPSOL SA	09/02/2023 17:32	84	NOTIFIED	Consignaciones Buque SA	Aqua	
	FSAI D202300001	ADA D	PANTALAN REPSOL SA	08/02/2023 09:33	83	NOTIFIED	Consignaciones Buque SA	Aqua	
	ESAI D202300001	ADA D	PANTAI AN REPSOL SA	08/02/2023 09:10	82	NOTIFIED	Consignationes Buque SA	Aqua	
	ESALD202300008	MILENIUMDOS	MUELLE DE RIBERA	08/02/2023 08:54	81	NOTIFIED	Consignaciones Buque SA	Aqua	
	ESAL 0202300001	404 D	PANITAL AN PERSOL SA	08/02/2023 08:41	80	NOTIFIED	Continuational Buque SA	Aqua	
	E3ALD202500001	AUR D	PAINTALAIN REPOUL SA	00/02/2025 00/41		NOTIFIED	consignationes buque 3A	Agua	
	ESALD202300001	ADA D	MANTALAN REPSOL SA	08/02/2023 08:39	/9	NOTIFIED	Consignaciones Buque SA	Agua	
	ESALD202300009	A. GAUDI	AMPLIACION M. PONIENTE 2	08/02/2023 08:34	78	NOTIFIED	Consignaciones Buque SA	Agua	

Figure 114 – Water and energy request management in Posidonia PCS

In the table there is a list with all the existing requests. We can create a new one pressing the \oplus button on the top of the table. A new window will be shown.

Water And Energy Supply				× (6
			NOTIFICADA	
Data				
- Identifying Data				
Id Service	Status			
	NOTIFICADA			
Requested by	Organization			
consigbuqueall	R5220633A	Consignaciones Buque SA	х	
Request date	Register date			
17/02/2023 10:59	17/02/2023 10:59			
Port of call				
Port				
Alcúdia 🗸				
Port of call				
	* ×			
IMO	Ship	Entry date	Depart date	
Operation/dock zone	* 🛇			
Requested data				
Request of	Quantity (Tm/Kw)		Supply line	
vvater	V 00		Terrestre V	
Request start 17/02/2023 11:00	Request end		Requested time (h)	
Notes				
Notes				
			ĥ.	

Figure 115 – Requesting water in Posidonia PCS

In this form we will select the Port and Port Call we want to request a service for. Then we will fill the Request data section choosing the kind of resource and the amount. For finishing the request, we will press the save button (()) on the top right of the window.

Once the action is finished the list will be shown again and will contain the new request.

9.4.4 Request Management

If the user has the rights to manage the requests, new options will appear on the application. Navigating to the water and energy request list, we will be able to pick a request and authorise or deny it.

