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D3.4 - Use cases and scenarios manual v2

Deliverable No.	D3.4	**Due Date**	15/03/2019
Type	Report	**Dissemination Level**	Public
Version	2.0	**Status**	Final
Description	Definition of use cases and different scenarios to deploy the PIXEL proposal. Every use-case definition will be accompanied by documentation devoted to gather every regulatory aspect related to the ports regarding the scope of the project, especially those referring to the pilots. Final version updating deliverable D3.3		
Work Package	WP3		

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19-Dic-2018	0.2	Added schedule of the chapters to be updated or included
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22.Feb-2019	0.5	Use cases for GPMB and ASPM (partial reviews and comments)
27-Feb-2019	0.6	Use cases for PPA and ThPA (partial reviews and comments)
05-Mar-2019	0.7	Global merges and updated document for final review
14-Mar-2019	0.8	Final review for last comments and changes
15-Mar-2019	2.0	Final release

Key Data

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Abstract

Use cases and scenarios definition play a **vital role** when dealing with large projects in order to clarify, identify and categorize **requirements** and **system functionalities**. They are intended to describe **systems**, **roles** and **interactions** from different perspectives, so that end users may understand the high-level view whereas technicians will also be able to interpret the details and extract the needed requirements.

In PIXEL we have identified four use cases to be mapped to 4 pilot ports within the Consortium:

- **Energy management**: characterization of energy needs within the ports to better plan and manage port activities and adequately dimension the introduction of (green) renewable energy. This use case will be applied in the **Port of Bordeaux**.
- **Intermodal transport**: development of different algorithms to monitor and simulate traffic according to certain policies to reduce congestion, specially between ports and inland ports. This use case will be applied in the **Port of Monfalcone** and **SDAG**.
- **Port-city integration**: implementation of sustainable and environmental friendly measures regarding transport demand between port and nearby city. This use case will be applied in the two Greek ports: The **Port of Piraeus** and the **Port of Thessaloniki**. The first one is focussed on passengers whereas the second one on goods/containers.
- **Port Environmental Index (PEI)**: generation of one single environmental metric that summarizes the environmental impact. It is a **transversal** use case to be implemented on all the four pilot ports.

This document describes the **use cases port by port**, not by topic, in order to better identify and list available resources (sensors, services and systems) and constraints per each port. Note that they even define different scenarios for the same topic (e.g. port-city integration in the Greek ports) and it is more practical to follow this strategy, as it will later serve as valuable input for the pilots (WP7). Also specific KPIs for each pilot port have been identified.

This document is an **update to the deliverable D3.3** including detailed information on several aspects that could not be provided before. They required additional work that was carried out in the following months after the submission of D3.3. Major updates relate to the regulatory and technical context, detailed description of the use cases as well as the specific scenarios for each use case.

Regarding the **technological context**, the updates are:

- **Sensors and existing sensors**: identification of available sensors and sensor networks to be connected to the PIXEL platform. Furthermore, any future system to be installed in ports was also identified (e.g. port of Monfalcone).
- **ICT systems**: identification of available systems in ports to connect with the PIXEL platform. Deployed systems in ports are another information source to be considered and integrated in PIXEL. It is important to identify the current status and the gap towards fully IoT platforms.
- **Data availability**: identification of all data sources and types to be connected to the PIXEL platform

As can be observed, previous updates had as main goal to clarify what is currently available in ports in order to feed the PIXEL platform. Thus, it has a direct impact on WP4 (modelling needs, expectations, processes involved) and WP6 (architecture, data acquisition layer and PIXEL information hub). A specific technical meeting of the PIXEL Consortium took place in order to handle such aspects properly (Bordeaux, November 2018).

Regarding the **regulatory context**, and in-depth analysis was performed in order to (i) identify all European, national and local regulations affecting the scope of the project and (ii) detect specific national and/or local regulations from each port that had to be addressed. Other deliverables dealing with regulatory context (e.g. D3.1) will link to this document for further reading.

Regarding the **use cases**, the updates are summarized the following:

- **KPIs**: the performance indicators from each port (port KPIs) have been re-evaluated again in order to identify realistic and practical indicators that can be really measured. A general list of KPIs (General

KPIs) was already identified in the proposal but small changes have been particularized for each port according to their needs.

- **Specific actions**: ports have provided specific user stories in order to highlight the most relevant processes to be included or improved according to their internal strategy. Such user stories have been worked out (mainly) by technical partners to furnish clarifying scenarios able to feed WP4 and WP6.
- **Actors and interactions**: as extension of the previous (clarifying) task, it is important to identify all relevant involved actors and the type of interaction they need to perform (within PIXEL related activities) to achieve a particular goal.
- **Use-case constraints**: the smooth execution of all identified interactions is based on a set of preconditions that the PIXEL platform assumes from the existing infrastructure. Furthermore, some constraints can also be applied internally to PIXEL to differentiate PIXEL subsystems and interactions.
- **Sequence diagrams for scenarios definition**: a common (visual) methodology has been followed to formulate the different scenarios from the user stories. The methodology includes the sequence diagram showing the interaction between entities (actors, system components), and summary table identifying: (i) the involved WPs responsible for the realization of the scenario, and (ii) the specific objectives targeted by each scenario.

Both regulatory context and use cases updates will serve for the **complete identification** of legal and technical **requirements** that are handled as task within WP3.

Regarding the use case work plan, an initial design was drafted in order to start aligning the realization of each use case with the requirements discussed in the deliverable D3.2, the technical achievements in the project as well as the necessary logistics requirements from each port, and finally the business and product development in the context of PIXEL's exploitation, that will be available in the deliverable D7.7.

Statement of originality

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List of acronyms

Acronym	Explanation
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
AP+	Cargo Community System connected to the VIGIEsip PCS and used in Port of Bordeaux
API	Application Programming Interface
ARPA	Regional Agency for the Environmental Protection in Emilia-Romagna Region
ASPM	Azienda Speziale Porto di Monfalcone
AQS	Air Quality Station
BTEX	Benzene, toluene, and the three xylene isomers
ERP	Enterprise Resource Planning
ESPO	European Sea Ports Organisation
FVG	Friuli Venezia Giulia Region
GCS	Gate Control System
GHG	GreenHouse Gases
GPMB	Grand Port Maritime de Bordeaux - Port of Bordeaux
HMI	Human-Machine Interface
HRM	Human Resources Management
ISO	International Organization for Standardization
ITU	International Telecommunications Union
KPI	Key Performance Indicator
LAeq	Leq (equivalent continuous sound level) is the preferred method to describe sound levels. It is measured in dBA. LAeq is commonly used to measure noise levels using the A-weighting setting built into all sound level meters. It is measured in dB.
LNG	Liquefied Natural Gas, alternative fuel for vessels with very low SOx and NOx emissions
MB	Megabyte
MC	Mobility Case (PPA Mobility Case)
N-NW	North-Northwest
NOMEports	Noise Management in European Ports
NTUA	National Technical University of Athens
OT	Operational Tools
PC	Personal Computer
PCS	Port Community System
PERS	Port Environmental Review System

pH	Logarithmic scale used to specify the acidity or basicity of an aqueous solution
PIXEL	Port IoT for Environmental Leverage
PM_{10}	Particulate Matter 10um
PMIS	Port Management Information System
PPA	Piraeus Port Authority SA
RO-LA	Rollenden-Landstrassen – „rolling road“
RoRo	Roll On-Roll Off
SEC	Safe and Efficient Cargo
SILI	Sistema Informativo Logistico Integrato (Integrated Logistic Informated System), a system provided by Regione Friuli Venezia Giulia and managed by Insiel to monitor and authorize entries to the Ports of Monfalcone and Trieste; it also monitors dangerous goods flows along the regional motorway network
ThPA	Thessaloniki Port Authority
TEN-T	Trans-European Transport Networks
TMC	Traffic Management Centre
TOS	Terminal Operating System
VHF	Very High Frequency – band of radio spectrum
WP	Work Package
XML	eXtensible Markup Language

1. About this document

This deliverable aims to provide a final detailed description of the use-cases that form part of the project. PIXEL is very use-case centred, considering the needs of the ports as well as their expectations as a substantial part of its nature. In this document, all considerations of the ports (global situation, the problems they are facing, available data and infrastructure) are depicted, establishing a complete development lever for further technical work packages of the project.

This document (as the final update of D3.3) is one of the pillars of the PIXEL project because it will set the basis of the technical work packages. Indeed, it will feed the works carried out on WP4 "Modelling, process analysis and predictive algorithms", WP5 "Port Environmental Index Development", WP6 "Enabling ICT Infrastructure Framework" and WP8 "Assessment and expansion plan".

1.1. Rationale of the deliverable

D3.4 is the second version of the specifications of the use cases. At this stage of the project, D3.4 extends and completes D3.3 by providing a fully functional specification of the use cases with a *common structure*. The level of detail of the description of the use cases is complete so that the related work packages can end with the information provided in this deliverable.

This document is released after the ninth-month of execution of the project. PIXEL stakeholders, who own use-cases within the work plan, worked under a common structure to provide the following information to the Consortium:

- **Context conditions of the use-case**: the main information regarding the port, traffic, geographical situation, relevant conditions affecting PIXEL execution and its regulatory context.
- **Technical context**: identification of the systems already available at the ports, the data which are currently collected and processed, software and hardware capacity plus sensors.
- **Description of the use-case**: what are the ports expecting from the project, what are they contributing for, how is it aligned with the whole consortium and objectives, and the global flavour of the use-case.
- **Scenarios**: definition of scenarios that compose the use-case.

These items of information will allow the technical work packages (WP4, WP5, WP6 and WP8) to continue working on their tasks with a detailed complete set of input parameters.

This deliverable, as a final version, contains all necessary level of detail to generate final requirements (WP3), design the necessary models (WP4), draft the architecture (WP6) and integrate and evaluate the generated pilots (WP7 and WP8). For example, the relevant port processes will be described thanks to UML diagrams. Moreover, the interfaces between local IT systems and PIXEL will be specified, too.

1.2. Deliverable context

The following table summarizes some of the objectives targeted in PIXEL and how they are mainly addressed by the involved ports. Note that not all details are described here and not all ports (GPMB, ASPM, PPA, ThPA) are equally involved in all objectives.

Table 1. Deliverable context

Keywords	Description
Objectives	*Objective 1: Enable the IoT-based connection of port resources, transport agents and city sensor networks* The PCS of GPMB (VIGIEsip) will send port's call data to PIXEL. Data coming from port's sensors (energy consumption, weather station…) will

	also be sent to PIXEL. Some city data (such as PM_{10} or $PM_{2.5}$ measurements) should also be integrated. Concerning FVG, PIXEL ICT based communication infrastructure will be integrated with SILI and sensor data to allow port entrance and transport planning. PPA will integrate air quality, meteorological and public transport data registered by devices, sensors and systems to PIXEL. Concerning ThPA, data from Port IT systems, stations, sensors and devices will be integrated to the PIXEL system. Furthermore, this system will also merge data from port users and Traffic Management Centre of the city. *Objective 2: Achieve an automatic aggregation, homogenization and semantic annotation of multi-source heterogeneous data from different internal and external actors* This objective is not addressed by a single use-case but is enveloped as a transversal use-case itself. In this deliverable, all ports provide useful information (environmental activities currently performed, tentative relevant indicators, related regulation plus sensor and measures availability) that will feed WP6 to develop the data acquisition layer and PIXEL hub. Finally, in WP7, the architecture components will be deployed in all ports, demonstrating feasibility and value of the product. *Objective 3: Develop an operational management dashboard to enable a quicker, more accurate and in-depth knowledge of port operations* The PIXEL dashboard is intended to serve as a frontend to a series of services. In order to facilitate easy integration with current systems in ports, a web interface will be considered as well as a REST API for both frontend and backend integration. Therefore, current services in ports may decide the process to follow. GPMB: The PCS of Port of Bordeaux (VIGIEsip) will integrate the developed dashboard providing a GUI to the main port's stakeholders. PPA: The PPA PMIS will integrate the developed dashboard providing a GUI to the main port's stakeholders. ThPA: The port and port's main stakeholders can see the operational data in a user friendly, easy to understand dashboard. Selected results could be presented to the citizens. Monfalcone: will integrate the dashboard to monitor congestion and trigger rerouting actions. *Objective 4: Model and simulate port-operations processes for automated optimisation* GPMB: The processes of loading and unloading goods in port of Bordeaux will be modelled. FVG: The processes of automated re-routing of trucks entering Port of Monfalcone in the case of congestion will be modelled. PPA: Port mobility management operations will be simulated to test their environmental impact in pursuit of finding optimal resource consumption. ThPA: The incoming and outgoing flows of trucks as well as the. loading/unloading operations of bulk and handling cargo will be modelled.

	Objective 5: Develop predictive algorithms GPMB, ThPA: This deliverable will contribute to identify the different inputs and outputs of predictive algorithms for ports operations (GPMB) and transportation operations (ThPA). FVG: Predictive algorithms will be developed to plan entries to the Port of Monfalcone and inland-ports connections avoiding congestions and reducing pollution. *Objective 6: Develop a methodology for quantifying, validating, interpreting and integrating all environmental impacts of port activities into a single metric called the Port Environmental Index (PEI)* This objective is enveloped as a transversal use-case itself. In this deliverable, all ports provide useful information (environmental activities currently performed, tentative relevant indicators, related regulation plus sensor and measures availability) that will feed WP5 to develop the PEI. Finally, in WP7, the PEI technology and methodology will be deployed in all ports, demonstrating feasibility and value of the product.
Exploitable results	There are no exploitable results from the work reported at this deliverable. Nevertheless, its content is highly relevant for the exploitation of PIXEL.
Work plan	This deliverable integrates the final works done in T3.2 and T3.3. It is a crucial document because it will feed WP4, WP5, WP6, WP7 and WP8. It also takes in consideration the market assessment of T3.1 and contributes to the project's innovation in WP9.
Milestones	MS2 and MS3
Deliverables	Detected inputs: • D3.1: Stakeholders and market analysis report: This deliverable presents the relevant stakeholders and current trends in ports, so that the described use cases and scenarios are connected to real situations in ports. • D3.3: Use cases and scenarios manual v1: D3.4 extends and completes the previous version (D3.3) with more detailed information on the target use cases and scenarios. It also establishes better links with other WPs. Detected outputs: • D3.2: PIXEL requirements analysis: Use cases and scenarios serve as the main common input for identifying requirements. • D4.1/D4.2 PIXEL models v1/ v2: D3.4 identifies available data and modelling tools which will be used for the description plus model implementation, reflected in D4.1 and D4.2. • D4.3 Predictive Algorithms v1: D3.4 describes the scenarios which will highlight the desired data to be predicted for an enhanced operation at ports. • D5.1 Environmental factors and mapping to pilots: D3.4 identifies all environmental related data available at ports in order to generate a proper input for the computation of the PEI.

	• D6.3 PIXEL data acquisition, information hub and data representation v1: D3.4 identifies all available data which has to be integrated in the PIXEL platform for later process. • D7.1 Integration Report v1: The description of use cases, scenarios and user stories serves as input to identify the components of the architecture that must be integrated in each port, as well as the data available in each port. • D8.1 Evaluation Plan: The description of use cases, scenarios and user stories, together with the KPIs identified, establishes the foundations for the final evaluation to be reflected in the evaluation plan. • D9.6 Identification of key stakeholders in the port-city ecosystem, in the context of PIXEL's exploitable outcomes. • D9.7 Preliminary identification of expected IPR items and first analysis of their potential market impact based on the collected requirements.
Risks	This deliverable includes the analysis of the existing ICT systems and the data they are able to transmit to the PIXEL platform. This contributes to the clearance of risk n°8 "Requirements fail to align with ICT systems". Risk nº11 "*[..] different pilot ports will have different types of data, or the same type of data measured with different methods […]*" has also been considered while working on T3.3, as huge differences among data format and availability have been addressed. Finally, risk nº13 "*Lack of attention to international laws and regulation, specially related to environment […]*" is also overcome in this deliverable as a thorough regulation review has been carried out under task T3.2.

2. Introduction

With more than 10 billion tonnes of global goods transported by sea, ports are logistics hubs that are essential for the development of each country. So, it is important for them to evolve and improve their performance according to the possibilities offered by the new technologies.

Since the 1990s, ports have been equipped with computer tools, programs, sensors and various other technologies to optimise their logistical, industrial, environmental and societal performance ratios. However, ports still have plenty of information not exploited to their highest degree of effectiveness. The PIXEL project aims to consolidate, process, exploit and optimize all of these data in order to increase the effectiveness and efficiency of port operations by responding to the challenges and issues they face.

Because maritime ports concentrate, in direct link to their transport activities, logistics and industrial activities and interact with urban territories, they need to engage ambitious policies and strategies to become “ports of the future” by lowering the environmental impacts of their activity and by targeting environmental excellence.

This document explains the current situation of the four ports involved in PIXEL: Bordeaux, Monfalcone, Piraeus and Thessaloniki, and their commitment to develop and contribute to shape “Ports of the Future” concepts through use-cases. According to the topic description of the ‘Port of the Future’ call, 12 important challenges have to be faced or considered, as reflected in Table 2. Some of them are common and typically mandatory for all ports, if they are considered a critical infrastructure in their locations (e.g. challenges 1 and 2). Others, on the contrary, may be subject for specific consideration (and prioritization) hinging on each particular port and its overall strategy.

Table 2. Challenges and contributions addressed by the PIXEL ports

<table>
<tr><th rowspan="2">Port of the Future challenges</th><th colspan="4">Challenges/contributions addressed by the ports</th></tr>
<tr><th>Bordeaux</th><th>Monfalcone</th><th>Piraeus</th><th>Thessaloniki</th></tr>
<tr><td>1. Ports are a major example of hubs' need for modernisation. Ports are essential for the European economy as a global player and for the internal market</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>2. They are a main catalyst for regional development. Consequently, their optimisation and inclusion in the territory is fundamental to ensure that efficient operations will not affect negatively the surrounding areas, including city-port relations and the smart urban development of port cities</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td rowspan="4">3. Specific issues (like dredging, emission reductions, and energy transition, including electrification, smart grids, port-city interface plus the use of renewables management and emissions) are combined with other challenges common to all multi-modal terminals</td><td>Port-city interface</td><td>Port-city interface</td><td>Port-city interface</td><td>Port-city interface</td></tr>
<tr><td>Energy transition</td><td></td><td></td><td>Energy transition (long-term)</td></tr>
<tr><td></td><td>Pollutant emissions monitoring</td><td></td><td>Pollutant emissions monitoring</td></tr>
<tr><td>LNG dredge</td><td></td><td></td><td></td></tr>
<tr><td>4. Re-engineering of port operational processes via process analysis and identification of interoperable ICT systems to improve the level of integration among all actors (Port Authorities, terminal operators, shipping companies, customs, city authorities, etc.) and facilitate critical decision-making</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>5. Sustainable maintenance, repair and reconfiguration</td><td>partially</td><td>partially</td><td>partially</td><td>partially</td></tr>
</table>

Port of the Future challenges	Challenges/contributions addressed by the ports			
	Bordeaux	Monfalcone	Piraeus	Thessaloniki
6. Better capacity management with reduced costs and land use		X	X	X
7. Identification of real-time indicators to improve the quality of services provided	X	X	X	X
8. Low environmental impact, climate change adaptation and mitigation, moving towards the circular economy	X	X	X	X
9. Advanced and efficient links and integration in the socio-economic industrial and urban surrounding environment (supporting the smart urban development of port cities)	X	X	X	X
10. Efficient connections with the hinterland transport network contributing to an increased use of the most energy-efficient transport modes, in particular rail		X	X	
11. Inland waterways and short sea shipping ports remains under-utilised and are not fully integrated in the multimodal European Transport system[1]	X			
12. Consider the possible transferability of solutions to other ports, measuring scalability potential	X	X	X	X

The previous table might be updated later on in the project in collaboration with the CSA, once the final constellation of opportunities, challenges and risks of Ports of the Future was depicted

All the ports will integrate existing systems (such as TOS, PCS) and devices (sensors) within the PIXEL solution. This will bring a broader repository than vertical IT systems and a calculation power able to boost data real-time analysis as well as in more long-term trends. Thanks to this comprehensive collection of data, PIXEL will grant added value to ports in different fields of activity such as transportation optimization and energy transition. More concretely, each of the four PIXEL ports has identified a main area (use case) to work on:

- The Port of Bordeaux will explore the opportunity to produce renewable energies to fulfil the port operations' needs.
- The Port of Monfalcone will aim to increase the efficiency of port-hinterland connections in order to improve port accessibility and transport planning.
- The Port of Piraeus will focus on the port city integration by implementing sustainable, cost-effective and environmentally-friendly measures regarding transport demand around the port area, and mobility.
- The Port of Thessaloniki will work on the interoperability between city and port regarding freight traffic to optimise the traffic and reducing pollution.

This does not mean that ports will have isolated use cases; on the contrary, it will allow to test and check that the PIXEL solution and the tools provided are able to address different use cases. In fact, a cross-domain use case is also envisioned in PIXEL affecting the four ports. This is related to the Port Environmental Index (PEI) performed mainly within WP5.

In order to have a clear view of the scope targeted by PIXEL in terms of use cases and pilot ports, a summary table (see Table 3) is provided in order to highlight the mapping. Only the PEI is considered as a transversal use case, as it is expected as one of the most innovative aspects in PIXEL and therefore it should be tested in all four pilot ports.

[1] Moving freight by Water: Sustainable Infrastructure and Innovative Vessels, Topic MG-2-6-2019 H2020 programme.