~					\\/ata	ar and Eng	arav Si	innly			
PORT CALLS MANAGEMENT					VValue		argy su	ирріу			
SHIPS MANAGEMENT	Consum		Facellah	N Carlon I						All as after	
DANGEROUS GOODS	Group		English	Quick search			YO AC	tions •		All ports	•
MASTER TABLES MANAGEMENT	Port of call ‡	Ship 🗧	Requested dock	Request date 🗘	Id Service 🗘	Status 🗘	Org: Re	egister	ly type 🌣		
PROFESSIONAL SERVICES	ESALD202300009		AMPLIACION M.				Cons Ca	ancel			
nu.srvmediosmecanicos			PONIENTE 2				Ca	onfirm			
ter and Energy Supply			ALINEACION				A	uthorize			
cupied Surface	ESALD202200021	AMBER	MUELLE DE RIBERA	15/02/2023 08:13	93	NOTIFIED	Cons	eny			
nu.srvplazagabarras	ESALD202300009	A. GAUDI	AMPLIACION M.	14/02/2023 19:40	92	NOTIFIED	Cons A	udit			
t Access			PONIENTE 2					uun			
MASTER TABLES			ALINEACION								
MENU.SERVICIOSCOMERCIALES	ESALD202300008	MILENIUMDOS	MUELLE DE RIBERA	14/02/2023 15:40	91	NOTIFIED	Consignac	iones Buque SA	Agua		
SUBSCRIPTIONS	FSAI D202200021	AMBER	MUELLE DE RIBERA	13/02/2023 10:27	90	NOTIFIED	Consignad	iones Buque SA	Aqua		
MENIIVIA											
MENULOBORRADOR.ROOT	ESALD202300008	MILENIUMDOS	MUELLE DE RIBERA	10/02/2023 17:04	89	NOTIFIED	Consignac	ciones Buque SA	Agua		
MENU.SERVICIOSBASICOS	ESALD202300008	MILENIUMDOS	MUELLE DE RIBERA	10/02/2023 17:03	88	NOTIFIED	Consignac	iones Buque SA	Agua		
SERVICIOS DIVERSOS	ESALD202300001	ADA D	PANTALAN REPSOL SA	10/02/2023 13:37	87	NOTIFIED	Consignad	iones Buque SA	Agua		
MERCANCÍAS/PASAJE	ESALD202300001	ADA D	PANTALAN REPSOL SA	09/02/2023 17:40	86	NOTIFIED	Consignad	iones Buque SA	Aqua		
	ESALD202300001	ADA D	PANTALAN REPSOL SA	09/02/2023 17:53	85	NOTIFIED	Consignac	tiones Buque SA	Agua		
	ESALD202300001	ADA D	PANTALAN REPSOL SA	09/02/2023 17:32	84	NOTIFIED	Consignac	tiones Buque SA	Agua		
	ESALD202300001	ADA D	PANTALAN REPSOL SA	08/02/2023 09:33	83	NOTIFIED	Consignac	iones Buque SA	Agua		
	ESALD202300001	ADA D	PANTALAN REPSOL SA	08/02/2023 09:10	82	NOTIFIED	Consignac	iones Buque SA	Agua		
	ESALD202300008	MILENIUMDOS	MUELLE DE RIBERA	08/02/2023 08:54	81	NOTIFIED	Consignad	iones Buque SA	Aqua		
								las art			

Figure 116 – Accept or deny requests in Posidonia PCS

Input and confirmation will be requested from the application in order to finish the action.





Figure 117 – Accept or deny requests detailed justification

9.5 POSIDONIA NOTIFICATIONS

9.5.1 Login

When a user accesses the application, the first required action before being able to use it is the authentication. So, in the first page the user will have to enter his authentication data to log. There is also have a button that can be select in case he wants to keep the session open:

Login	
Usuario	
Contraseña	
	<i>S</i>
Mantener sesión abierta	Iniciar sesión

Figure 118 – Posidonia Notifications login interface

9.5.2 Common actions

In the application you can find buttons that have common functionalities in different views of the application, to use them well we have to see their functionality.

To access the different views just select them from the respective side menu to the left:



Figure 119 – Posidonia Notifications welcome page

Each of these buttons performs the following functions:

- Actions: Here are indicated all the actions that we can perform to the elements of the table, in this case (subscriptions).
 - Disable/enable subscriptions: Allows us to activate or deactivate subscriptions, if a subscription is deactivated, the notification is not made.
 - Disable/enable the mute in the subscriptions: Mute as opposed to unmute if they will be done but you will not receive a notification of these.

Subscriptions

Subscriptions

Actions 🔺	₽ ~ ● 🔟 0	G	Filters 🛩	$ \pmb{T} \mid \pmb{v}_{i}$	47.1.*	Q- Search
ALL	FAVORITES	Topic		No. of destinatio	ons	# Muted
Q Search			No dat	a available in tab	ble	
Disable	☆					
5 Enable	Å.					
∮ Mute	ង					
Unmute	숩					
🖗 Audit						

Figure 120 – Posidonia Notifications common actions

• The following button will allow us to export to the indicated formats, the content of the table:



Figure 121 – Posidonia Notifications common tools

• The next button (new record) will allow us to create an element to the table.