Table 3. Mapping between use cases and pilot ports

	Energy Management use case	Intermodal Transport use case	Port-City Integration use case	Port Environmental Index
Grand Port Maritime of Bordeaux	X			X
Port of Monfalcone/SDAG		X		X
Port of Piraeus			X	X
Port of Thessaloniki			X	X

3. Common repository

The rationale behind a common repository is to deploy on a certain place all relevant information regarding each port, serving as main source of knowledge for technical developments. Here we may find questionnaires, KPIs, list of available sensors, etc. This data will increase throughout the project.

3.1. Questionnaires

In order to provide relevant inputs to WP4 (Modelling, process analysis and predictive algorithms) and to WP5 (Port Environmental Index Development), dedicated questionnaires were established to collect the current situation of each port:

- **environmental maturity of the port (WP5)**
- **modelling and data analysis (WP4)**

In appendix A of this document, final versions of the filled questionnaires are attached.

3.2. KPIs

A set of common KPIs to describe and appoint the different use-cases has been identified. It should be enhanced throughout the project with future tasks (e.g. WP5 and especially the task T5.2 "KPI Definition").

Table 4. KPIs for description of use-cases

Impact	KPI	Description
Reduction of impact on climate change and the environment due to port activities	Greenhouse gases (GHG) emission / carbon footprint	Total CO2 emissions of the port in a year
	Fine particles emission (NOx, SOx…)	Emissions of internal combustion engines and dredging activities
	Rate of renewable energy in the energy mix of the port	Renewable energy sources with respect to total energy consumption
	Green Marine Indicator (existing environmental indicator)	1-5 scale indicating how port authorities encourage their tenants and users to improve their environmental performance
	PEI adoption	Does the port measure, calculate and publish the PEI?
	PEI improvement	PEI score improvement compared to the first measurement
Reduction of operational and infrastructural costs	Electricity consumption of the port authority	Total electric power consumed due to port activities in a year
Local adoption of PIXEL solution	Local IoT platform implementation	Has the port set up a local IoT platform?
	Number of sensors / devices connected to the local IoT platform	Measure the dissemination of the technology
	Number of types of data (sensors) connected to the local IoT platform	Measure the diversity of data collection
	Number of end-users	Number of partners accessing PIXEL data

For each applicable KPI, the ports have set a reference value defined by their current situation. Each use case will describe the actions that will be performed to improve these KPIs. Some local KPIs can also be added such as "electricity consumption of the port area (Bassens)" for GPMB.

4. Use case of GPMB

4.1. Main changes from the previous version

The purpose in this deliverable relates to providing useful and clear descriptions of the use cases and scenarios. Therefore, most of the contextual information of GPMB has been completed/updated and shifted to Annex B in order to better focus on the use case and involved scenarios. The current deliverable springs from user stories to develop the scenarios and identifies actors and interactions.

4.2. Challenges for GPMB and PIXEL contribution

GPMB needs to align with the development of its territory and especially of Bordeaux Metropolis. It has identified four main challenges for its future, as described below. Getting more physical and operational data from port activities and port environment to take better decisions is definitely one of the paths that GPMB has chosen to face these challenges. Using PIXEL's IoT and big data platform, GPMB will be able to monitor, to analyse and then to improve several key port processes. For example, GPMB can pinpoint its energy needs/uses and the impact of the provided services on consumption.

In order to measure the environmental efficiency of the port processes and to improve the acceptance of port activities, GPMB would like to adopt a systematic procedure of measuring the environmental impact proposed by PIXEL’s PEI (Port Environment Index).

4.2.1. A safer port

To get a safer port, GPMB is developing a 3D model of the Estuary of Gironde ((Laborie, 2013 and 2018, Huybrechts)) to anticipate its evolution and to provide real-time guiding tools. To feed the model and the related software tools, GPMB needs to acquire more physical data from the river.

Although the performance of the sensors networks developed by GPMB is very much appreciated, their conception is old-fashioned and does not rely on new technical standards (for instance, a dedicated VHF communication protocol was implemented to replace the lack of 3G/4G network around the Estuary). Furthermore, the energy consumption and the price of those PC are high making the densification of measuring devices along the Estuary difficult and expensive. Another aspect relates to the potential exploitation of past gathered data with computing power.

In summary, safety is improved by the incorporation of (i) cost-effective sensor platforms and (ii) computing facilities and tools to exploit the information gathered from the devices. PIXEL will provide **a more affordable IoT platform** to boost the knowledge of port’s operations by widening the use of new physical sensors and by taking profit from the power of cloud calculations; it seems therefore a good candidate solution for this challenge.

4.2.2. A greener more cost-attractive port

GPMB is convinced that the electricity price will be an advantage to attract new activities in the port area. Instead of depending on the market price of electricity, GPMB aims to leverage on the potential of photovoltaic electricity and on self-consumption. But the investments are high, the return on investment (ROI) is difficult to achieve and the capability of the GPMB electric network must be assessed. PIXEL will provide energy models to analyse, for example, **local energy needs during the call of a ship** in order to cope with **renewable energy production**; it seems therefore a good candidate solution for this challenge.

4.2.3. A more citizen-friendly port

Although GPMB has spent several millions euros to reduce its environmental impact (mitigations, innovative LNG dredge purchase), citizens are neither aware nor have an idea of how righteous GPMB is compared to other ports. There are no relevant indicators to show to the citizens the strong commitment of GPMB to strongly reduce the environmental impacts of its activities.

An ISO 14001 approach only proves that a port has environmental procedures and wants to improve itself continuously. But it does not measure its environmental impact. Undoubtedly, implementing the **PEI** within the scope of PIXEL will help GPMB to assess and communicate the **environmental impact** and its decrease due to the investments and actions undertaken.

4.2.4. A wiser investor port

Comprehensive analysis on the different traffic trends are very difficult to get. Decision tools to feed port policies are missing. Some recent investments have failed to reach their objectives in a short term point of view.

GPMB has stored in its database at least 20 years of traffic data but it has no methodology and no computation power to analyse the traffic trends and the future logistics needs. PIXEL will provide **predictive algorithms based on past data to grant better insights concerning major traffic long-term trends** for investment decisions, so it is a great candidate solution for this challenge.

4.3. Main objectives and expected impact

4.3.1. Objectives of the use case

The objectives of the use case of GPMB are four-fold and can be easily disseminated to other ports:

1. To improve the access to IoT devices and big data calculations to increase the number of physical measurements in ports. This includes **setting up an (open) IoT platform** and connecting existing and new sensors.
2. To raise awareness and to provide decision tools about port operations and port development thanks to the integration of PIXEL components (advanced port statistics analysis) to PCS (Port Community Systems) and to "big data calculations". This implies **developing an API** (Application Programming Interface) **between VIGIEsip and PIXEL** in order to exchange data in standardized formats. Some PIXEL components could be integrated into VIGIEsip to give an appropriate end-user experience.
3. To develop a methodology to assess the opportunity to supply local renewable energies to the port's customers at a competitive price. This will include the design of simulation algorithms for:
    a. estimating the **real-time quantity of energy consumed during port operations** depending on the type of cargos and vessels, and to size the electricity network needed in the port area to encourage self-consumption
    b. estimating **port traffic evolution**
4. To measure the green policy outcomes of a port (for instance, LNG dredge, energy efficiency actions, comprehensive environmental and energy transition strategy) thanks to **PEI**.

Figure 1 depicts an overview of the GPMB use case.

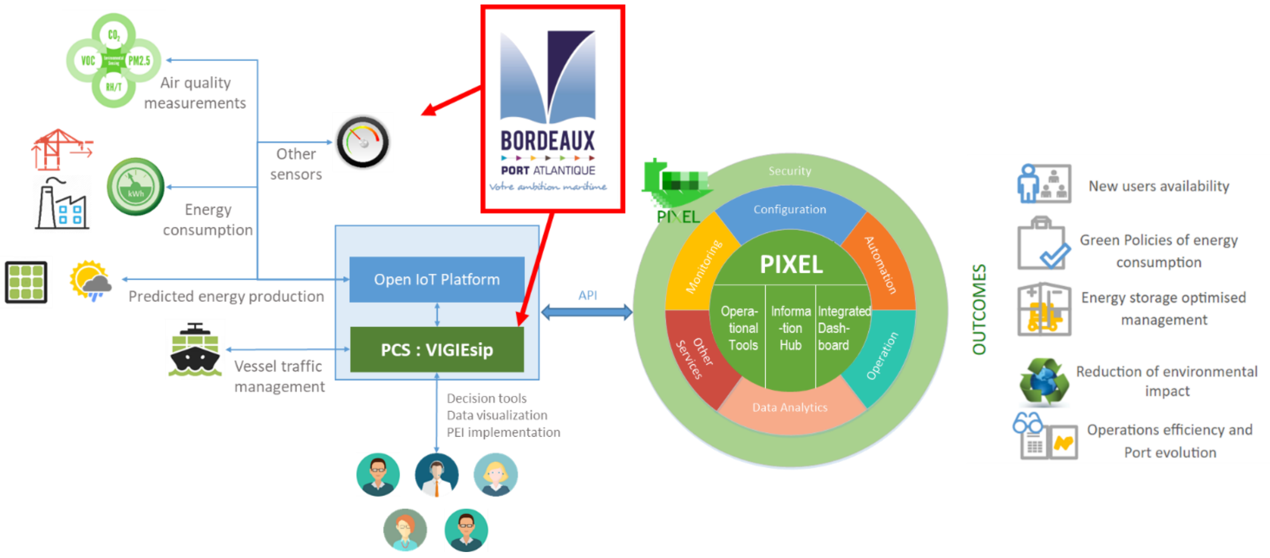

Figure 1. Port of Bordeaux use-case overview

4.3.2. Expected impacts and KPIs

The expected impacts from the GPMB use-case are four-fold:

1. To answer the question: how renewable energy could be produced and used in the port?
2. To answer the question: how can PCS bring more knowledge to citizens and port consumers?
    - GPMB has data in its PCS that is being used for operational things, but are not shared to other relevant port agents nor the city. Clearly, it could be used for citizen plus customer awareness, letting them know the port environmental impact, thanks to the PEI. This would mean: **democratizing port operational information**.
    - During the last years, it has been noted that ports own vast amounts of administrative information that is not being leveraged for optimizing port operations. This use-case in PIXEL would be a very good opportunity to share data **for optimizing port operation among different actors**. Hence, the approach needed would be different: how to handle that operational information and migrate it to a data source that has to do with port secure relations within its scope.
    - Furthermore, the use case of GPMB shall demonstrate that Port Community Systems are not only regulatory tools. They are also communication tools enabling people working in a port to share information and data in order to improve operations efficiency in a collaborative way.
3. Outstanding technological output. GPMB use-case will offer to PIXEL a very good environment, with no limits to integrate every piece of information. The PIXEL solution will be here leveraged as **a powerful integrator** (of very diverse types of data) as well. The key point is to enable the integration of PIXEL functionalities and data into VIGIEsip, allowing further developments such as a screen with the energy prediction that will be consumed during the next period.
4. Providing capacity to check if ports can, by using renewable energies, be actors on the EU strategy of reducing emissions and environmental impact on transportation.

GPMB also expects several relevant impacts related to deploying PEI in the transversal PIXEL use-case:

1. By contributing to better investment decisions thanks to PEI, simulations and high level analysis, PIXEL would help GPMB to become a more efficient contributor to the development of the Atlantic Corridor. PIXEL sets the foundations for port development in all those domains: higher rate of

renewable energy, more affordable energy, more predictable activities, less maintenance costs, new digital services, all highlighted by a PEI.

2. Thanks to the availability of PEI, GPMB can strengthen its energy transition strategy and contribute to better citizen-port relationships in order to raise the acceptance of port industrial activities

Considering the previous points above, GPMB could be spotted in a clear position with regards to the global impacts of PIXEL. In the following table the 4 impacts identified in the proposal are listed. The goal is to centre how GPMB's use-case will contribute to each one of them. The scale ranges from 0 to 3, being 0 non-relevant for the use-case and 3 the maximum impact.

Impact identified in the proposal	**GPMB use-case**
Climate change and environment	3
Operational and infrastructural costs	2
Logistics efficiency	0
Port-city relations/integration	2 to 3

Thus, it can be summarised, about impacts addressed, that GPMB is clearly focused on environment (energy, mostly) and port-city relations:

a) **Climate change and environment**: Less energy demand, and less energy surpluses.
b) **Operational and infrastructural costs:** Diminishing the infrastructural cost thanks to a cheaper electricity price and to a lower cost of ownership of sensors (less energy consumption, less maintenance costs by deployment of an IoT network with cost-effective sensors and gateways…). It refers both to CAPEX (infrastructure costs) and OPEX (infrastructure maintenance and operation cost). CAPEX because when GPMB wants to add a new tidal sensor there is a need to adapt the VHF communication protocols and update the "firmware" of each motherboard we are using. OPEX thanks to less energy consumption and less bugs.
c) **Logistics efficiency:** Not applicable for this port.
d) **Port-city relations/integration:** The electricity to be used in the port will be green, so the image towards the citizens, and the actual impact created to the nearby area will be decreased**.** The other environmental-friendly actions will also be promoted like the LNG dredge or the sediment management plan. This relates only to promotion but not modelling as commented in deliverable D4.1.

On the other hand, regarding the KPIs expected to reach within PIXEL in this use-case, is worth to mention that the following figures (see Table 5) are only a rough estimation considering that the PIXEL consortium is still in month 9 of the project. Data has been extrapolated from the original established goals (GA KPIs) and adjusted to current reality. The impacts have been more detailed textually, but the final figures are still being evaluated by the port teams.

Table 5. Use case KPIs for GPMB

IMPACT	KPI	Current Value	Expected impact
Reduction of impact on climate change and the environment of port activities	Integration to an existing program concerning the quality of life of citizens (this includes GHG and fine particles emissions)	No	GPMB will be a member of the "High Quality of Life"[2] program of Bordeaux Metropolis.
	Rate of renewable energy in the energy mix of the port in Bassens	0%	30% (if solar panels are finally installed, otherwise simulation tools will be used)
	PEI adoption	No	Yes
	PEI improvement	PEI indicators must be initialized with the implementation of Green Marine Program, especially "Environmental leadership"	GPMB's actions regarding reduction of impacts of port activities will naturally improve its PEI. Environmental leadership (Green Marine Indicator) : 3 to 5
Reduction of operational and infrastructural costs	Electricity consumption of the port authority concerning sensors	To be measured at the beginning of the implementation of the use-case of port of Bordeaux	-30%
Local adoption of PIXEL solution	Local IoT platform implementation	No	Yes
	Number of sensors / devices connected to the local IoT platform	0	10-30
	Number of types of data (sensors) connected to the local IoT platform	0	5 (tidal level, energy consumption, weather, wind speed, air quality) –mainly for recording purposes (see D4.1)
	Number of end-users	0	20-50 in a first stage
	Number of port operations modelled	0	At least 5 handling operations processes
	Number of API developed between VIGIEsip and PIXEL	0	At least, the following API: Ship calls forecast, Ships characteristics, Ship calls in a period, Energy consumption, Sensors measurements (including weather station), Computation requests

[2] https://participation.bordeaux-metropole.fr/sites/default/files/bordeaux_metropole/bm_strategie_dd_deliberation_7juil2017_annexe.pdf

4.4. User stories and scenarios

In order to provide a more detailed view of expected specific actions for the general GPMB use-case in the different port operations a set of user stories have been drafted for a better identification of targets and requirements. It involves 7 different roles or actors, as depicted in Table 6. From each actor, one or more scenarios will be described as a sequence diagram. Each scenario has an ID so that it can be better referenced at requirement analysis phase (task T3.4)

Table 6. User stories for GPMB

As a/an	I want to …	So that …
Statistics manager	Analyse the structure and periodicity of ships calls from the internal database including notions of time of call, goods, tonnages, berth, etc…	I could estimate the average call time of a targeted piece of goods taking into account the berth and potential seasonality
	Be able to update this database annually by adding ships calls of the past year	I could anticipate the possible evolution inherent to a given piece of goods
Energy manager[3]	Evaluate/Quantify the energy consumption of each logistic chain model by measuring the consumption of each element related to loading/unloading considering technical features	I could determine the relative share of each energy in the targeted logistic model and identify the potentially interesting elements for renewable energy injection
	Be able to update this database at any time by adding/substituting/erasing components	I could obtain the most reliable data
	Obtain an average value of energy consumption for each element whose actual data would not be available based on technical characteristics of the machines	I could substitute a missing item by an average value
	Link the results calculated before, namely: ships call data analysis and energy consumption of the logistics chains	I could determine the energy consumption of any ship that has called to Bordeaux in the past and estimate the likely energy consumption of future ships whatever their goods.
	Analyse the distribution structure of electrical energy on Bassens from sensors available on the entire terminal	I could study from a data collection platform the consumption structure of all or part of a targeted area in order to distribute the adequate proportion of electricity according to needs.
	Measure the real conditions of sunshine from a weather station located in the port in Bassens	I could evaluate precisely the amount of solar energy produced and adapt the need of conventional electricity. I could accurately determine the handling downtime due to rain or wind type situations, too.
IT manager	Reduce the cost of ownership of connected sensors in the port and simplify the addition of new sensors	I can multiply the number of connected sensors in the port area to raise the knowledge on the evolution of the environment and on ports operations

[3] This is new job to create in GPMB

As a/an	I want to …	So that …
	Have more calculation power (thanks to cloud computing)	I can get more useful data analysis and provide optimisation solutions
Environmental manager	Promote my actions done for the protection of the environment and for the mitigation of port activities	The port-city relationships and acceptance of port activities could improve
Port manager	Estimate if the investment in solar panels on the rooftops of the port's warehouses is valuable	I can decide whether to invest or not
	Assess the relevance to add new functionalities in PCS (Port Community Systems) such as port environmental index, outcomes of cloud computation…	I can define an appropriate roadmap for VIGIEsip
Software editor	Assess the relevance to add new functionalities in PCS (Port Community Systems) such as port environmental index, outcomes of cloud computation	I can define an appropriate roadmap for VIGIEsip
Port agent/operator	Master my energies consumptions	I can save money by optimising these consumptions
	Buy cheaper green electricity	I can save money and contribute to actions for climate change

4.4.1. Statistics manager scenario (GPMB-StM-1)

The scenario overview (as sequence diagram) is depicted in Figure 2. It mainly refers to a datamining scenario, which currently does not exist in GMPB premises. The flow is as follows:

- VIGIEsip (GPMB's PCS) sends information about the ship calls which is stored in the PIXEL hub. This communication will use appropriate data formats to send port's traffic statistics, expected port calls and sensors data to the PIXEL platform. These formats can rely on existing formats (XML files used between VIGIEsip and AP+). A beta version of VIGIEsip integrating data form PIXEL will be released and be assessed by the project group. If VIGIEsip is not able to integrate directly with the PIXEL, then the PIXEL Acquisition Layer will be introduced.
- Through the Operational Tools (OT) in PIXEL (models and predictive analysis), all these pieces of information are processed in order to estimate average call time depending on various input parameters (see D4.1 for more details). For example, the loading/unloading rate is not the same for a similar piece of goods on a wharf (for instance grains) especially due to crane or conveyor belt used. Seasonality is also important. For the same goods, ships are bigger depending on harvest season. Information in the database owned by GPMB should allow to identify these parameters.
- The result of the process is then stored internally for later access. The Statistics Manager (SM) has then two possible options:
  A) Directly access VIGIEsip to get the information (AverageCallTime1). VIGIEsip will integrate requesting the API provided by the OT.
  B) Access the PIXEL dashboard as standalone service (AverageCallTime2). Here the dashboard, previously customized by the SM to access the OT API, presents the information in a graphical view.

If there are any past data available, it can be also integrated in the PIXEL hub through its API.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1,2,3
EU Legal framework to be considered	SafeSeaNet , European maritime single window environment, Port Reception Facilities, Transport regulation, EU data protection rules

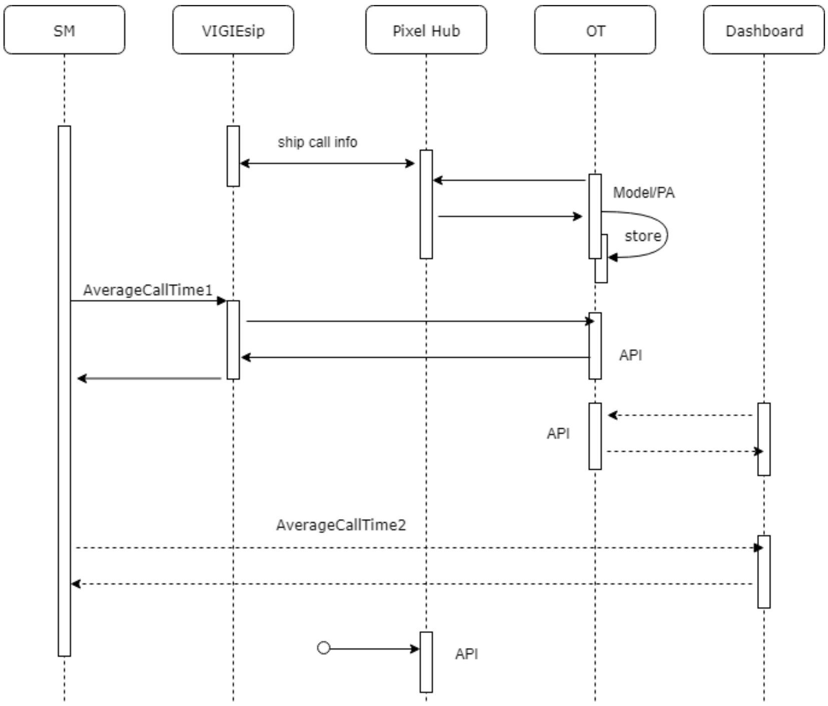

Figure 2. Statistics manager at GPMB. Sequence diagram

4.4.2. Energy manager scenario (GPMB-EM-1)

Thanks to the knowledge of port's operations processes and to the data collected, modelling, simulations and predictive algorithms will be created in order to assess the opportunity to invest in photovoltaic rooftops and in the improvement of the port electricity network and especially in energy storage.

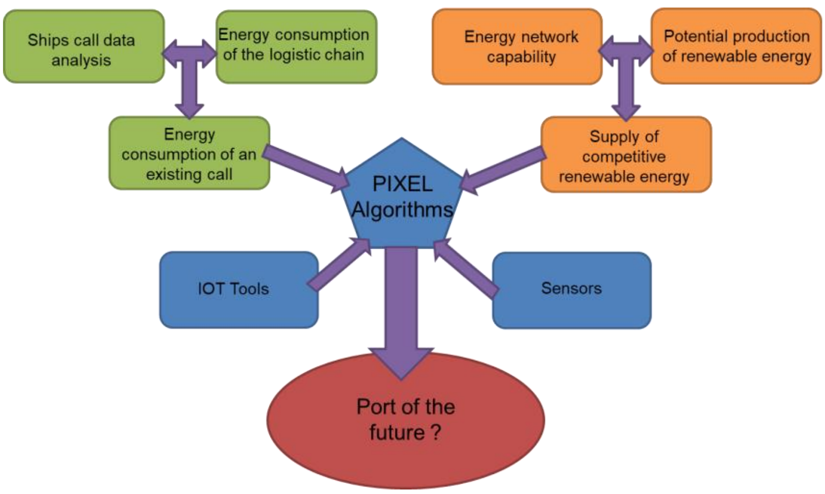

Figure 3. PIXEL algorithms from GPMB use-case point of view

The scenario overview (as sequence diagram) is depicted in Figure 4. It mainly refers to an energy modelling scenario, which currently does not exist in GMPB premises.

GPMB plans to take advantage of the electricity consumption available, machine specification, and other contextual information to simulate and optimise the balance between energy produced /energy consumed / energy to be bought / energy to be provided.

Starting with the ideal port, WP4 team will leverage all data available to get as close as possible to it, then to perform the modelling and simulation.

It is planned that simulation will be able to predict, at least: (i) energy consumption related to ships operations and involved logistics chain, and (ii) energy to cover consumption needs of the port (how much green energy the port could provide and anticipate how much will be needed). To be included in this modelling:

- Lighting
- Buildings near the area of loading/unloading ships
- Consumption of different engines of machinery when loading/unloading cargo to/from vessels
- Reefers consumption
- Weather and other contextual information

The consumption planning will be done based on these values. Next, to apply this modelling to other ports or use-cases only the values and pieces of the process should be changed, and the model should automatically adapt to a particular case.

The component that provides extra value on simulation allows to know how the traffic will change, and evaluate if PIXEL will still be able to model this change and act consequently.

Therefore, the flow for GPMB-EM-1 scenario is as follows:

- An energy model has already been configured and is able to evaluate the energy consumption of each logistic chain; it may have input data but it may also potentially interact with the PIXEL hub for any necessary (additional) data, if any. The logistic chain processes identified: (i) Import/Export of liquid bulk, (ii) Import/Export of containers, (iii) Import of handled solid bulk, (iv) Export of handled solid bulk, (v) Import/Export of non-handled solid bulk. They are described with more detail in Annex B.
- The energy model may run periodically and stores the data internally.
- As every model is encapsulated as a service within the Operational Tools, the results are accessed from external components through its API. So the energy manager (EM) interacts with VIGIEsip to get the data, which will somehow act as proxy invoking the API of the OT. Finally, the role of PIXEL on this regard will be to perform all the calculations and simulations plus provide status and results (through PIXEL Operational Tools). A report based on the results of the algorithms will be released to advice GPMB on its future investment decision, linking with GPMB-PM-1.
- The results may be retrieved by logistic chain or by item, supported by the API. The API should also support editing the model in case something changes. For example, whenever a crane is changed for a better one that consumes less energy (or an existing diesel-based is replaced with an electric one), so that the consumption on the logistics chain evolves. The model should be able to work with real-time and past data; in maritime operations usually/most of the time ships are supposed to transport the same kind of goods (or intermodal units), so they will stay at the same logistics chain. In addition, this data processing will allow other features such as predicting the energy consumption of a vessel that has never called at GPMB by considering related parameters (e.g. size of the vessel) with tonnage and goods in particular. These extrapolations and analyses will enable determining in advance a reliable range of energy consumption.
- Once again, as optional approach, the results may be presented through the dashboard (specially dedicated for graphical results) and VIGIEsip may potentially embed the dashboard. Or just let the EM interact directly with the dashboard.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1,2,3
EU Legal framework to be considered	Alternative Fuels, Transport regulation, European maritime single window environment, EU data protection rules

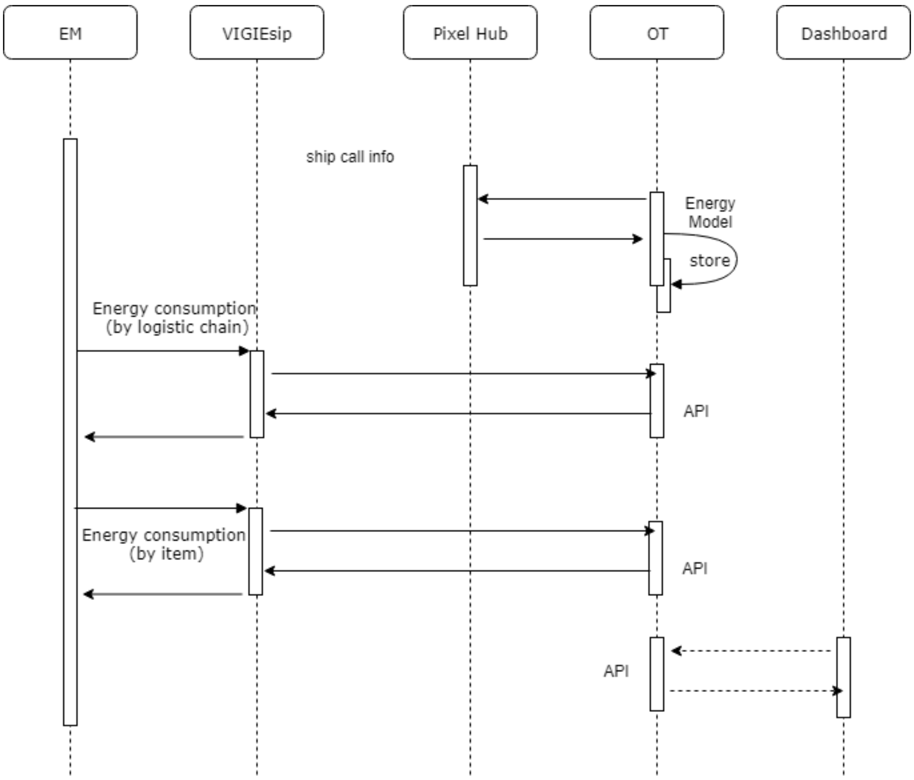

Figure 4. Energy Manager at GPMB (I). Sequence diagram

4.4.3. Energy manager scenario (GPMB-EM-2)

The scenario overview (as sequence diagram) is depicted in Figure 5. It mainly refers to two basic energy models derived from the acquisition of data arriving from existing in GPMB premises. The flow is as follows:

- Some smart meters are already deployed in GPMB premises, but the data has not yet been analysed. In this sense, several new sensors will be acquired apart from the existing ones (see Annex B).
- A weather station will be purchased in order to allow the calculation of the theoretical quantity of photovoltaic electricity that the port's warehouses rooftops shall produce. The weather station will be also used to measure very precisely the periods where rain falls in order to bring precious data to cereals operators. The simulation tools will be able to get historical data from them and also set comparisons with measured data. This is also in line with energy models described in deliverable D4.1.
- Those smart meters will be integrated into PIXEL through the Data acquisition layer, which will send the data to the PIXEL hub for proper storage
- An energy model has already been configured to process the stored data and is able to analyse the distribution structure of electrical energy in Bassens.
- The energy model may run periodically and stores the data internally.

- As every model is encapsulated as a service within the Operational Tools, the results are accessed from external components through its API. So the energy manager (EM) interacts with VIGIEsip to get the data, which will somehow act as proxy invoking the API of the OT.
- An analogous process applies for the integration of any additional sensor to be processed (in this scenario a weather station). As the data and analysis differs, a new model has to be created. The model may potentially use existing available online weather services.
- Once again, as optional approach, the results may be presented through the dashboard (specially dedicated for graphical results) and VIGIEsip may potentially embed the dashboard. Or just let the EM interact directly with the dashboard.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (Data Acquisition Layer, PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1,2,3
EU Legal framework to be considered	Alternative Fuels, Transport regulation, European maritime single window environment**,** EU data protection rules

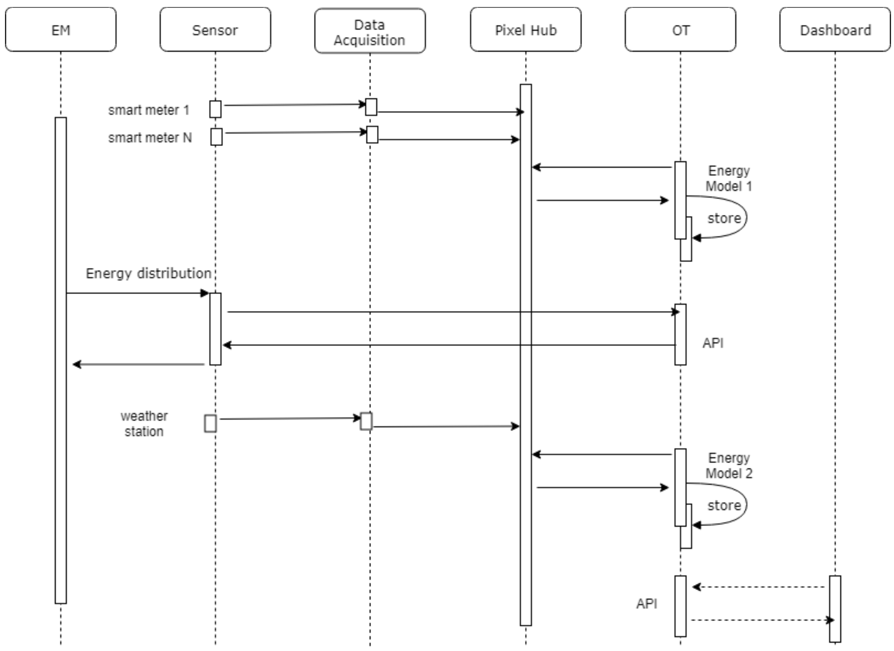

Figure 5. Energy Manager at GPMB (II). Sequence diagram

4.4.4. IT manager scenario (GPMB-IT-1)

The scenario overview (as sequence diagram) is depicted in Figure 6. It mainly refers to IoT Big Data integration and the corresponding benefits in terms of cost and cloud computation. The flow is as follows:

- Some sensors are already deployed at GPMB premises. However, the cost of connectivity is one-to-one which does not scale in terms of cost and maintenance. In this sense, it is planned to bring new communication functionalities to old sensors. Instead of changing tide level sensors, new communication abilities (with new standards such as LTEM-5G) will be added, and it will be much more useful to follow this approach:
  - In order to connect a few old-fashioned sensors (without any communication stack but serial connection) to the PIXEL IoT-like platform, GPMB will guide CATIE and ORANGE to find

on the market a more modern "PC". This new device must reduce strongly the overall costs of connected sensors: less energy consumption, very cheap, very adaptive (every kind of sensor should be plugged in) and able to send data via standard protocols and via ports means of communication (VHF). This will be done in the context of WP6 and WP7 work packages.
  - Enabling the modern transmission of data to IoT platforms by old sensors thanks to cheap equipment should be a key element for spreading the use of PIXEL in ports.
- Sensors in a nearby area will be aggregated by means of an IoT gateway, which will form part of the PIXEL data acquisition layer. The IoT gateway will then communicate with the PIXEL hub for proper storage (or any other management action). As an end-user, GPMB expects to exploit this gateway ("sensor IoT connector") and to use it for replacing the current PC dedicated to these means.
- The PIXEL hub is deployed in a cloud infrastructure and the same applies for the Operational Tools. Any process deployed here (e.g. model, predictive algorithm, etc.) can potentially scale with endless computation power.
- The IT manager will invoke the computation through VIGIEsip, for example, which in turn invokes a standard API. The cloud infrastructure will scale automatically in order to cope with big data analysis, if needed, without impact on VIGIEsip, which will seamlessly perceive more computation power.
- Once again, as optional approach (not represented in Figure 6), the results may be presented through the dashboard (specially dedicated for graphical results) and VIGIEsip may potentially embed the dashboard. Or just let the IT interact directly with the dashboard (not represented in Figure 6).

Links with other WPs	WP6 (PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1,2
EU Legal framework to be considered	Alternative Fuels, Transport regulation, European maritime single window environment**,** EU data protection rules

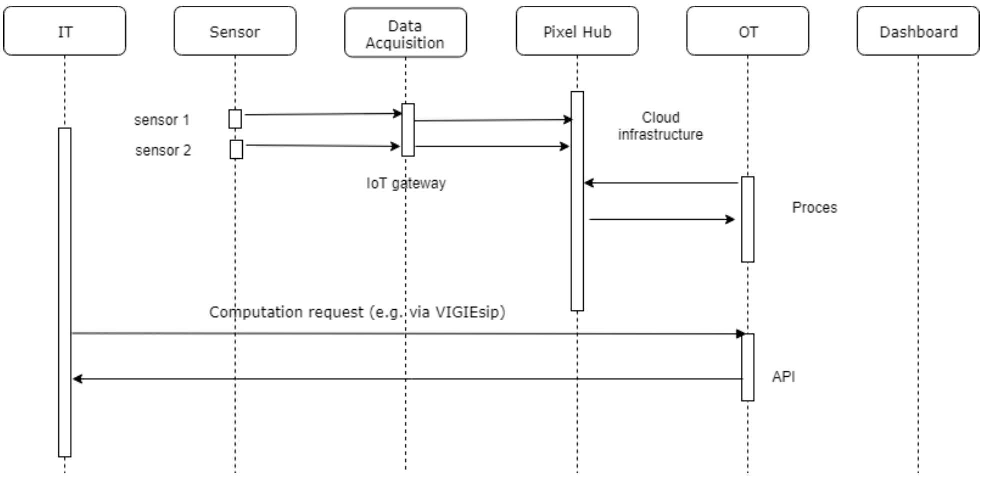

Figure 6. IT Manager at GPMB. Sequence diagram

4.4.5. Environmental manager scenario (GPMB-EnvM-1)

The scenario overview (as sequence diagram) is depicted in Figure 7. It mainly refers to a decision support scenario considering environmental values. The flow is as follows:

- Environmental models are already deployed in PIXEL and accessible through the operational tools. The models may potentially access the PIXEL hub to retrieve (real-time) input data. The PEI is also accessible through the OT.
    - GPMB would like to be sure that its new dredge, l'Ostréa, will have positive effects on air quality thanks to its LNG motorisation, and that cruise ships respect the regulations about fuels. In Bordeaux, the air quality monitoring is performed by an association, ATMO Nouvelle-Aquitaine. GPMB is establishing a collaboration with ATMO in order to define some new processes to get air quality data (Open Data) automatically from them. Thus, it may be necessary to buy an air quality sensor to extend their network. This will be decided later in the project (prior to WP7-execution of the pilot).
    - During the course of the use-case execution, the Port of Bordeaux will study the most relevant way to show the PIXEL outcomes in terms of environmental actions (PEI) and decision tools in its Port Community system VIGIEsip
- The environmental manager accesses VIGIEsip and requires some information regarding environmental performance or status before taking a decision on a particular action. Through VIGIEsip, the PEI value and the results of environmental models (with strong connection to the PEI) are retrieved through a standard API.
- Once again, as optional approach, the results may be presented through the dashboard (specially dedicated for graphical results) and the environmental manager may interact directly with the dashboard to get a fast view and take pertinent actions.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1,2,3
EU Legal framework to be considered	SafeSeaNet , Air Emissions, Air Pollution, Greenhouse Gases, Sulphur Dioxides, European maritime single window environment, Port Reception Facilities, Transport regulation, EU data protection rules

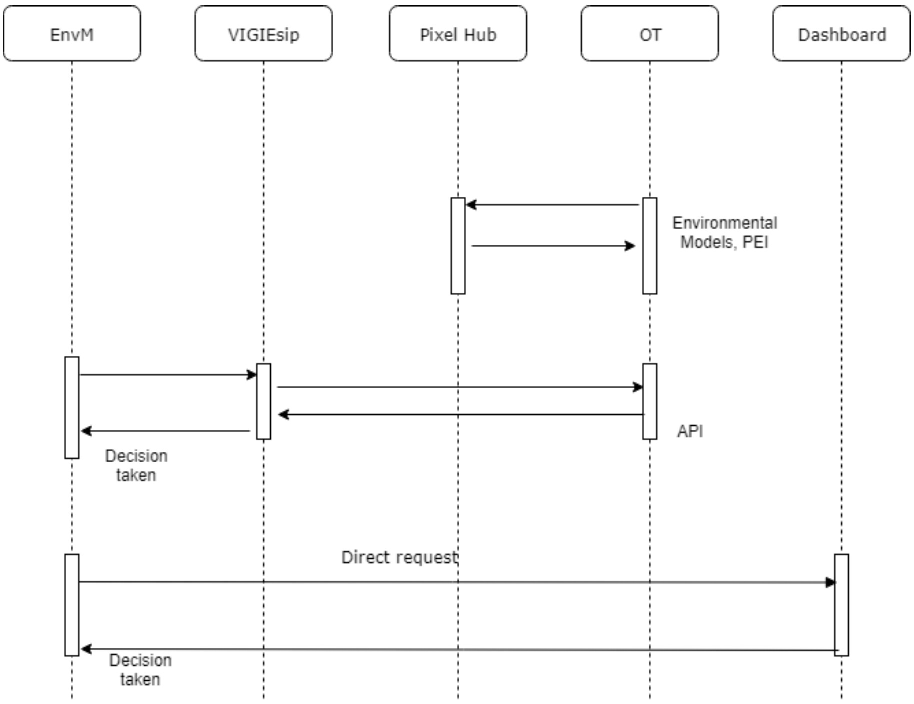

Figure 7. Environmental Manager at GPMB. Sequence diagram

Apart from this scenario, and in order to go beyond a common questionnaire, the Port of Bordeaux will implement the Green Marine program. That will allow not only to assess this North American initiative but to bring inputs and feedbacks to the WP5. The implementation of PEI by GPMB will be focused on the air quality aspects specially to highlight the impacts of the LNG dredge, Ostréa.

The appropriate integration of GPMB specificities (long channel, dredging, strong cruise activities) in PEI and the implementation of Green Marine program should highlight the proactive strategies of GPMB regarding the environment. This will be a useful input to WP9.

4.4.6. Port manager scenario (GPMB-PM-1)

The scenario overview (as sequence diagram) is depicted in Figure 8. It mainly refers to a decision support scenario for investment on green energy. The flow is as follows:

- Estimation models are already deployed in PIXEL and accessible through the operational tools. The models may potentially access the PlXEL hub to retrieve (real-time) input data. The estimation models are oriented to provide some hints for the potential viability on green energy investment
- The port manager accesses VIGIEsip and triggers the action of estimating energy viability. Some internal information available in VIGIEsip may be potentially added to the request towards the OT API.
- The estimation is calculated and forwarded back to VIGIEsip, which presents it to the port manager.

This scenario is more business oriented and it is not yet clear how the estimation should be realized, as it may depend on external variables that may change over time (e.g. energy tariffs, solar panels, etc.). Besides, the estimation model may be executed under request through the API, or it may run as a daemon and trigger a notification whenever a certain threshold is reached. A complete explanation of this estimation model is expected to be provided during the pilot trials.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1,2,3
EU Legal framework to be considered	EU data protection rules

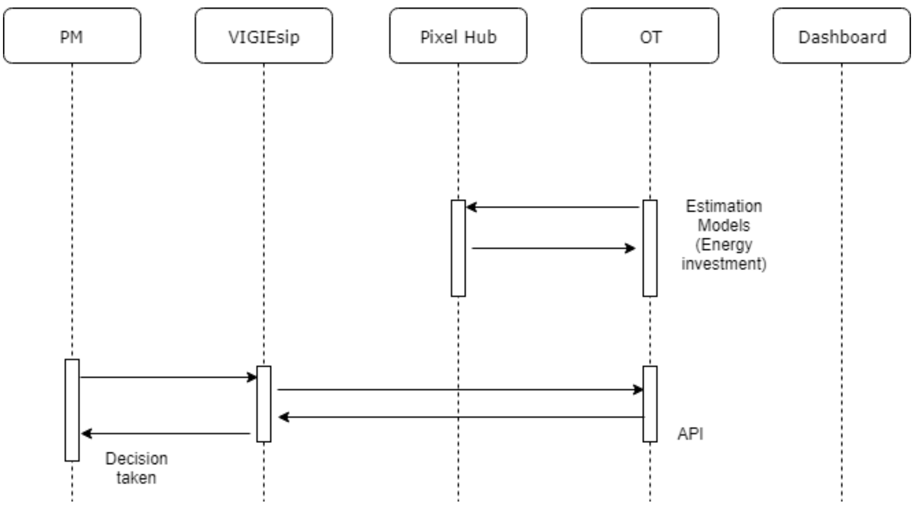

Figure 8. Port Manager at GPMB. Sequence diagram

4.4.7. Software editor scenario (GPMB-SE-1)

This scenario does not have a sequence diagram as it is not needed here. It mainly relates on how VIGIEsip integrates with the PIXEL components. From the PIXEL perspective, the integration should be as powerful and easy as possible. Therefore:

- The PIXEL hub will have an open REST API (e.g. Swagger) to invoke services, if any. This API also preserves security mechanisms.
- The PIXEL Operational Tools will have an open REST API (e.g. Swagger) to invoke models and predictive algorithms as services. This API also preserves security mechanisms.
- The PIXEL dashboard is a web graphical tool to easily present the data obtained by models, predictive algorithms or any other process providing results in a ready-to-show format.