Figure 122 – Posidonia Notifications create registry functionality

• The red trash can icon allows us to select which elements we want to delete.



Figure 123 – Posidonia Notifications delete registry functionality

• The next button is used to refresh the table, in case you have updated data.



Figure 124 – Posidonia Notifications refresh list functionality

• Filters: Here the saved filters will be shown, both those created by the user and those created by the system.

Filters 🔺	T (•	.4₹. I					
USER	SYSTEM						
Q Search							
Disabled hidden	fields are						

Figure 125 – Posidonia Notifications filters

• The next button on the left allows us to activate and deactivate the filters, and the drop-down menu allows us to create our own filters.



Figure 126 – Posidonia Notifications advanced filters

• The next pair of buttons are used to toggle and modify the sorting of the columns.

DataPorts

4₹ ()	^	■ 1 ×	Q- Search			
n	Sort					
9		Priority	~	Ascending	~	庯
		column	~	Ascending	~	Ē
	+ A	dd Column				_
	Res	et			A	pply

Figure 127 – Posidonia Notifications list sorting

• The last pair of buttons allow us to hide or show columns of the table, as well as to save our column configurations.



Figure 128 – Posidonia Notifications column selection

• Finally, we have a search bar that allows us to search among the various elements, as well as a drop-down that allows us to select on which columns to search.



Figure 129 – Posidonia Notifications quick search

9.5.3 User Destinations

It allows us to create destinations where the notifications will arrive, if we select the add button, we can create a new element for the table.

Us	er destinations										
ι	Jser des	tinatio	ons								
	Actions 🗸	B • ~	€	💼 C	Filters 🗸	T •	47 1 👻	⊞ ▼	Q- Search		
	Channel			Destination	÷ Dest	tination descript	ion			Priority	
					No da	ta available in ta	ble				



Figure 130 - User destinations list

Once here we have to fill in the mandatory data (marked with a red *) and click on save to create a new element.

User destination configuration	
Channel *	Destination *
Email	▼ test@example.com
User destination description	Priority
Example destination	1

Figure 131 – Creating a new user destination

Once the element is saved it will appear in the table (In case the table has not been updated we can always use the refresh button).

User dest	User destinations											
Actions 🖌	₽, ~ ⊕	C	Filters 🛩	▼ ! • IF ! • ■ ! •	Q - Search							
Channel		Destination		Destination description	Priority							
Email		test@example.com		Example destination	1							

Figure 132 – List after creating a new user destination

9.5.4 Subscriptions

If we select in the side panel subscriptions, we will go to the subscriptions view where we will be able to create, activate/deactivate, mute/unmute, delete our subscriptions.

To create a subscription just click on the add button.

Subscriptions											
Subscriptions											
-											
Actions 🗸 🖹 🗸		en Filters 🗸	T 1 *	47.1.*		Q					
Time created	† Topic	No. of destin	ations			4 Muted					
No data available in table											

Figure 133 – List of user subscriptions

In this view we will have to fill in the necessary data to create a subscription.

In the filters section we can indicate at which level we want the subscription.

If we select organization level, we will receive all the notifications of events that have taken place in our organization (port authority in this pilot), if we select division, we will receive all the notifications that happened in the same division of the user (port in this pilot). Stakeholder will create notifications only if our user is sent as part of the input event.



 Subscription 			
Subscription configuration			
Topic *			
Change of ETA	~		
Muted Disabled			
Filters			
Available		Selected	
Q Search		Q Search	
# Division	+	∷ All	×
II Organization	+		
# Stakeholder	+		
Add all			1 item selected Empty

Figure 134 – Creating a new subscription

We also set the destinations where the notifications will arrive.

Destin	ations		
			Channel *
:	test@example.c	×	Email 👻
			Destination
			test@example.com
Add	Destination		

Figure 135 – Adding destinations to a subscription

Once all required fields have been filled in, we can proceed to save the subscription.