Therefore, any action in VIGIEsip to integrate with PIXEL can be:

- Instantaneously and seamlessly by embedding a web page and connecting to the dashboard. Here the configuration control resides in the PIXEL dashboard and user profiles must be exchanged between VIGIEsip and the dashboard.
- Fast and iterative by invoking the corresponding API (typically the OT API). Here the configuration control resides entirely in VIGIEsip. An iterative approach is also possible and VIGIEsip may only integrate some of the functions exposed by the API. Note that some functions may be straightforward (e.g. obtaining the current PEI)

This scenario can be considered a study case of integration of their PCS (VIGIEsip) with the PIXEL components. This also allows establishing the roadmap of VIGIEsip: if some functionalities are already available in PIXEL or can be easily 'externalized' to PIXEL, then it is not necessary to consider it in VIGIEsip. Furthermore, if some parts of PIXEL can be identified as add-on for VIGIEsip, it may also have an impact at exploitation level, as VIGIEsip is used in other ports. These works will contribute to identify the most appropriate bundles including PIXEL in a market point of view.

Links with other WPs	WP6 (PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	2
EU Legal framework to be considered	EU data protection rules

4.4.8. Port Agent scenario (GPMB-PA-1)

The scenario overview (as sequence diagram) is depicted in Figure 9. It mainly refers to transferring or extending some of the previous functionalities/models to the port ecosystem (e.g. terminal operator). It is therefore extrapolated from the scenarios GPMB-EM-1 and GPMB-PM-1. The flow is as follows:

- An energy model has already been configured and is able to evaluate the energy consumption of each logistic chain (similar as for Annex B); it may have input data but it may also potentially interact with the PIXEL hub for any necessary (additional) data, if any. In this case, more detailed data can be provided in order to get more accurate results: for example, a terminal operator can provide better information about the machinery employed and how it is used in the logistics chain.
- The energy model may run periodically and stores the data internally.
- As every model is encapsulated as a service within the Operational Tools, the results are accessed from external components through its API. So the port agent (PA) interacts with VIGIEsip to get the data, which will somehow act as proxy invoking the API of the OT. Finally, the role of PIXEL on this regard

will be to perform all the calculations and simulations plus provide status and results (through PIXEL Operational Tools).

- The results may be retrieved by logistic chain or any other item relevant for the port agent, supported by the API. The API should also support editing the model in case something changes. The model should be able to work with real-time and past data.
- Additionally, the PA has also available through VIGIEsip any potential offers from the port authority as green electricity supplier. Considering that the ports authority decides to invest on the deployment on green energy as result of the GPMB-PM-1 scenario, it may promote port agents to get energy at a cheaper price (economic reason) and also reflecting commitment to environmental friendly approaches.
- Once again, as optional approach, the results may be presented through the dashboard (specially dedicated for graphical results) and VIGIEsip may potentially embed the dashboard. Or just let the PA interact directly with the dashboard.

This scenario is business oriented and it is not yet clear how the estimation should be realized, as it may depend on specific requirements from each port agent. Besides, the estimation model may be executed under request through the API, or it may run as a daemon and trigger a notification whenever a certain trigger is reached. The green energy offer may also be presented as pop-up for port agents triggered by any policy configured in VIGIEsip (agents consuming too much or too many energy, etc.). Here we identify a potential business case (or part of it) to be further analysed within WP9. Anyway, in this scenario appears more clear the potential usage of the PIXEL hub not only as shared data integrator but also as the ground layer for a marketplace.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1,2,3
EU Legal framework to be considered	EU data protection rules

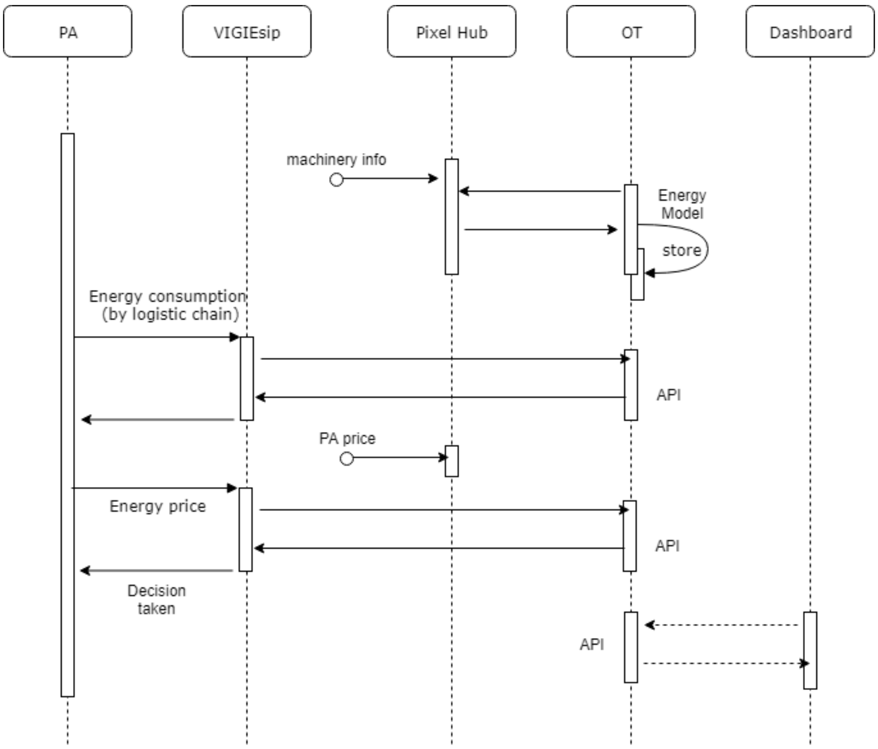

Figure 9. Port Agent at GPMB. Sequence diagram

5. Use case of the Port of Monfalcone

5.1. Main changes from the previous version

The purpose in this deliverable relates to providing useful and clear descriptions of the use cases and scenarios. Therefore, most of the contextual information of the Port of Monfalcone has been completed/updated and shifted to the Annex C in order to better focus on the use case and involved scenarios. The current deliverable starts from user stories to develop the scenarios and identifies actors and interactions.

5.2. Challenges for Port of Monfalcone and PIXEL contribution

Despite of the efforts and investments of FVG region, a regional logistic platform is still missing; ports and inland ports have not a joint coordination and this means issues that must be solved, as described below.

In summary, the use case of the Port of Monfalcone consists in taking advantage from the PIXEL solution in order to handle the freight traffic in urban and surrounding area, through the creation of an IoT platform to share data and make interoperable different types of information and sensor systems. The use case will help understanding and measuring the benefits coming from a new model of logistic solutions and the related impact on the environment.

5.2.1. Lack of common services

Despite the area of the Friuli Venezia Giulia Region is not much extended and the freight traffic influences the functioning of the regional ports and interport operators such as the Port of Monfalcone and SDAG, the services available within the organization are different and are not linked with any type of coordination and cooperation. The different regional administrations did not plan a regional services platform to manage or to orchestrate the services that the different actors can provide to the logistic sector. Thus, the main problem that must be solved is that the allocation of public resources, local and regional, must be coordinated and based on a complete vision of the logistic activity on the regional territory in order to avoid bottlenecks and oversize infrastructures compared to the services demand. PIXEL will provide an **interoperable IoT platform** able to **integrate information systems** from the Port of Monfalcone and SDAG, thus setting the foundations for a local strategy to build common services.

One strategy has been envisioned: triggering services in different entities based on several circumstances or actions occurred in other agents of the supply chain. A common approach for intermodal hinterland issues can be achieved if the synchronisation among parties can be enhanced.

Furthermore, a common vision of environmental awareness is not currently deployed in the region. To achieve this, PIXEL aims at applying all data (that could be collected) to feed various predictive algorithms. These algorithms will try to simulate the impact on the environment of a shared traffic management; such as: CO2 impact in the urban area, and road traffic and related accidents. Other potential possibilities may consider waste disposal costs and urban mobility planning.

5.2.2. No data sharing and interchanging

The information system adopted by ports and inland ports does not allow to share and exchange any type of data, so even if each organization that provides services related to the logistic fields are in the position to cooperate, they are not able to exchange data. Local information and exchanging data can help each regional organization to define their strategy and plans improving the efficacy and efficiency, thanks to a better awareness on what happens in each regional organization. PIXEL will provide an **interoperable IoT platform** able to **support the exchange of data** between the Port of Monfalcone and SDAG.

In the relevant use case for PIXEL, the Port of Monfalcone (partner ASPM in the project) is logistically related to the inland port SDAG. However, the information exchange between these two entities is far from optimal. Being able to share the requests to access to the port with SDAG would immensely enhance the distribution of vehicles among Monfalcone and SDAG premises. This action would also imply improvements in several aspects, including waiting time of trucks, parking congestion, road traffic and even environmental impact.

5.2.3. Congestions in port areas, reduced use of inland premises

The lack of common services and sharing data between the logistic services organizations in the regional territory cause events of congestions in ports areas, with a strong impact also on the urban surrounding area in terms of mobility citizens’ safety and environment. These congestion events could be prevented if Monfalcone Port and SDAG (in general ports and inland ports) could share data concerning the services demand and the joint services offer. Currently the parking of the inland of SDAG is not much used by Monfalcone port because it is not possible to establish a clear commercially-interesting strategy. The normal flow of action is: first the cargo goes to a middle point and then finally reaches the port. With an appropriate shared information this situation would be avoided and this cooperation would be boosted. In this way, when the port receives a lot of service requests that generate a lot of traffic in the port area it can redirect these calls to other regional structures. PIXEL will allow **sharing the requests** to access to the port with SDAG, in order to **distribute the traffic among** Monfalcone and SDAG premises. By **using sensors** to know the availability in the parking area of the Port of Monfalcone, the **accesses to the port can be managed** based on the days of the week, triggering the use of the SDAG premises.

5.2.4. Reduced use of rail and inland-ports services

The incomplete monitoring system of the freight traffic in the Friuli Venezia Giulia (FGV) Region, originated from the aforementioned: (i) not common regional plans and (ii) not interoperable information systems between the regional stakeholders (included Monfalcone Ports and SDAG) causes a reduced use of the railway and inland ports services with the consequent congestion of the ports areas and of the motorway and urban roads with a high risk for the citizens’ mobility. This trend could be modified using a system that put in communication and cooperation all stakeholders of the Region in order to increase the knowledge on the typology of the traffic (from, to, what, when) and to manage the traffic using all available resources (ports, inland ports, railway) in order to reduce the impact on the traffic, addressing the traffic towards multimodal transport, in particular railway, and improving the services provided to the truck drivers using all regional resources such as inland port service provider. PIXEL will integrate an infrastructure to **monitor road traffic**. A PIXEL predictive model will be able to **detect and forecast peak traffic** that could create congestion in the port and urban areas. It should be redirected to dedicated services area or to the railway transport. Currently the only railway transport tested by PIXEL model is related to slabs between Monfalcone and Aussa Como Industrial District. Moreover, applying all data to predictive models will also allow to **simulate the impact on the environment** of a shared traffic management; such as CO_2 impact in the urban area, road traffic and related accidents, waste disposal costs and urban mobility planning.

5.2.5. Environmental and safety risks on ADR flows

The ADR (dangerous goods) traffic is an additional risk that needs a special attention. Currently, SILI system allows to identify in some check point of the Regional territory that flow of dangerous goods and to store data concerning the typology of goods and where and when it passed. Moreover, SDAG is able to provide parking services for dangerous goods, in compliance with legislation. The problem with dangerous goods, is that it is not possible to know the complete path/flow of the ADR traffic, so if a truck with dangerous goods parks on an urban parking area close to a petrol station, the current system doesn't allow to avoid this risk and to redirect the truck towards another way. So, a more detailed and shared ADR traffic data could help the traffic forecast and to improve the management of this transport. PIXEL interoperable IoT that will allow to integrate SDAG system to regional SILI system sharing ADR traffic data helping traffic forecast and the management of this transport and therefore monitoring and mitigate risks deriving from dangerous goods transport by implementing specific parking areas.

The SILI system was realised with the first aim to track ADR goods, then it was modified/converted as a port access tool. But each time an ADR truck asks for a port entry permit, it is being tracked on some SILI gate settled at the entrance of the inland ports, ports and some roads. A challenge for PIXEL is to use these pieces of information in order to prepare specific ADR truck parking slots when the truck flows is diverted to SDAG in order to avoid congestions in Monfalcone.

5.3. Main objectives and expected impact

5.3.1. Objectives of the use case

To properly address previous challenges, the objectives of this Use Case are the following:

1. **Data sharing** between the Port of Monfalcone and SDAG to **reduce bottlenecks and congestions** in port areas and to **promote the use of railways** where necessary.
2. **Reinforce** the **safety related to ADR** transport through the **operability of data** with regional stakeholders and in connection with SILI.
3. Collect data on Regional logistic flows to support the activities of the **Regional Environment and Health Observatory (REHO)**. Here the objective is to give the REHO the possibility to monitor the flows on the road. Within the ARPA (Regional Environmental Agency of Friuli Venezia Giulia), the REHO structure has the aim to put in relation health population status and environmental factors. Moreover, there are air data pollution in open data format available on the ARPA website.
4. **Collect and analyse** data on **Regional logistic flows** to support the activities of the Regional Government (another public entity) to evaluate specific programs to promote rail logistic solutions as well as the implementation/expansion of other logistic infrastructures. This objective refers specially to the side study of slabs traffic from the port of Monfalcone to the regional iron mills. If the externalities related to the slabs transport by truck are measured, it is possible to promote the rail transport mode for this traffic and specific economic bonus for operators that use rail instead of trucks.

The technical implementation of PIXEL in the Port of Monfalcone will be carried out by adopting the following key elements: (i) ICT infrastructure for data sharing, (ii) IoT solutions to manage automated booking and re-routing systems, (iii) predictive algorithms and models calculating impact, and (iv) Integrating SILI monitoring system with PIXEL. Figure 10 depicts an overview of the Port of Monfalcone use case.

Regarding the importance for the use-case in a wider context, the PIXEL Consortium has tried to picture it within the scope of the "Port of the Future" concept: "*one port can find itself in a traffic situation (due to vacation, weather, difficulties due to crashes, strikes or whatsoever), and will leverage the modelling, operational tool and whole PIXEL solution for the ASPM's use-case. Things that can be used by other ports:*

traffic models to be extrapolated to other routes or other type of traffic. SDAG has also role as facility. If atmospheric events cause problems on the road network, an inland port (SDAG in the case of ASPM) can organise multimodal split (so trucks make the trip by trail or can be re-routed to other regional infrastructures, for example)".

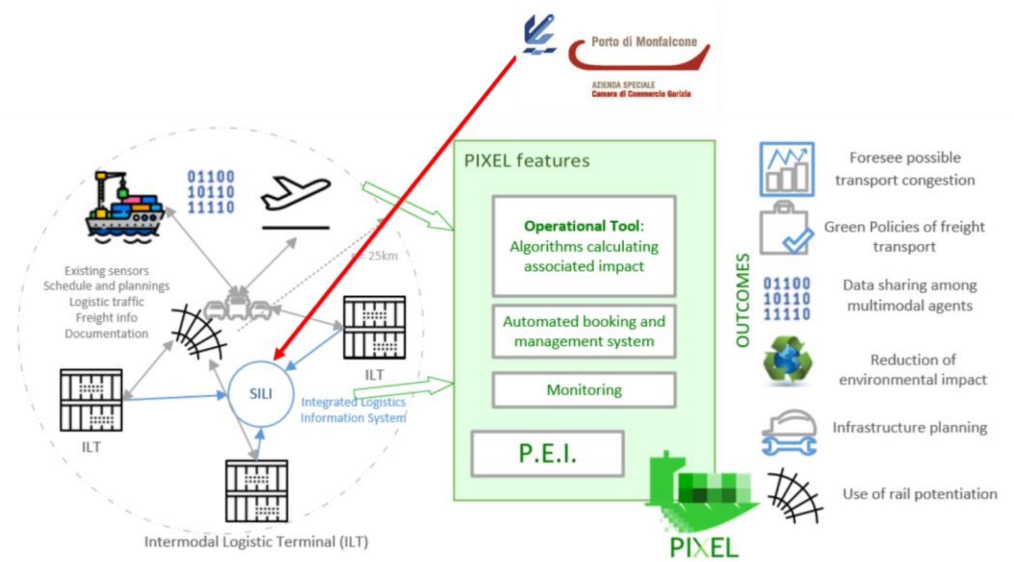

Figure 10. Port of Monfalcone use-case overview

5.3.2. Expected impacts and KPIs

The expected impacts from the Port of Monfalcone use-case are three-fold:

1. Improvement of the current **safety and environmental** policy by:
    - Monitoring and re-routing of goods, especially if they are dangerous (ADR goods in SILI system and specific parking slot reservation in SDAG). Actually multimodal transport modelling will trigger rerouting in case of congestion inside or outside the port premises, independently of the type of cargo.
    - Provisioning of data to improve the correlation between air pollution and specific diseases
    - Reducing CO2 emissions and acoustic pollution in port surrounding areas
2. Enhancement of the current **port operations/management** by:
    - Providing a better distribution of the waste costs
    - Developing "on-time" and "on -demand" logistic integrated services. It refers to the opportunity to use PIXEL as a platform to book services for trucks diverted to SDAG.
3. Significantly contributing to a **regional management platform** thanks to a:
    - Better road planning to reduce urban and extra urban traffic. PIXEL should predict congestion and promote SDAG inland terminal as parking area. This will reduce road traffic peaks.
    - Regional joint planning and managing of flows towards and from port areas
    - Joint spatial planning with a reduction of land consumption. If PIXEL becomes a useful tool for truck companies, the role of inland port will be better used instead of port parking areas that, therefore, can be smaller.
    - Better integration of multimodal services automatically triggering and monitoring rail services.

Considering the previous points above, the Port of Monfalcone could be spotted in a clear position with regards to the global impacts of PIXEL. In the following table the 4 impacts identified in the proposal are listed. The goal is to centre how Monfalcone use-case will contribute to each one of them. The scale ranges from 0 to 3, being 0 non-relevant for the use-case and 3 the maximum impact.

Impact identified in the proposal	Port of Monfalcone use-case
Climate change and environment	1
Operational and infrastructural costs	0
Logistics efficiency	3
Port-city relations/integration	1

Thus, it can be summarised, about impacts addressed, that the Port of Monfalcone is clearly focused on logistics (inland, mostly):

a) **Climate change and environment**: supporting the activities of the Regional Environment and Health Observatory.

b) **Operational and infrastructural costs:** Not applicable for this port.

c) **Logistics efficiency:** Congestion avoidance and redirection of traffic flows.

d) **Port-city relations/integration:** The traffic of flows are better tracked, especially ADR related goods.

On the other hand, regarding the KPIs expected to reach within PIXEL in this use-case, is worth to mention that the following figures (see Table 7) are only a rough estimation considering that the PIXEL consortium is still in month 9 of the project. Data has been extrapolated from the first established goals (GA KPIs) and adjusted to current reality. The impacts have been more detailed textually, but the final figures are still being evaluated by the port teams.

Table 7. Use case KPIs for the Port of Monfalcone

Impact	**KPI**	**Current Value**	**Expected impact**
Reduction of impact on climate change and the environment of port activities	Greenhouse gases (GHG) emission / carbon footprint	2680 T	The project should help to both monitor and reduce this indicator.
	Fine particles emission (NOx, SOx…)	Not measured	-
	Environmental leadership (Green Marine Indicator)	1	4-5, for the global PIXEL project outcome
	PEI adoption	No	Yes
Reduction of operational and infrastructural costs	Electricity consumption of the port authority	Not measured	Not the main objective of the use-case
	Decreasing the costs due to not allowing optimized parking allocation	Not measured	After PIXEL, this will be measured and improved
Local adoption of PIXEL solution	Local IoT platform implementation	No	Yes
	Number of sensors / devices connected to the local IoT platform	0	At least 5 These are the sensors that monitor the port gate entry lanes (1 for lane)
	Number of types of data (sensors) connected to the local IoT platform	0	At least 3 (weather, wind speed, air quality)
	Number of end-users	0	30 Actually the institutional users for SILI platform can be set as 4 (gate, Policy, Maritime Authority and ASPM) but can be enlarged to 30 as these are the “destination” company inside the port.

5.4. User stories and scenarios

The main result expected is to minimize the congestion in the port area. Common end users, mainly truck companies and agencies, will benefit from decreased congestion in terms of time, fuel consumption and from a better planning of the logistic solution to be used (promotion of rail transportation, stop planning at SDAG). The Port, as end user, will benefit from minor externalities related to heavy traffic and overcrowded street and area in terms of safety and environmental emissions.

In order to provide a more detailed view of expected specific actions for the general Port of Monfalcone use-case in the different port operations a set of user stories have been drafted for a better identification of targets and requirements. In this use case there are two major perspectives: the Port of Monfalcone and the inland port (SDAG), as depicted in Table 8 and Table 9, respectively. From each actor, one or more scenarios will be described as a sequence diagram. Each scenario has an ID so that it can be better referenced at requirement analysis phase (task T3.4)

Table 8. User stories for Port of Monfalcone

As a/an	I want to …	So that …
Gate/Access Manager	Have automatic predictions of parking occupancy in the port entry parking area using the actual parking occupancy, the port gate flows and the vessels scheduling and historical traffic data on a daily basis with "some" hour range	Truck operators can be notified of congestion of port access and parking availability / predictions if they overpass certain threshold, as well as other stakeholder (municipality, police), in order to evaluate proper actions to minimize the issue and port-city interference
		In case a parking is full (or almost) and the automatic predictions of parking occupancy forecast an increment in traffic flows and parking needs, truck drivers/operators can be notified of it and linked to SDAG in order to reroute their parking destination towards the interport or delay their arrival to the port/parking area
Environmental Manager	Be able to collect and analyse environmental data	I can support the activities of the Regional Environment and Health Observatory and plan future investments/procedures to promote a greener port
Software editor	Assess the relevance to add new functionalities in SILI	I can define an appropriate roadmap for SILI

Table 9. User stories for SDAG

As a/an	I want to …	So that …
Parking area manager	receive automatic alerts of trucks diverted to SDAG from the port of Monfalcone and confirm slot availability	I can check automatically the availability of parking slots and/or reserve + address trucks to the different parking areas
	have an automatic booking system for trucks that are diverted to SDAG	I can reduce/optimize manual work from the internal personnel and the use of resources
	receive automatic alerts of ADR (dangerous) transport coming to SDAG	I can reinforce the security (in a dedicated parking area) related to ADR transport and/or divert trucks in other infrastructures

As a/an	I want to …	So that …
	have anticipations or simulation of the traffic congestion in the port/surrounding areas (through a system that put in communication more stakeholders thanks to SILI platform, for example: Autovie Venete and other authorities)	"I can estimate the n° of trucks coming to SDAG and I can evaluate the use of all available resources (ports, inland ports and railway) to address the traffic towards other multimodal transport and support the decision making in addressing the trucks towards Monfalcone or other infrastructures. Furthermore, I can improve all the services offered to the truck drivers in the inland ports"

5.4.1. Gate Manager (PoM-GM-1)

The scenario overview (as sequence diagram) is depicted in Figure 11. It mainly refers to a congestion detection system, which currently does not exist in the Port of Monfalcone. The flow is as follows:

- SILI (ASPM IT system) will be first enhanced with two subsystems:
  - A system that counts the vehicles entering and exiting the port's parking area. Therefore, it will provide a measure of the parking occupancy
  - A video system able to monitor a defined area of the access road to the port and send an alarm if the trucks are stuck for more than X time. The data will be available on line.
- The PIXEL Data Acquisition Layer is able to retrieve all this information, together with ship call info and send it to the PIXEL hub.
- Through the Operational Tools (OT) in PIXEL (models and predictive analysis), all these pieces of information are processed in order to estimate the traffic for the remaining day. Peak hours can be therefore detected in advance. The result of the process is then stored internally for later access.
- From the truck driver perspective, it maintains its interaction with the SILI system but perceives two new functionalities:
  a) Whenever the truck driver sends a request for accessing the port, the SILI system will grant authorization, but it will add additional information about parking availability and forecast incoming to the port road traffic. This information is obtained from the OT through its API. Therefore, truck drivers (or companies) can better plan when to arrive.
  b) For usual truck drivers there is a special badge that grants access to the port for a period of time. Here there is no request needed. However, in order to notify all interested drivers, a subscription model is also envisioned. Any truck driver can subscribe (e.g. via the SILI system or directly through the PIXEL platform) in order to be notified about potential traffic peaks and congestion. Besides the alert, a suggestion for rerouting to SDAG can also be launched. On the PIXEL side, there would be a CEP (Complex Event Processing) engine able to detect the (i) congestion and (ii) port parking slot availability, and trigger notification.
- Access to the results generated by the model can also be visualized in the PIXEL dashboard, able to use the OT API.

If there are any past data available, it can be also integrated in the PIXEL hub through its API. One added value from PIXEL to Monfalcone will be integrating data coming from different systems (gate system, data from the video system, data from and to SDAG (note that they are not integrated in SILI). Another good outcome will be to share this information with the municipality of Monfalcone, enabling the decision making on several traffic issues.

The notification system is not only intended for truck drivers, but potentially for **any stakeholder**. Spreading congestion alerts among authorities can trigger specific activities in order to lower port-city externalities. Specific users can be allowed to access the PIXEL platform but ASPM can also display some PIXEL data in their own website, such as parking availability, congestion status and predictions

With the correct implementation of this scenario in the Port of Monfalcone, PIXEL will help improving logistics efficiency while avoiding congestion inside the port and in the external nearby, while monitoring the congestion and the occupancy of the parking system.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (Data Acquisition Layer, PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1,4
EU Legal framework to be considered	SafeSeaNet, European maritime single window environment, Port Reception Facilities, Transport regulation, EU data protection rules

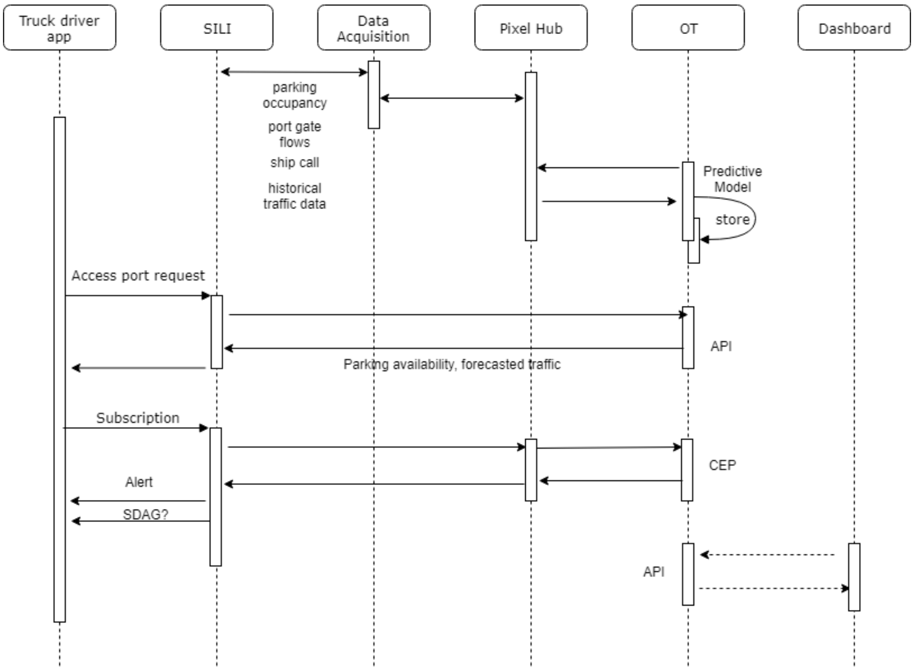

Figure 11. Gate Manager at PoM. Sequence diagram

5.4.2. Environmental Manager scenario (PoM-EM-1)

The scenario overview (as sequence diagram) is depicted in Figure 12. It mainly refers to a collection system, in order to support the activities of the Regional Environment and Health Observatory (REHO). The flow is as follows:

- The SILI system (and potentially also ASPM PMIS) contains relevant data that the PIXEL Acquisition Layer can retrieve and insert in the PIXEL hub.
- Additional open and environmental data can be inserted in the PIXEL hub through the PIXEL Data Acquisition.

- For the moment there is no need for data analysis and modelling, therefore the OT activity remains empty. Anyway, some environmental models developed for other ports may be ported here, under request. At least the PEI will be calculated and exposed.
- The REHO will then be able to request all information regarding the port (e.g. the PEI) through a single API. SILI will act as proxy, if necessary.
- The Dashboard is able to show part or all of the data as it can also interact with the PIXEL hub API (besides the OT API).

Links with other WPs	WP6 (Data Acquisition Layer PIXEL hub and Dashboard).
Main objectives targeted of this use case	1,4
EU Legal framework to be considered	SafeSeaNet , Air Emissions, Air Pollution, Greenhouse Gases, Sulphur Dioxides, European maritime single window environment, Port Reception Facilities, Transport regulation, EU data protection rules

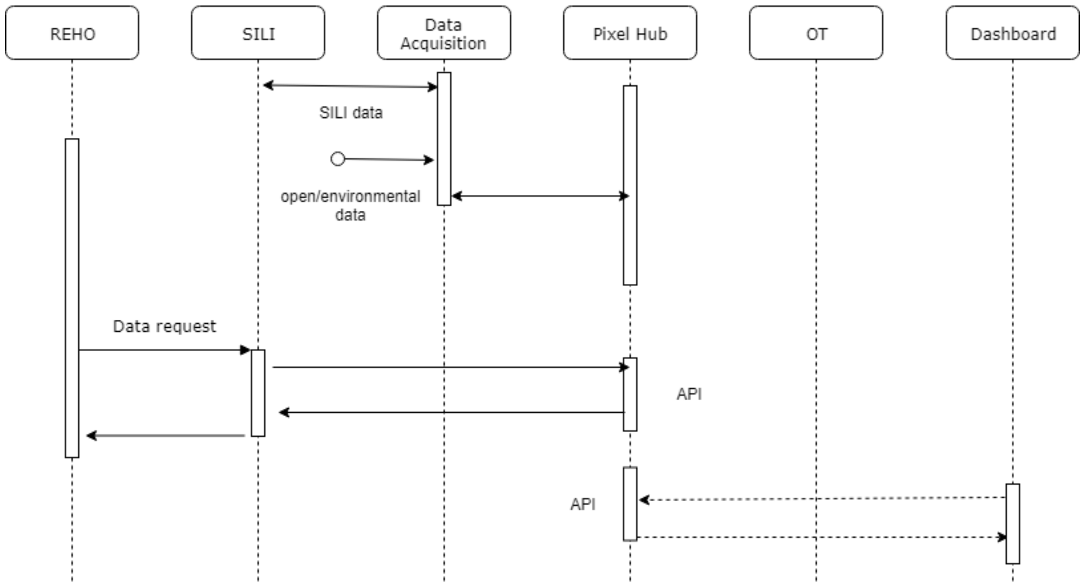

Figure 12. Environmental Manager at PoM. Sequence diagram

5.4.3. Software editor scenario (PoM-SE-1)

This scenario does not have a sequence diagram as it is not needed here. It mainly relates on how SILI integrates with the PIXEL components. The scenario is analogous as for GPMB (GPMB-SE-1, see section 4.4.7) where we only need to replace VIGIEsip with SILI.

Links with other WPs	WP6 (PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1,3,4
EU Legal framework to be considered	EU data protection rules

5.4.4. Parking area Manager (SDAG-PM-1)

The scenario overview (as sequence diagram) is depicted in Figure 13. It mainly refers to a basic continuation of the scenario described in PoM-Ga-1 involving SDAG. The flow is as follows:

- The truck driver interacts as usual with the SILI system to access to the Port of Monfalcone.
- Whenever congestion is detected it is indicated to the truck driver, and a suggestion of re-routing to SDAG is also sent. If the truck driver confirms, the notification is also sent to SDAG. The confirmation from the truck driver is not necessary if the PIXEL platform is able to automatically book the parking plot for the truck driver. This will be described in the following scenario. Furthermore, the re-routing decision to SDAG is not mandatory, but highly recommended, in order to prevent congestions and pollution. Here we are taking into consideration only the case of diversion to SDAG. Note that it may be possible that the rerouting to SDAG is not to be the best solution, but this will depend on to the information available to compare congestion in both sides (Port of Monfalcone and SDAG).

This scenario will enhance the information exchange between SDAG and ASPM and aims at triggering the simulation of the process of parking occupancy based on the information (and thresholds) coming from SDAG's video camera setup. In other words, the system should check the parking availability in SDAG before sending the divert alert, and this is done with a connection to SDAG parking video system.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (Data Acquisition Layer, PIXEL hub and Operational Tools).
Main objectives targeted of this use case	1,4
EU Legal framework to be considered	Transport regulation, EU data protection rules

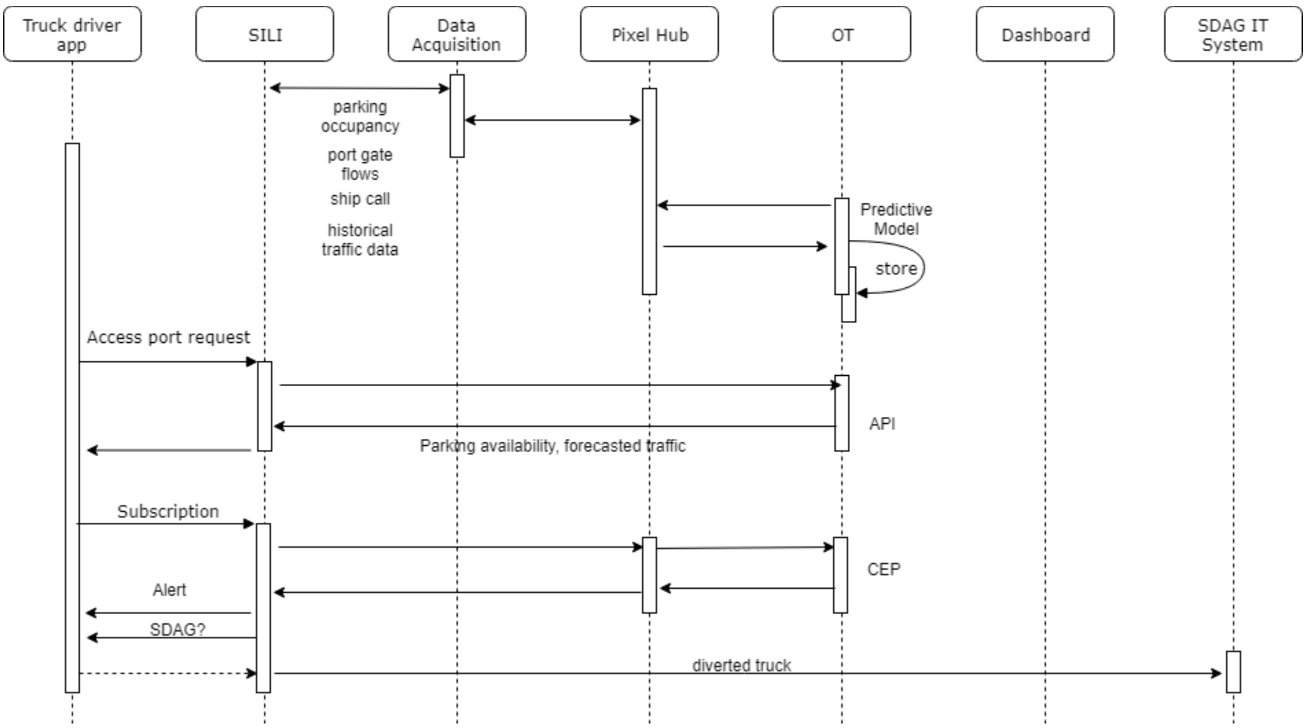

Figure 13. Parking area Manager at SDAG. Sequence diagram

5.4.5. Parking area Manager (SDAG-PM-2)

The scenario overview (as sequence diagram) is depicted in Figure 14. It mainly refers to a basic continuation of the scenario described in the previous chapter (SDAG-PM-1). The flow is as follows:

- The truck driver interacts as usual with the SILI system to access to the Port of Monfalcone.
- Whenever congestion and port parking unavailability is detected it is indicated to the truck driver, and a suggestion of re-routing to SDAG is also sent. If the truck driver confirms, the notification is also sent to SDAG.
- The truck driver (or, optionally the SILI system acting as proxy) interacts with the SDAG IT system to generate an automatic booking. The confirmation is finally propagated to the driver and to the SILI system.
- The truck driver should be able to cancel the booking sufficiently in advance. In fact, there is no need of formal certification, the automatic booking is enough. The bill and any other certifications will be made when entering/exiting the parking in SDAG.

The automatic booking system is already foreseen in the GA as part of PIXEL developments; however, it makes more sense (currently) to associate this service into the SDAG IT infrastructure. During the development phase we will study the best location for this service.

The main goal in this scenario is having an automatic booking system for trucks that are diverted to SDAG with arrival and departure time of truck. The booking is automatically made after a prior evaluation: **free parking slots in SDAG, type of truck** (i.e. ADR = dangerous) and **arrival/departure time** from SDAG. The size of the truck is not relevant, only the type (i.e. ADR, because in this case there are specific parking slot dedicated only to ADR transport).

A transport is identified as ADR if there is a specific number plate (normally in orange colour) that can be registered also by video camera (there is one at the entrance of the parking area in SDAG). As there is no notification system between the Port of Monfalcone and SDAG so far, it will be useful to have it through the PIXEL system.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (Data Acquisition Layer, PIXEL hub and Operational Tools).
Main objectives targeted of this use case	1,2,4
EU Legal framework to be considered	Transport regulation, EU data protection rules

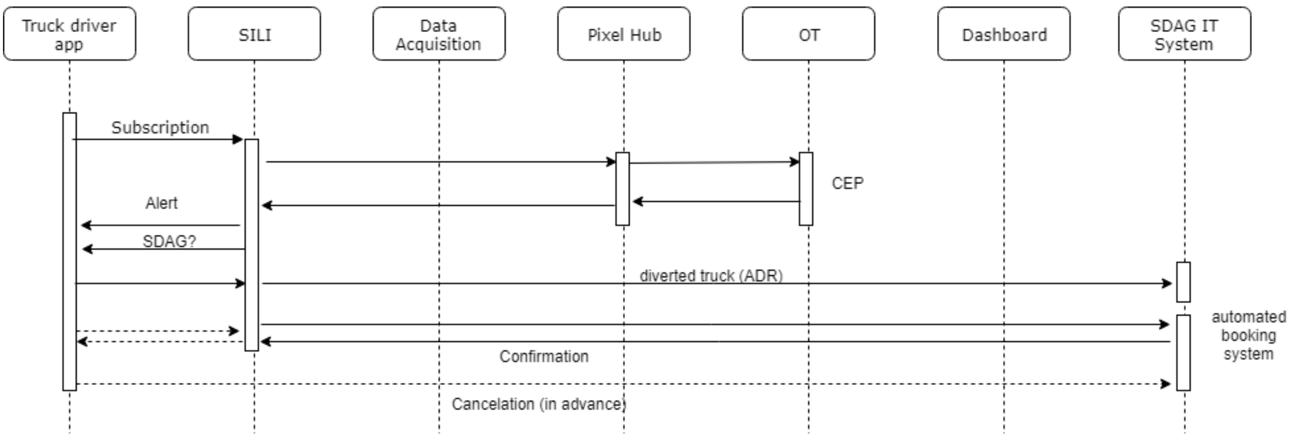

Figure 14. Parking area Manager at SDAG (II). Sequence diagram

5.4.6. Parking area Manager (SDAG-PM-3)

The scenario overview (as sequence diagram) is depicted in Figure 15. It mainly refers to accessing the service for predicting (peak) traffic. The flow is as follows:

- The PIXEL Data Acquisition Layer is able to retrieve all necessary information, either from the SILI system or from any other relevant open data source and send it to the PIXEL hub.
- Through the Operational Tools (OT) in PIXEL (models and predictive analysis), all these pieces of information are processed in order to estimate the traffic for the current day. Peak hours can be therefore detected in advance. The result of the process is then stored internally for later access.
- The SDAG IT system accesses the OT and, through its API, obtains the information of the forecasted traffic from the corresponding model, as depicted in Figure 15. With this scenario SDAG will get a sort of simulation of the traffic, using the data provided by other stakeholders, in order to predict possible congestions and so address trucks to SDAG by the other roads available or by the railway.

  Note that the interaction depicted in Figure 15 is just a possibility for obtaining this data under request; another approach could be based on a subscription model where an alert is sent to SDAG whenever a specific congestion threshold is triggered.
- The forecasted traffic can also be visualized through the PIXEL Dashboard as alternative approach.