Subscriptions Subscriptions								
Actions 🗸 🕒 😧 💼 C	Disabled fields are hidden	Filters 🗸		▼ 1. • 4₹1. •	(Ⅲ) ↓ ★	Q,- ETA		
Time created	Торіс		N	lo. of destinations			Muted	
16/02/2023 15:32	Change of ETA		1	1			No	

Figure 136 – Result of creating a subscription

9.5.5 Notification

If we select notifications in the side menu, we can access the view that shows us all the notifications of the subscriptions we have.



Notifications	ions					
Actions 🗸	₽· · C		Filters 🗸 🛛 🕇	4≣ I ¥ ⊞ I ¥	Q-	
Created	🕴 Торіс	Message	Channel	Destination	Notification status	
			No data availab	ole in table		

Figure 137 – List of user notifications

If a notification arrives at any level (according to the test subscription that has been created above) it will be displayed here, like this:

Notifications	;										
Actions 🗸 📑	~	C		Filters 🗸	\mathbf{T}	• 4	t v		Q- Search		
Created	÷	Topic ϕ	Message			Channel		Destination		Notification status	
16/02/2023 15:52		Change of ETA	The ETA	has been changed		Email		test@example.c	om	Sent	

Figure 138 – List of user notifications after receiving the first one

10 ANNEX B: CHANGE LOGS

10.1 CPU

Change ID	Description
CPU.1	The blockchain has been deployed in ThPA.
CPU.2	The COREOR application has been deployed in ThPA.
CPU.3	The application now POSTs a COREOR request to the ThPA backend API.
CPU.4	The application now receives COREOR acceptance/rejection through a POST call.
CPU.5	The application now receives booking requests through an POST call.
CPU.6	The application now receives booking acceptance/rejection through a POST call.
CPU.7	The application now receives truck departures through a POST call.

Table 60 – THPA CPU changelog

10.2 THPA ANALYTICS

Change ID	Description
CPU.1	The analytics applications have been deployed in ThPA.
CPU.2	Analytics now receive their respective datasets through the DAV component.
CPU.3	ThPA statistics and Queues Predictions are now available through the same authentication-based frontend used in the COREOR use case.
CPU.4	Passenger and COVID statistics are now available through a publicly available webpage.

Table 61 – THPA Analytics changelog

10.3 TOS

Change ID	Description
TOS.1	Created endpoint to accept new COREOR request XML.
TOS.2	Created functionality to send COREOR permit ID to CPU application.
TOS.3	Created functionality to send COREOR request rejection to CPU application.
TOS.4	Created functionality to send new booking request to CPU application.
TOS.5	Created functionality to send acceptance for new booking to CPU application.
TOS.6	Created functionality to send booking rejection to CPU application.

DataPorts

TOS.7

Created functionality to send truck departure info to CPU application.

Table 62 – THPA TOS changelog

10.4 POSIDONIA PCS

Change ID	Description
PCS.1	Created the functionality to send a POST request to an API on demand.
PCS.2	The application sends events on Water Supply requests changes.
PCS.3	The application sends events on Electricity Supply requests changes.
PCS.4	The application sends events on Port Access requests changes.
PCS.5	The application sends events on Waste Removal requests changes.
PCS.6	The application sends events on Surface requests changes.

Table 63 – Posidonia PCS changelog

10.5 POSIDONIA MANAGEMENT

Change ID	Description
MNG.1	Created the functionality to send a POST request to an API on demand.
MNG.2	The application sends events when a visit/port call starts or ends.
MNG.3	The application sends events when the ETA or ETD of a visit changes.
MNG.4	The application sends events when the cargo manifest has been activated.
MNG.5	The application sends events when a visit to port has been authorized.

Table 64 – Posidonia Management changelog

10.6 POSIDONIA OPERATIONS

Change ID	Description
OPE.1	The application can read data from AISHUB.

Table 65 – Posidonia Operations changelog