With the correct implementation of this scenario, if there is a congestion in the port area, and PIXEL can estimate the waiting time that a truck must experience in the port, ASPM can recommend parking in other area, or maybe taking a different route (or even mode) to reach the port.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (Data Acquisition Layer, PIXEL hub and Operational Tools).
Main objectives targeted of this use case	1,3,4
EU Legal framework to be considered	Transport regulation, EU data protection rules

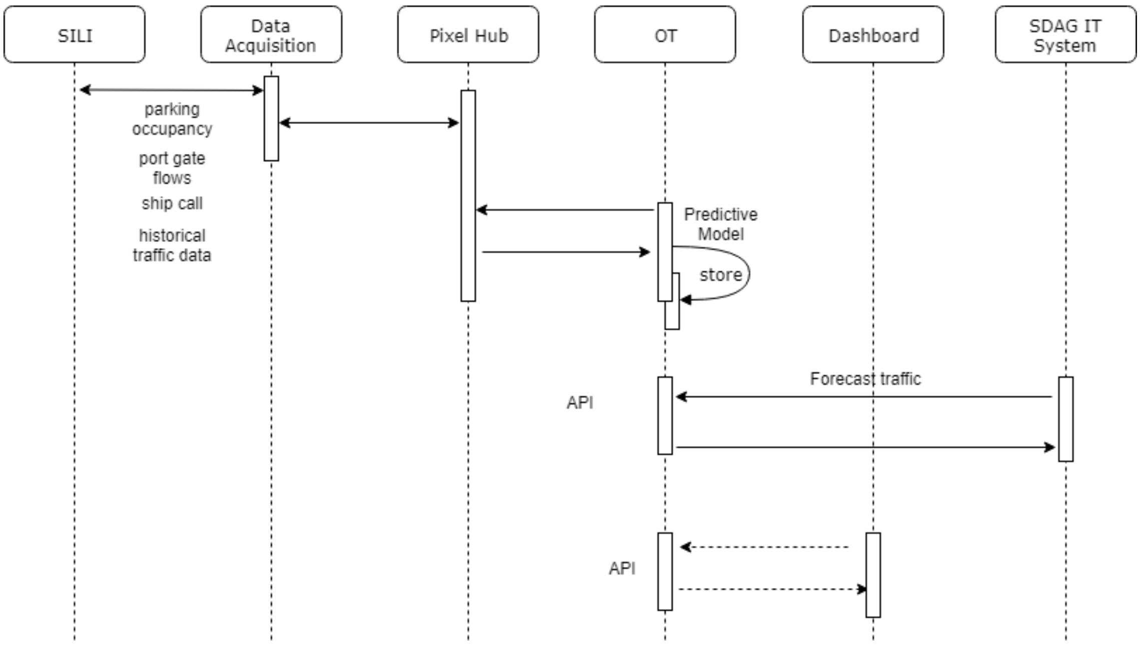

Figure 15. Parking area Manager at SDAG (III). Sequence diagram

6. Use case of the Port of Piraeus

6.1. Main changes from the previous version

The purpose in this deliverable relates to providing useful and clear descriptions of the use cases and scenarios. Therefore, most of the contextual information of the Port of Piraeus has been completed/updated and shifted to the Annex D in order to better focus on the use case and involved scenarios. The current deliverable starts from user stories to develop the scenarios and identifies actors and interactions. For the Port of Piraeus, scenarios mainly relate to air and noise pollution.

6.2. Challenges for the Port of Piraeus and PIXEL contribution

The passengers port is very near to the city of Athens, and there are residential areas very near of the port. During all holiday periods, a lot of traffic is experienced in the terminal, and affect the living of the people living around. It creates reactions from citizens to solve this problem. It is not only a problem caused from the port, but it is believed that is up to the port to provide a solution.

When lots of cruises arrive and it coincides with current traffic in the city, the touristic buses are not able to reach the Acropolis in a reasonable time for tourist to really spend time in the place. It also implies more traffic congestion, noise pollution and overall environmental impact. This use case does not involve only cruise but also container and coastal (passenger) traffic operations.

6.2.1. A Green Cruise Port

Environmentally friendly traffic integration of cruise ports into the transport system of the port locations (incl. near hinterland) and Activities / Outputs. The concept of «environmental sustainability» is widespread and is being implemented with the main objective of maintaining change in a balance, where the exploitation of resources, the investment direction, the technological development orientation and institutional changes are all harmoniously developed and respect both human needs and the environment. In this context, the port of Piraeus, as one of the largest developing companies at European level implements the principles of sustainability in all its development and operation steps with main objective of protecting the environment of an urban network, such as Piraeus, and the prosperity of the local community.

PPA will establish an air quality improvement plan in order to monitor the pollution emitted within their areas of operation that is caused by each possible source category (ships, cars, trucks, equipment) via the air monitoring sensors to sample, report and simulate air quality models, including the concentrations of key pollutants.

6.2.2. Reduced Noise levels

The Port of Piraeus is located at the same area where it used to be the ancient Athenian port, currently serving almost all types of cargo and passenger maritime transportation. Piraeus is a port-city containing the largest Greek seaport and one of the largest seaports in the Mediterranean Sea. At the same time, these new transportation patterns must not contribute to the deterioration of the urban environmental conditions and worsening the quality of life, due to traffic noise and emissions of nitrogen oxides and particulates that have negative impacts on public health and the environment terminal operators. Mitigation measures shall be applied in case of critical contribution of ship noise or noise from terminal operation. A noise measurement campaign was conducted to collect data for three purposes:

1. Feasibility of a noise monitoring system:
    - Identification of suitable positions and suitable concept
    - Determination of accuracy
2. Check whether emission requirements are achieved for the residential area, evaluate contribution from berthing cruise ships
3. Acquisition of emissions levels of berthing cruise ships

6.2.3. A more citizen-friendly port

The Port of Piraeus is confronted with accessibility and connection problems, both between the port area and the greater Athens and Piraeus cities. Moreover, the development of economic activity, the growth of tourism and the rise in movements of goods and passengers puts a high level of pressure on both the coastal and urban area and on the main transport corridors. PPA will benefit from PIXEL in order to **improve the access to the seaport** so that it can ensure sustainable economic growth in the port city of Piraeus, leveraging enabled communications at data level proportioned by PIXEL.

The Port of Piraeus through PIXEL, will enable the port stakeholders and policy makers to exercise control over the perspective of the mobility in the port city. To this end, PPA will be using the platform connectivity services, to publish cruise and freight ship schedules and updates to schedules as necessary, and the mobility policies set by the port (e.g. accessibility timelines for passing, loading and unloading and other restrictions). PIXEL will **enable the deployment of services publishing events** (accessible via APIs) in the city affecting road traffic (planned roadworks by utilities, accidents, expected traffic increases due to sports, cultural, etc. events) and city mobility policies.

Of special interest is the **Open and Linked Data** Publishing: PIXEL will provide pertinent **user interfaces** with interactive map editing support for content creation and management to support open-linked data services (including restricted/private access interfacing). Accurate supporting data such as ship and engine data, emission factors and external cost factors will be gathered in order to improve monitoring and control of emission inventories and their externalities towards effective environmental policy-making and will become available via the PIXEL solution, enabling their access via appropriate APIs. The stakeholders will use PIXEL value added services (real time Monitoring of air quality directly operated by the port with weekly, monthly and annual reports, and measurement of sound levels to reduce congestion inside the terminals) to manage the mobility of trucks connecting them in real time, via deploying multimodal logistics services and configuring services components that:

- transform and edit contextual city and regional maps via the map creator services
- subsume policies and updates according to the needs and restricting access and traffic for the city and the port via the policy making interpreter services, and restrictions.
- detect changes in the mobility context due to city events via the real-time status detection services as part of the pilot
- ingest transportation means routes status and locations via by the PIXEL Operational Tools. This will be done by building upon existing infrastructure established in previous project, and in particular, the PPA Community Nodes. These nodes will be utilized to facilitate the information sharing among the Port and City authorities and the engaged network of users (trucks, cars etc)
- transform changes detected, compute (new) routes and push actions to the on-line route calculation services
- push routes and routes updates to embarked mobile devices of the vehicle drivers

6.3. Main objectives and expected impact

6.3.1. Objectives of the use case

The Port of Piraeus overall use case objective is to create a development strategy that meets the demands on transport in and around the port area while at the same time mitigating the negative impact on the environment and on specific social groups. The PIXEL use case will lead PPA to **efficiently implement** sustainable, cost-effective and environmentally friendly **measures** regarding **transport demand** around the port area and mobility. The use case will make use of the PIXEL Hub integrating data from the different data sources, to improve synchronization of mobility services and improve the awareness of the general public. It will **enhance** the **PPA visibility and awareness** through the PIXEL platform operational tools and will **improve collaboration** and logistics operators with the City and authorities.

Previous objectives will be mainly targeted by actions triggered through environmental monitoring in terms of air quality and noise levels. They have been decomposed and grouped considering these both perspectives.

1. **Air quality monitoring** related objectives encompass:
   a. to *reduce GHG* by means of rationalizing the traffic in the cities of Piraeus and Athens around. 3% when fully deployed. This will be achieved by delivering plans to address the impact of city events and tourism, i.e. the arrival of passenger ships and cruisers, improving logistics efficiencies, minimising idle times, GHG emissions and operational costs. Real time monitoring of air quality directly operated by the port with weekly, monthly and annual reports:
      - 2 sensors already implemented measuring the following parameters: quality indices ($NO2$ and $O3$).
      - 1 sensor already implemented in testing phase measuring PM1;0
      - 1 sensor to be implemented measuring the $NO2$ and $SO2$ parameters

      The main objectives of the monitoring are: to ensure periodic supervision, to check the tendencies, to intervene in case of alerts, to realize punctual studies generated from the raw data collected

      Periodic air quality study and modelling by the national agency in charge of air quality monitoring.

   b. to mitigate the traffic-related air quality impacts on the environment. Through the exchange of experiences, PIXEL use case in the Port of Piraeus will produce mobility concepts for effective mobility management measures in the port areas which are ready for implementation, generate knowledge and result in:
      - facilitation of transport intermodality in passenger traffic
      - development of innovative methods to overcome bottlenecks in the transportation network
      - creation of a positive awareness of sustainable transportation methods
      - promotion of the acceptance of public transport in port cities
      - improvement in the quality of life and the economic situation in port areas

      The PPA use case aims to create a development strategy that meets the demands on transport in and around the port area while at the same time mitigating the negative impact on the environment and on specific social groups.

   c. to *have predictions* for the effect at the city (emissions alarm mapping) by the air emissions associated with the Cruise and passenger Terminal assisting in this way the policy makers to develop the most appropriate and effective reduction strategies.
   d. To *reduce accident risks* by introducing standardized processes to be followed by vehicle drivers. entering the port.

2. **Noise level monitoring** related objectives encompass**:**
   a. to *estimate the port noise level portion* of contribution from the port activity to the residential area.
   b. to *have adequate data for noise mapping* and real time alert system.

c. to accurately estimate the *noise level impact of the Container Terminals* in the residential area
d. to *reduce the residential area complaints* due to the port activities noise levels
e. to *limit the noise levels effect* at the residential local community area, especially during the night.

Figure 16 depicts an overview of the PPA use case which is focussed on a clear impact on passengers.

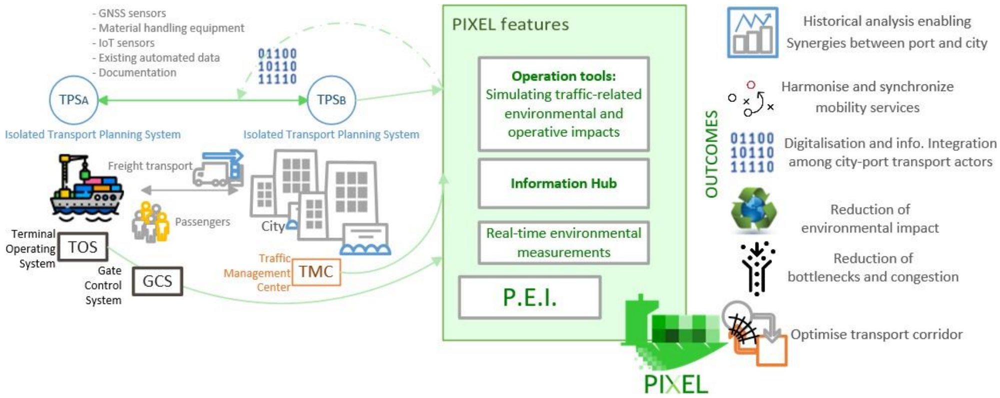

Figure 16. PPA use case overview

The port of Piraeus will use PIXEL technology to set up a mobility use case. PPA will utilize the Port Environmental Index, the PIXEL Platform and its associated interface (HMI) to self-monitor and appraise of different mitigation measures in order to define and apply effective mobility management measures in the port surrounding area aiming at the improvement of the air quality, energy consumption, noise, relationship with local community, port development (land related) and dust KPIs.

In particular, the port wishes to model, simulate or perform data analysis on the noise and air emissions from the container terminal and passenger /cruise terminal activities respectively. The noise distribution at the port of Piraeus needs to be addressed via modelling the following activities:

- Co-evaluate in combination with the results of LAeq indicator measurements in order to have adequate data for noise mapping in the residential area.
- Estimate the noise level impact of the Container Terminal in the residential nearby area.
- Determination of the main sources that dominate the noise emitted by ships during port operations.
- Overview of the possibilities to attenuate the noise sources with technical solutions.
- Assess the key noise source in the area.
- Determine the noise levels per activity fluctuation during the period of study.
- Estimate the influence of the air emissions related with the port activities (cruise and passenger terminals) at the city

6.3.2. Expected impacts and KPIs

PIXEL will be constantly led by the stakeholder’s strategy, which will be fed and monitored during the project progress, applying an impact mapping technique. The Impact Analysis and Monitoring Framework of PPA pilot case will be applied in order to collect and analyse data using the Project’s assigned measurable indicators (KPIs). The KPIs and measurements will in turn be linked to the PIXEL interventions in the PPA use case. The data for analysis of impact (external data, PPA IT and field measurement data), in addition to traditional techniques, as surveys, questionnaires etc. will be gathered, cleansed and integrated via the PIXEL framework direct connections to the deployed services.

In the last two decades, transport-related greenhouse gas emissions have increased substantially, one third of these emissions is attributed to freight transport. The execution of this use-case is expected to result in an overall CO2 reduction compared to the as-is situation and other economic and quality of service improvements.

The PPA use case is expected to bring the following impacts:

1. Capacity of the PIXEL solution to suppose an improvement of the access to the seaport. Through the exchange of experiences, the PPA use case, will produce mobility concepts for effective mobility management measures in the port areas which will generate knowledge and will result in the improvement of the access to the seaport.
2. Make use of PIXEL to the **mitigation of traffic-related impacts** on the environment. PIXEL will mitigate the port's total traffic, through the analysis and simulation use case models of the ports' traffic structure in relation with the Noise and Pollution levels.
3. **Facilitate transport intramodality** in passenger traffic. o PIXEL will facilitate the development of a strategy that will meet the demands on transport in and around the port area while at the same time mitigating the negative impact on the environment and on the passenger groups.
4. Incorporate innovative methods to reduce road congestion around the port area by the creation of a positive awareness of sustainable transportation methods.
5. To incorporate **new methodologies** for **mobility planning** and management for smart ports.

Considering the previous points above, PPA could be spotted in a clear position with regards to the global impacts of PIXEL. In the following table the 4 impacts identified in the proposal are listed. The goal is to centre how PPA's use-case will contribute to each one of them. The scale ranges from 0 to 3, being 0 non-relevant for the use-case and 3 the maximum impact.

Impact identified in the proposal	Port of Piraeus use-case
Climate change and environment	3
Operational and infrastructural costs	0
Logistics efficiency	0
Port-city relations/integration	2

Thus, it can be summarised, about impacts addressed, that PPA is clearly focused on environment (pollution, mostly) and port-city relations:

f. **Climate change and environment**: Air and noise pollution monitoring systems will be deployed and/or enhanced to feed properly simulation models to establish impact and anticipate actions to reduce the effects.

a) **Operational and infrastructural costs:** Not applicable for this use case.
b) **Logistics efficiency:** Not applicable for this use case.
c) **Port-city relations/integration:** The pollution impact on the city is provided and may be accessed by the policy makers be informed or also take mitigation measures whenever possible (traffic management). Primarily in summer time, when tourism rate is higher, the traffic jams caused by vessels berthing in the port and bringing tourists into the city, several concerns are raised that could be addressed and mitigated by the bounties of PIXEL

On the other hand, regarding the KPIs expected to reach within PIXEL in this use-case, it is worth to mention that the following figures (see Table 10) are only a rough estimation considering we are still in month 9 of the project. Data has been extrapolated from the original established goals (GA KPIs) and adjusted to current reality. The impacts have been more detailed textually, but the final figures are still being evaluated by the port teams.

Table 10. Use-case KPIs for the Port of Piraeus

Impact	KPI	Current value	Forecasted impact
Reduction of impact on climate change and the environment of port activities	Greenhouse gases (GHG) emission / carbon footprint	108300 T, to be recalculated	Reduction > 10 %
	Fine particles emission (NOx, SOx…)	To be calculated	Reduction >10 %
	Environmental leadership (Green Marine Indicator)	1	3-5
	PEI adoption	No	Yes
	PEI improvement	Not measured	Improvement >20%
Local adoption of PIXEL solution	Local IoT platform implementation	No	Yes
	Number of sensors / devices connected to the local IoT platform	0	5-30
	Number of types of data (sensors) connected to the local IoT platform	0	Air quality, Meteorological data
	Number of end-users	0	15

6.4. User stories and scenarios

In order to provide a more detailed view of expected specific actions for the general Port of Piraeus use-case in the different port operations a set of user stories have been drafted for a better identification of targets and requirements, as depicted in Table 11. From each actor, one or more scenarios will be described as a sequence diagram. Each scenario has an ID so that it can be better referenced at requirement analysis phase (task T3.4)

Table 11. User stories for Port of Piraeus

As a/an	I want to …	So that …
Environmental operator	Estimate the influence of the air emissions related with the port activities (cruise and passenger terminals) at the city	The port will develop air pollution dissemination models based on evaluation of air quality measurements and meteorological data
	Have predictions for the effect at the city (emissions alarm mapping) by the air emissions associated with the Cruise and passenger Terminal	The port will enhance further the Air Quality monitoring network by establishing an additional air quality monitoring station 24/7 in the Cruise Terminal.
	Co-evaluation with results of LAeq indicator measurements in order to have adequate data for noise mapping and	Establishment of a permanent noise monitoring network with suitable sensors for24/7 measurements of Lden indicator in the Container Terminal area

	Accurate estimation of the noise level impact of the Container Terminal in the residential nearby area	Establishment of a permanent noise monitoring network with suitable sensors for24/7 measurements of Lden indicator in the Container Terminal area

6.4.1. Environmental Manager (PPA-EM-1)

The scenario overview (as sequence diagram) is depicted in Figure 11Figure 17. It mainly refers to a datamining scenario for pollution, which currently does not exist in the Port of Piraeus. The flow is as follows:

- Several data sources must be connected to PIXEL. For each relevant data source, a specific connector at the PIXEL data Acquisition Layer will be developed:
  - **External data sources**: meteorological data, vessel traffic monitoring data and traffic volumes in the greater port city area.
  - **PPA IT systems**: The N4 EXPRESS systems from PPA will provide information about cruises, vehicle movements, ship arrivals, etc.
  - **PPA field measurements**: air quality data from the air quality station.
- All this information will be integrated in the PIXEL hub.
- A pollution model will be able to get all environmental related information accessing the PIXEL hub and generate a result, which will be stored as a facility from the Operational Tools. The result may depend on:
  - Space: pollution across a geographical area. The result may be represented in a map or GIS.
  - Time: pollution throughout one day on a per hour basis. The result may be represented as a bar chart (each hour). Furthermore, two graphs may be overlapped in order to show one specific aspect of the pollution vs the total amount.
- The dashboard is able to retrieve and display the result through the Operational Tools (OT) API.
- The environmental manager can access the dashboard to see the result of the model.

Through the model simulations the aim is to estimate the influence of the air emissions related with the port activities (cruise and passenger terminals) at the city and have predictions for the effect at the city (emissions alarm mapping) by the air emissions associated with the cruise and passenger Terminal.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (Data Acquisition Layer, PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1
EU Legal framework to be considered	SafeSeaNet , Air Emissions , Air Pollution, Greenhouse Gases, Sulphur Dioxides, EU data protection rules

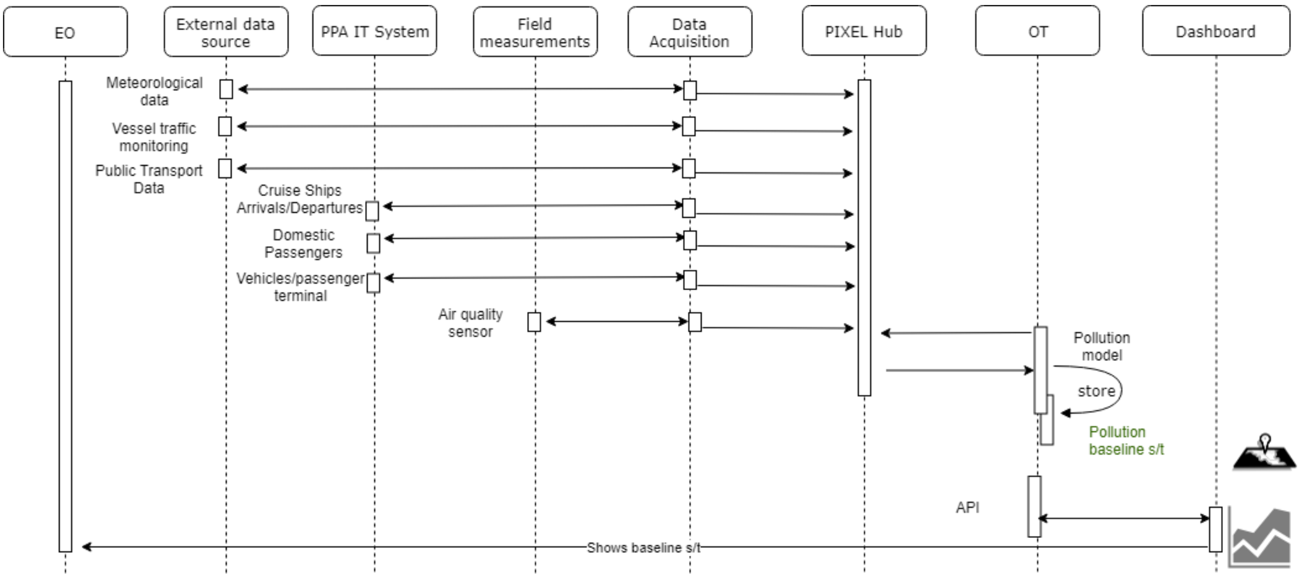

Figure 17. Environmental manager at PPA. Sequence diagram

6.4.2. Environmental Manager (PPA-EM-2)

The scenario overview (as sequence diagram) is depicted in Figure 18. It mainly refers to a datamining scenario for noise, which currently does not exist in the Port of Piraeus. The flow is analogous to the previous scenario, but this time considering noise sources:

- Several data sources must be connected to PIXEL. For each relevant data source, a specific connector at the PIXEL data Acquisition Layer will be developed:
  - **External data sources**: meteorological data, vessel traffic monitoring data and traffic volumes in the greater port city area. This is the same as for the previous scenario (PPA-EM-1), but concerning noise.
  - **PPA IT systems**: the ORAMA ERP and N4 EXPRESS systems from PPA will provide information about container dangerous cargo, vehicle movements, car terminal data, ship arrivals, etc. This is the similar as for the previous scenario (PPA-EM-1), but concerning noise.
  - **PPA field measurements**: noise data from 25 spots around the port.
- All this information will be integrated in the PIXEL hub.
- A noise model will be able to get all (noise) environmental related information accessing the PIXEL hub and generate a result, which will be stored as a facility from the Operational Tools. The result may depend on:
  - Space: noise across a geographical area. The result may be represented in a map or GIS.
  - Time: noise throughout one day on a per hour basis. The result may be represented as a bar chart (each hour). Furthermore, two graphs may be overlapped in order to show one specific aspect of the noise vs the total amount.
- The dashboard is able to retrieve and display the result through the Operational Tools (OT) API.
- The environmental manager can access the dashboard to see the result of the model.

Through the model simulations the aim is to run simulations and co-evaluate the output with the results of the LAeq indicator measurements in order to have adequate data for noise mapping and establish an accurate estimation of the noise level impact of the Container Terminal in the residential nearby area.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (Data Acquisition Layer, PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	2
EU Legal framework to be considered	SafeSeaNet , European maritime single window environment, Port Reception Facilities, Transport regulation, EU data protection rules

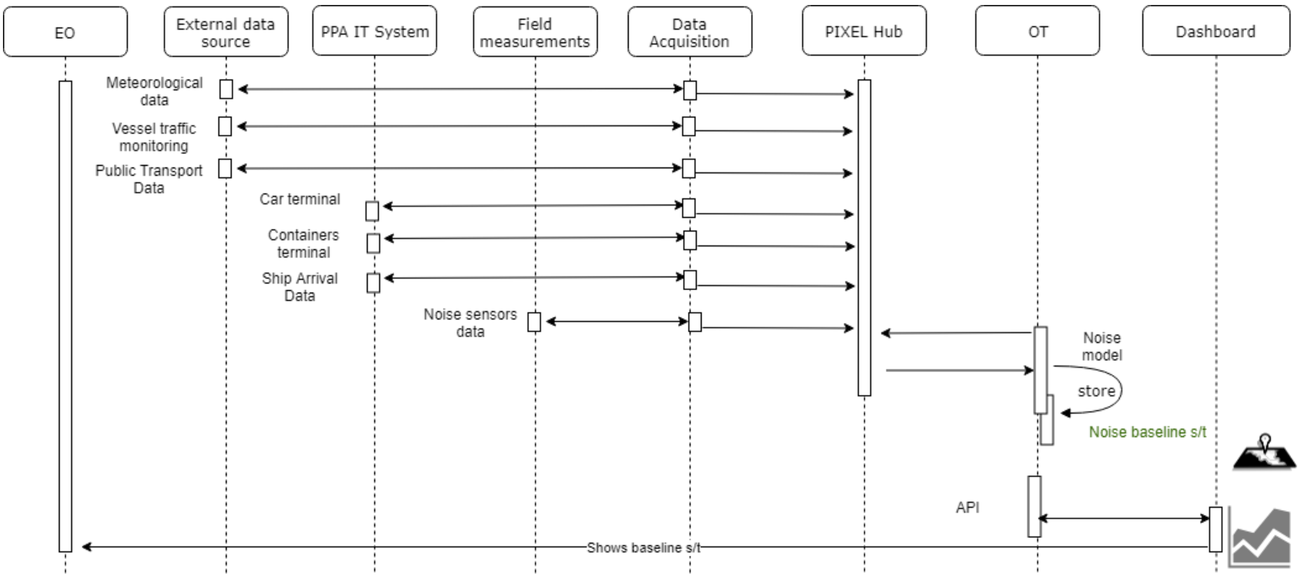

Figure 18. Environmental manager at PPA (II). Sequence diagram

7. Use case of the Port of Thessaloniki

7.1. Main changes from the previous version

The purpose in this deliverable relates to providing useful and clear descriptions of the use cases and scenarios. Therefore, most of the contextual information of ThPA has been completed/updated and shifted to Appendix E in order to better focus on the use case and involved scenarios. The current deliverable springs from user stories to develop the scenarios and identifies actors and interactions.

7.2. Challenges for the Port of Thessaloniki and PIXEL contribution

ThPA SA, as operator of the port of Thessaloniki, is responsible for the protection and conservation of port environment and for ensuring that necessary social and environmental considerations, are included in any decision-making process regarding port operations (Tubielewicz, 1995). Despite possible increase of revenues, or technological advances, protection of port environment from all forms of pollution, continues to be a central objective of ThPA SA.

While cost reduction may drive operational and technical innovations, sustainability is also a true shareholder value for ThPA SA. While difficult to list on balance sheets, it provides a longer-term payback, measured in Thessaloniki's residential acceptance, which is one of the expected outcomes, from the PIXEL project.

In this framework, ThPA SA will rely on PIXEL's PEI (Port Environment Index), using it as a universal language among ports and stakeholders, stating its environmental efficiency on port operations. Furthermore, gathering operational data from port activities, measuring its environmental state and the consolidation of all, in one single platform, is sure to assist in the decision-making process. ThPA SA expects to take advantage from the PIXEL solution, in order to better handle the freight traffic in the surrounding area, through the creation of an IoT platform to share data and make interoperable different types of information and sensor systems.

ThPA SA has identified three main challenges for its future, as described below.

7.2.1. A greener more cost-attractive port

Cleaning up shipping and its emissions is a hot topic, pushing the whole industry towards a greener future, with governmental mandates for achieving regulatory compliance, including safety, security or environmental requirements. Meeting these requirements has been typically perceived as added costs. However, ThPA SA considers that the port's environmental compliance, could be transformed into a **business attribute**, that would produce an enhancement of a port's competitive position.

ThPA SA port environmental policy, as far as cargo handling is concerned, is to minimize nuisance and environmental impact caused by port operations, with the ambition, to further develop port operations, without affecting the air quality of the wider area. All users of the port of Thessaloniki, should be challenged to work on this ambition, which requires effective operation of port traffic, terminal operations and hinterland transport. The outcomes of the project are expected to assist in this effort.

The challenge for ThPA SA, is to **accommodate port operations and port development** that meet its short- and long-term goals and ambitions, **related to the environmental state**, as perceived by owners, users and stakeholders of the port or required by legislation. However, so far, it lacked the tools.

That is why, ThPA SA will use the **outcomes of the PIXEL project as a leverage**, in order to ensure that all interested parties are involved in the decision-making process. As the Port authority, ThPA SA must seek to identify alliances with all stakeholders that have a liability or responsibility towards green shipping/differentiated charging schemes, in order to share knowledge, experience and some of the costs.

7.2.2. A more citizen-friendly port

In recent years, ports all around the world have been demonstrating an increasing commitment to environmental protection and sustainable operations through a variety of actions, mandates and initiatives. Ports, coastal cities and their local communities are amongst the most vulnerable to extreme weather conditions, resulting from global warming. Those marine ports, that are located close to major cities, must become integrated into their surroundings, to ensure that a sustainable development takes place in harmony with the economy and social development of the port itself and of the host city.

ThPA SA, due to the proximity of the port to the city of Thessaloniki, considers air quality a top priority. ThPA SA has strived through numerous initiatives and investments to raise awareness and improve the acceptability of the citizens. However, today, there are no relevant indicators to show to the citizens the strong commitment of ThPA SA, to reduce the environmental impacts of its activities. Approaches, such as an ISO 14001, are not port specific and only prove that a port has environmental procedures and wants to improve itself continuously, but it does not measure its environmental impact. Undoubtedly, **implementing the PEI** within the scope of PIXEL will assist ThPA SA in **assessing and communicating the environmental impact of its operations**.

For ThPA SA, sustainability must translate into lower environmental footprint and, thereby, lower costs: attractive for both the port and its users.

7.2.3. A wiser port

Although, ThPA SA is constantly striving to improve its environmental footprint, decision tools to feed its policy are missing. There are a number of benefits deriving from carefully measuring the port’s environmental impact, since one can only manage what can be measured. Apart from bettering its environmental state and strengthening its relationship with the citizens of Thessaloniki, increasing their acceptance, ThPA SA will use the **outcomes of the PIXEL project to boost its knowledge of port’s operations and act proactively**, in order to minimize all impacts (congestion/bottlenecks, air quality).

Through the **incorporation of cost-effective sensor platforms** and computing facilities and tools, ThPA SA will exploit the information gathered from the devices already installed and new, in order to render traffic and port operations eco-friendly. The PIXEL project will provide ThPA SA, an **advanced decision support** tool for investigating managerial and policy implications in an eco-friendly framework. Accurately tracking its emissions, requires investment and the establishment of comprehensive monitoring systems composed of meters, sensors and recorders. Once such a platform is set, Terminal operators can then focus on the areas or procedures that can be optimized, by correlating between processes and corresponding equipment, giving priority to areas (or procedures) with realistic reduction potential and a cost-benefit ratio. Such procedures are:

- Process-centric practices, such as gate policies in order to specify a time slot during which trucks are allowed to enter the port area;
- Relationship-centric practices, such as training operators (of machinery, vehicles, etc.) with the goal of minimizing bad practices that can have a negative environmental impact

In that way, best practices can be identified, that simultaneously reduce the negative impacts of port operations on the environment and improve Terminal performance metrics, providing insights for investment decisions.

7.3. Main objectives and expected impact

7.3.1. Objectives of the use case

ThPA SA considers its environmental identity a serious matter and an asset; through the PIXEL project aims to: (i) Improve the economic efficiency and rationalize its use of resources, (ii) Improve and strengthen the firm’s market position through the promotion of services designed to be eco-friendly, and (iii) Improve risk management processes by strengthening and promoting collaboration among companies, suppliers, customers, local authorities, research universities and environmental groups.

The use case of the Port of Thessaloniki focuses on the interoperability of city and port in freight traffic and in pollution impact towards the city. The expectations from THPA for the project and the particular execution of its use case are the following:

1. To optimize the traffic between the city and the port area and thus alleviate congestion or bottlenecks, caused by its operations.
2. To measure air and noise pollution thus being able to establish mitigation actions to reduce its environmental impact while at the same time, strengthen its relationships with the city of Thessaloniki.
3. To integrate existing systems and devices (already installed and new) with the broader platform of PIXEL

All available information sources for environmental monitoring of port activities will be fused to populate an online platform presenting in real time environmental measurements from a variety of operational areas (e.g. inferred emissions from the container handling equipment in the Container Terminal based on TOS feedings, inferred emissions from vessel operations, measurements from online sensors etc.).

Moreover, the Port of Thessaloniki will gain insight about:

- Inbound and outbound traffic flows
- Environmental footprint of the port

The study and evaluation of the above will allow ThPA to identify traffic bottlenecks, optimise traffic flows and reduce the environmental impact for the port and the city of Thessaloniki

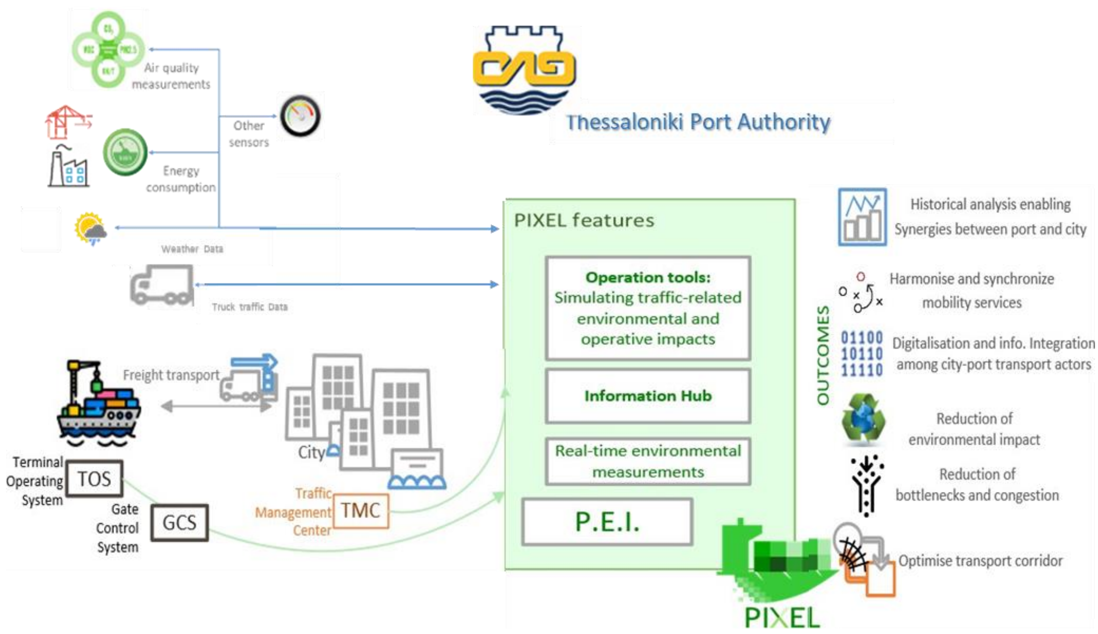

Figure 19. Port of Thessaloniki use-case overview

The port of Thessaloniki will use PIXEL technology to set up a port city integration use case. ThPA will utilize the Port Environmental Index, the PIXEL Platform and its associated interface (HMI) to monitor and appraise of different mitigation measures in order to define and apply effective measures in the port aiming at the improvement of the air quality and noise.

PEI implementation of ThPA SA will focus on air quality and noise aspects. Aim will be, in collaboration with the ports operations stakeholders and the traffic management system of the city to optimize trucks flows and mechanical equipment used for port operations in order to minimize environmental impact. Currently, only PM_{10} measurements exceed the limit requirements of the legal framework. The use case will focus on these measurements and their combination with the other measures currently done.

The Port of Thessaloniki is very close to the city center. During the last five years' business activities have been transferred to the surrounding area of the Port. A number of luxury hotels and new business centers have been constructed just outside the port area, thus being directly influenced by normal daily port activities. As consequence they face the problem of dust and noise due to their proximity to the port, although the port is offering a great view to their customers and employees. Moreover, the industrial area of Thessaloniki, the main bus station and logistic centers are all located at the west side of the city; it is an area already environmentally burdened.

The main truck gate of the Port is on its west side and imposes a significant amount of traffic during the peak hours.

The Port of Thessaloniki through PIXEL, and combining all available resources, will collect, monitor and publish real time traffic and environmental data. Data analysis will enable the port to identify periods of time with emissions above accepted levels and optimise inbound and outbound truck flows and mechanic equipment movements.

7.3.2. Expected impacts and KPIs

The pilot in the Port of Thessaloniki will focus on achieving digitalisation and information integration synergies among the port, the city and the transportation actors. By combining the data already collected (weather, wind, dust, noise, trucks, etc.) with new PIXEL data ThPA will try to develop new solutions in order to reduce environmental impact without affecting productivity.

The use case expected impacts are the following:

1. Monitoring and optimization of inbound and outbound truck traffic
2. Reduction of CO_2 emissions and acoustic pollution in port surrounding areas
3. Optimization of port's mechanical equipment use
4. Optimization of planning and managing in port areas

Considering the previous points above, ThPA could be spotted in a clear position with regards to the global impacts of PIXEL. In the following table the 4 impacts identified in the proposal are listed. The goal is to centre how ThPA's use-case will contribute to each one of them. The scale ranges from 0 to 3, being 0 non-relevant for the use-case and 3 the maximum impact.

Impact identified in the proposal	ThPA use-case
Climate change and environment	1
Operational and infrastructural costs	2
Logistics efficiency	2
Port-city relations/integration	3

Thus, it can be summarised, about impacts addressed, that ThPA is clearly focused on environment (emissions, mostly) and port-city relations:

a) **Climate change and environment**: Information that is received (traffic congestion, noise, air quality, pollution, PEI) can help greatly to develop an improved, less-environmental impacting relation towards the city of Thessaloniki.

b) **Operational and infrastructural costs:** PIXEL will provide insight on significant factors that influence costs (infrastructural, maintenance, etc.) and assist in the decision-making process, offering the tool for a more sustainable use of infrastructure and machinery.

c) **Logistics efficiency:** Alleviate bottlenecks / congestion.

d) **Port-city relations/integration:** Use of resources in a more sustainable way and adoption of "greener" practices, so the image towards the citizens, and the actual impact created to the nearby area will be decreased**.** This use-case will also impact the port and the community through the concept of “democratization of the information”. ThPA SA will be able to share more information on port’s impact to the environment and to the city.

On the other hand, regarding the KPIs expected to reach within PIXEL in this use-case, it is worth to mention that the following figures (see Table 12) are only a rough estimation considering that the PIXEL consortium is still in month 9 of the project. Data has been extrapolated from the first established goals (GA KPIs) and adjusted to current reality. The impacts have been more detailed textually, but the final figures are still being evaluated by the port teams.

Table 12. Port of Thessaloniki use-case KPIs

Impact	KPI	Current Value	Forecasted impact
Reduction of impact on climate change and the environment of port activities	Greenhouse gases (GHG) emission / carbon footprint	9380T	Reduction between 15~20%
	Fine particles emission (NOx, SOx…)	N/A	Measurement and a final reduction >10 %
	Environmental leadership (Green Marine Indicator)	1	3
	PEI adoption	No	Yes, and demonstration through an integrated pilot on-premises during the project.
	PEI improvement	Not measured	Ports actions will contribute to the improvement of PEI
Reduction of operational and infrastructural costs	Electric energy consumption	9,9 GWh	Reduction to 85% of current consumption
	Total energy consumption	23 GWh	Possible decrease (long-term view)
Local adoption of PIXEL solution	Local IoT platform implementation	No	Yes
	Number of sensors / devices connected to the local IoT platform	0	At least 2 (Air quality, Meteorological)
	Number of types of data (sensors) connected to the local IoT platform	0	At least 2
	Number of end-users	0	At least 2 (Stakeholders of the use case)
	Number of operations modelled	0	5 handling operations (conventional cargo, containerized, dry/liquid bulk, cereal) Entry/exit of trucks

7.4. User stories and scenarios

Knowledge of port's operations processes and to the data collected can be used for predictive models and/or algorithms in order to assess the current situation and optimize truck and mechanical movements. The main expected results are: (i) better insight of inbound and outbound traffic, (ii) reduction of air pollution (iii) reduction of the congestion in the port area, and (iv) Reduction of noise in the port surrounding areas. All the afore mentioned results can broadly affect all end users such as the port itself and all members of the port community.

In order to provide a more detailed view of expected specific actions for the general ThPA use-case in the different port operations a set of user stories have been drafted for a better identification of targets and requirements, as depicted in Table 13. From each actor, one or more scenarios will be described as a sequence diagram. Each scenario has an ID so that it can be better referenced at requirement analysis phase (task T3.4)

Table 13. User stories for the Port of Thessaloniki

As a/an	I want to …	So that …
Terminal Operator	To estimate the impact of the current inbound / outbound flow of trucks entering /exiting the port, considering the actual traffic in the nearby (city)	We can regulate the number of working entry/exit gates to optimize the inbound/outbound traffic without impacting too much in the city traffic (alleviate bottleneck).
Environmental Manager	Estimate the air pollution impact of bulk cargo operations to the city due to specific/bad forecasted weather conditions, for the next day	We can make decisions to decrease the impact (sprinkling, reduce number of operations, etc.)
	Estimate the air pollution impact of handling cargo (loading / unloading) to the city due to specific/bad forecasted weather conditions, for the next day	I can have a clear picture of the quantity that adds to the pollution of the city
	Estimate the air pollution impact of handling cargo (loading / unloading) to the city due to specific/bad forecasted weather conditions, for the next day	I can have a clear picture of the parts of the city that are affected by port operations (as result of air pollution dispersion models)
	Estimate the amount of noise from operating machinery for handling cargo (loading / unloading) to the city	I can have a clear picture of the quantity that adds to the noise of the city
	Estimate the amount of noise from operating machinery for handling cargo (loading / unloading) to the city	I can have a clear picture of the parts of the city that are affected by port operations (as result of air pollution dispersion models)

7.4.1. Terminal Operator (ThPA-TO-1)

Currently, the gate appointment system at the entrance/exit of the port is not automated nor based on quantitative values. This causes that, often, if a truck enters at a certain point of time, it can be stuck for two hours due to internal occupancy (machinery in use, waiting area congestion, etc.). The port does not count with a vehicle booking system, vehicle appointment nor anything similar. The aim of PIXEL in this scenario is not to create that of a complex system, but to have more data available to make decisions on the gate appointment.

The scenario overview (as sequence diagram) is depicted in Figure 11Figure 20. It mainly refers to a predictive scenario for traffic, which currently does not exist in the Port of Thessaloniki. The flow is as follows:

- Some data sources are identified and must be connected to PIXEL. For each data source, a specific connector at the PIXEL data Acquisition Layer will be developed:
    - **ThPA IT system**: it will provide information about ship calls.
    - **External data sources**: traffic in the neighbourhood will be gathered from traffic volume data.
- All this information will be integrated in the PIXEL hub.
- A predictive model will forecast the traffic in the port by means of accessing the PIXEL hub, extracting the necessary data and generating a result, which will be stored as a facility from the Operational Tools. The result may be time dependent: traffic forecast throughout one day on a per hour basis. The result may be represented as a bar chart (each hour).
- The Terminal Operator request the ThPA IT system for an estimation of inbound/outbound traffic. It interacts with the OT API to get this information, acting as proxy. Depending on the result, the Terminal Operator may trigger some specific action, e.g. opening an additional gate to alleviate the traffic.
- From another point of view, the dashboard is able to retrieve and display the result through the OT API, thus the Terminal Operator can (potentially) also access the dashboard to see the result of the model without the use of the ThPA IT system.

Through the traffic predictive model, the aim is to estimate the inbound and outbound traffic related with the port activities. Some triggering action will relate internal (e.g. opening an additional gate), but this information can be shared with the municipality and road authorities to generate an integral traffic mitigation plan.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (Data Acquisition Layer, PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	1
EU Legal framework to be considered	SafeSeaNet, European maritime single window environment, Transport regulation, EU data protection rules

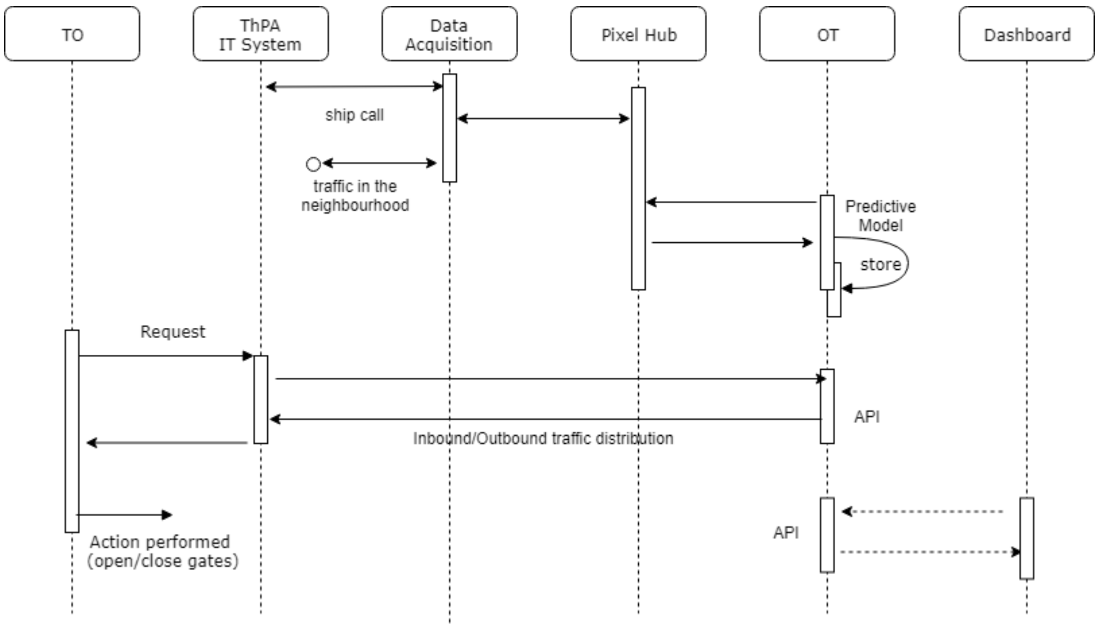

Figure 20. Terminal Operator at ThPA. Sequence diagram

7.4.2. Environmental Manager (ThPA-EM-1)

The scenario overview (as sequence diagram) is depicted in Figure 21. It mainly refers to a datamining scenario for air pollution, which currently does not exist in the Port of Thessaloniki. The flow is analogous to the previous scenario, but this time focussing on air pollution:

- Some data sources are identified and must be connected to PIXEL. For each data source, a specific connector at the PIXEL data Acquisition Layer will be developed:
    - **ThPA IT system**: it will provide information about ship calls and, specially, for those affecting bulk and handling cargo operations. According to the type of cargo, a certain number of machinery is involved, which will be mapped to a certain amount of pollution.
    - **Environmental data sources**: both data from sensors deployed in ThPA as well as weather information from external data sources are identified and connected to the Data Acquisition Layer. If we have the (air) pollution values from the city, we can compare both. Data sources on this regard:
        - Noise-measuring portable device, that can measure noise at certain points, but it cannot be done in real time.
        - Currently, pollutants are measured in two points of the port (check data availability for THPA in Appendix E). With this PIXEL may get a comparison with other sources more related to the city pollution, thus the system can infer the pollution associated only to the port.
        - Station measuring the force and direction of the wind in real time.
- All this information will be integrated in the PIXEL hub.
- An air pollution model will simulate the air pollution impact by means of accessing the PIXEL hub, extracting the necessary data and generating a result, which will be stored as a facility from the Operational Tools. The result will indicate the quantity that adds to the pollution for the city (e.g. 15-20%) as well as the parts of the city more affected (e.g. depending on the weather). Through a number of studies in ThPA, it has been determined that the worst wind direction for the dispersion of pollution to the city, is the southwest, combined with humidity. Such information may not be that relevant for the model itself, but probably for the CEP (Complex Event Processing) able to react on certain rules (e.g. configured thresholds).

  The result of the model may be time dependent (pollution forecast throughout one day on a per hour basis) and/or space dependent (pollution forecast by areas).
- The Environmental Manager request the ThPA IT system for an estimation of the air pollution impact. It interacts with the OT API to get this information, acting as proxy.
- From another point of view, the dashboard is able to retrieve and display the result through the OT API, thus the Environmental Manager can (potentially) also access the dashboard to see the result of the model without the use of the ThPA IT system.

Through air pollution model, the aim is to estimate the air pollution impact related with bulk and handling cargo activities. The predictive model may accept input parameters for letting environmental operators alter a factor (e.g. weather conditions for next day), and then provide a picture of the amount and area that will get affected by port operations. Some sort of visualization by dispersion maps is envisioned. All (air) pollutants are relevant. The developed model should try to generate any potential assumptions (e.g. pollution deriving from ships, machinery and trucks) and combine them. Currently PM10 is the primary pollutant to observe.

Some triggering action will relate internal (e.g. delay cargo operation) to the port, but this information can also be shared with the municipality to generate an integral environmental plan.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (Data Acquisition Layer, PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	2,3

EU Legal framework to be considered	SafeSeaNet, Air Emissions, Air Pollution, Greenhouse Gases, Sulphur Dioxides, European maritime single window environment, Port Reception Facilities, Transport regulation, EU data protection rules

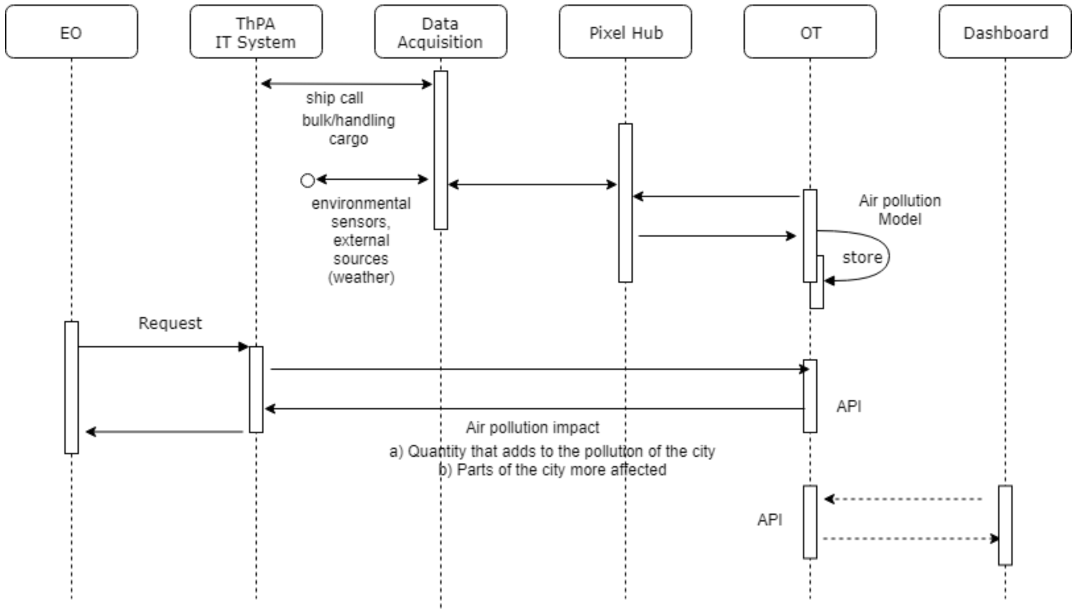

Figure 21. Environmental manager at ThPA. Sequence diagram

7.4.3. Environmental Manager (ThPA-EM-2)

Currently, the port receives a significant amount of complaints from the city regarding noise and pollution caused by the port. With this user-story and the associated predictive algorithms and model we intend to develop a prediction of the noise and pollution, some information of the most impactful operations/areas and to provide recommendations for decision making. THPA expects PIXEL to provide the information in order to be able to make wiser decisions with regards to the city impact caused by the port.

The scenario overview (as sequence diagram) is depicted in Figure 22. It mainly refers to a datamining scenario for noise pollution, which currently does not exist in the Port of Thessaloniki. The flow is analogous to the previous scenario, but this time focussing on noise pollution:

- Some data sources are identified and must be connected to PIXEL. For each data source, a specific connector at the PIXEL data Acquisition Layer will be developed:
    - **ThPA IT system**: it will provide information about ship calls and, specially, for those affecting handling cargo operations in order to map it to the involved machinery to be utilized for such operations (and how much noise they generate).
    - **Noise data sources**: currently ThPA does not have data on noise, other than the annual measurements; therefore, some noise sensors will be deployed and connected to the Data Acquisition Layer. Berthing position are fixed, thus the area of loading/unloading (noise source) and thus the optimal place to place the sensors.

      Noise data, from the city, if available (currently not) will also be connected.
- All this information will be integrated in the PIXEL hub.
- A noise pollution model will simulate the noise pollution impact by means of accessing the PIXEL hub, extracting the necessary data and generating a result, which will be stored as a facility from the

Operational Tools. The result will indicate the quantity that adds to the noise for the city (e.g. 15-20%) as well as the parts of the city more affected. Therefore, the result of the model may be time dependent (noise forecast throughout one day on a per hour basis) and/or space dependent (noise forecast by areas).

- The Environmental Manager request the ThPA IT system for an estimation of the noise pollution impact. It interacts with the OT API to get this information, acting as proxy.
- From another point of view, the PIXEL Dashboard is able to retrieve and display the result through the OT API, thus the Environmental Manager can (potentially) also access the dashboard to see the result of the model without the use of the ThPA IT system.

Through noise pollution model, the aim is to estimate the noise pollution impact related with handling cargo activities. Some triggering action will relate internal (e.g. re-schedule operation) to the port, but this information can be shared with the municipality to generate an integral environmental plan.

Links with other WPs	WP4 (models and predictive algorithms) and WP6 (Data Acquisition Layer, PIXEL hub, Dashboard and Operational Tools).
Main objectives targeted of this use case	2,3
EU Legal framework to be considered	SafeSeaNet, European maritime single window environment, Port Reception Facilities, Transport regulation, EU data protection rules

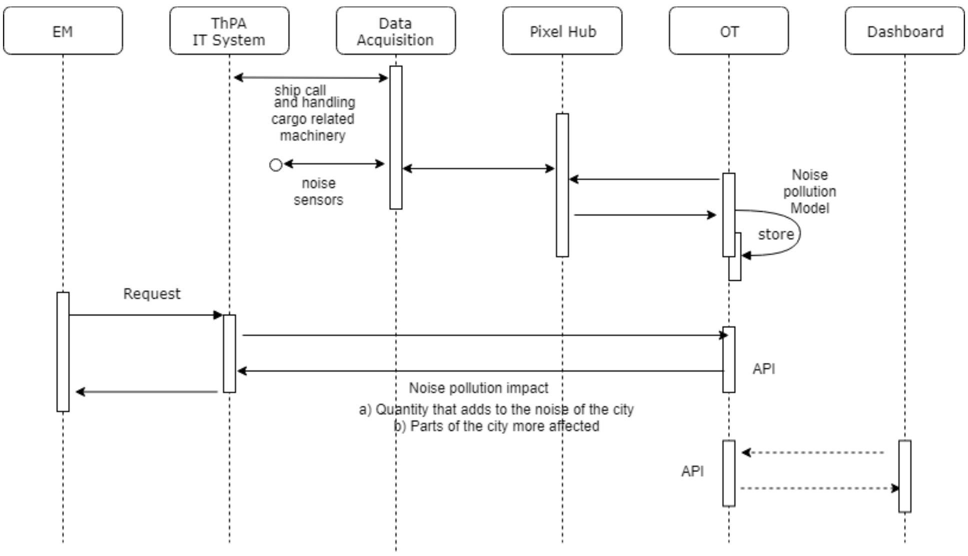

Figure 22. Environmental manager at ThPA (II). Sequence diagram

Conclusions

This document describes in detail the different use cases and scenarios in the PIXEL project. Considering the target topics (energy management, intermodal transport, port-city integration and PEI) it is blatantly obvious that the PIXEL project is extremely concerned about environmental impact as we consider it as a fundamental cornerstone of the Port of the Future.

However, translating environmental policies, actions and systems to port operations is extremely heterogeneous caused by the nature of each port, as they range from small, medium and large and have different resources available and even different strategies.

Therefore, for each of the four ports involved in the PIXEL project (Port of Bordeaux, Port of Monfalcone-SDAG, Port of Piraeus and Port of Thessaloniki) and in-depth study has been performed in order to:

- **Translate** the corresponding use case to the needs of each port, defining **challenge**s, **objectives, KPIs** and **expected impact**.
- **Describe** the particularized use case simply by means of a set of **user stories** that anyone can understand.
- **Formalize** the user stories in **sequence diagrams** to identify actors and interactions
- **Identify** all **available data** to perform sensing, acquisition and processing
- Serve as **reference document** to finalize requirements (D3.2), define models in WP4 (D4.1, D4.2), and better describe PIXEL technology components in WP6 (D6.1)

The **Port of Bordeaux** deals with **energy management**. The port authority of Bordeaux is mainly interested in modelling and predicting the consumed energy in the different port operations in order to better manage and develop a plan for renewable energy. The introduction of an interoperable IoT platform with their VIGIEsip (GPMB's PCS) software is another relevant goal to succeed in the use case. **Eight different scenarios** have been described to target all the specific goals of this use case.

The port of Monfalcone deals with intermodal traffic where traffic management can be potentially better managed by means of sharing data with other entities, not only with SDAG (inland port), but also with other public entities (local and regional) in order to build an integral plan. The user stories have been summarized into 6 **different scenarios.**

The **Port of Piraeus** and the **Port of Thessaloniki** deals with port-city integration, which relates to promoting cooperative actions between the port and the nearby city in terms of environmental impact. The Port of Piraeus is mainly involved in **air and noise monitoring** and infer the impact on the city caused by **passengers** (cruises). On top of that, different policies may be defined to alleviate or mitigate the impact. The user stories have been summarized into **2 different scenarios**. The Port of Thessaloniki, on the contrary, it is mainly important to model the impact of goods (containers), not passengers. The user stories have been summarized into **3 different scenarios**.

Note that for each port, there will always be a scenario including the **Port Environmental Index** (**PEI),** a single metric to measure the environmental impact. One of PIXEL most innovative outcomes will be the PEI and therefore we will need to test it in as many pilot ports as possible in order to better compare and evaluate it. The description of the PEI will be subject to detailed work within WP5.

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Appendix A – Questionnaires

As it has been stated at different parts of the document, a common work that all ports have been asked to carry out is the completion of questionnaires to extract information. These questionnaires (when all properly fulfilled and recollected) will help to describe and contextualize each use-case on a common basis, to serve as a development lever for further technical packages in the project.

A.1. Questionnaire template

The template that has been distributed to the stakeholders (ports) for compiling information are the following:

A.1.1. Environmental questionnaire

(1) Does the port have an environmental policy including clearly defined objectives, targets, timelines, measurements, etc. In other words, does the port have implemented an Environmental Management System (EMAS)?

(2) If yes, what type of EMAS?

(3) If yes, is the EMAS accredited by a third-party accreditation body?

(4) Is the port fully complying with the national environmental legislation?

(5) Provide a brief description on how environmental responsibilities are being managed (please provide an organogram, if possible)

(6) Do you have an environmental officer?

(7) How many people in the organization are specifically employed to be working on environmental issues?

(8) What is the yearly budget which is being spent on environmental actions?

(9) Does the port go beyond legal environmental compliance?

(10) Does the management perceive environmental actions to be a cost or an asset to the ports operations?

(11) Is the port taking any action to improve its environmental performance or is just passively monitoring the impact? If yes, what are the actions undertaken?

(12) Do the employees that work on environmental issues feel that they are making real and meaningful difference with respect to ports environmental performance?

(13) How big is your potential market? Why?

(14) Please specify the costs of monitoring activities

(15) Please specify if data on waste generation are being collected

(16) If yes, does any information exist on what type of waste is being generated (hazardous v. non-hazardous)?

(17) What are the approx. the costs of managing waste?

(18) Is the port using the port environmental data for marketing purpose?

(19) Are there any environmental issues with the local communities?

(20) What are the main barriers for improving the environmental performance of ports (costs, the management doesn't think it is very important, lack of initiatives, etc.)

(21) Which are the environmental-related sensors implemented?

(22) Which sensors do you feel to be more important to incorporate in PIXEL?

A.1.2. Modelling and data analysis questionnaire

The following questions are related to port activities that ports wish to model as part of the PIXEL project. The aim is to have a first definition of the problem to model. A definition as clear as possible of the objectives of the models and its scope are required to conduct study. Overall this should lead to an exhaustive view of the questions that we must try to answer in the WP4. The use-case should provide a vision as detailed as possible of the needs and constraints of the model, that is to say "what" and "why", in order to allow us to provide WP4 the "how".

It is worth to mention that, despite of create for WP4 input, the information contained in these questionnaires' answers could be modified later. This responds to the lack of perspective that ports may have about what can be done with their available data or what not. It is up to each task within WP4 to decide an particularise each model scope and final form.

About the port activities to model and / or analyze

(1) *What port activities does the port wish to model, simulate or perform data analysis?*

(2) *What type of need does this scenario respond to? (e.g. piloting of the port's activities, regulatory constraint, communication, budgeting, strategy of investment).*

(3) *Is this need critical or optional?*

(4) *What are lack of the tools already in use that we are trying to fill through this model?*

(5) *Can you describe the events involved in the activities to be modeled?*

(6) *For these activities, what are the problems to be solved?*

(7) *What is the objective of the modeling that will be implemented? Should it allow to understand, measure, design, predict and / or optimize a port activity?*

(8) *What are the expected results of this modeling, data analysis and / or predictive algorithm? (e.g. numerical values on energy consumption, amounts of pollutant emissions, a decision support tool to optimize container evacuation, ...)*

(9) *What are the main constraints (execution, technical and / or regulatory) on the processes to be modeled?*

(10) *Which are the different actors taking part on the activities to be modeled? What are their interactions?*

(11) *Who will use the model? Who will give information to the model? Who will take info from the model? Who will be the operator? Who will be the recipient?*

(12) *What is the flow event within which the model takes place? Which elements will trigger modeling? Which elements will stop it? Which elements will depend on the result of the modeling?*

(13) *How frequently do you expect the model to be call?*

About the data on the port's activities to be modeled and / or analyzed

(14) *On the processes to be modeled / analyzed, can you identify the input data, the output data as well as the external parameters influencing the process? To your knowledge, are some input data of significant influence?*

(15) *Is there any data already available on these processes?*

a. *If yes, are these data already qualified?*

b. *In what form and by what means are these data collected today?*

c. *Are there any needs for new sensors to better know the inputs and outputs of the port activities to be modeled?*

d. *Is there any key date & factor (regulation, market shift, port infrastructure) to consider that can bring notable discontinuities into historical data.*

About the model type

(16) *What type of model is expected? A static model that focuses on the state of the system at a particular point in time (for example, a time-independent problem). A dynamic model that includes a temporal dimension with a focus on the evolution of a system in time.*

(17) *What is the degree of fidelity of the model that you need? A microscopic vision with the aim of representing in the finest possible way the system. This approach requires modeling many interactions and having the model inputs in a fine way. The model will provide more accurate results but will be less adaptable to different situations. A macroscopic vision based on an aggregation of information. The model will be less accurate but also requires less accurate data.*

(18) *What is the scope and the limits of the model? Generic: a large board spectrum of operation; Focused: targets only a very narrow subset of operations. What elements does the model have to consider? (e.g. the port itself, the boats waiting, the carriers in / out of the harbor, the neighborhood (city), ...)?*

(19) *What type of output is expected for the model ? Continuous: describe the state of a system at any point. Discrete time: describe the state of a system at fixed time steps. Discrete event: describe the state of a system event by event.*

A.2. Environmental questionnaires

A.2.1. Port of Bordeaux use-case

Questions	Answers, if applicable
(1)	Not yet. An ISO 14001 approach has been launched 3 yers ago.
(2)	N/A
(3)	N/A
(4)	-
(5)	An environmental department is integrated in the Works Direction.
(6)	Yes
(7)	4

(8)	-
(9)	In some cases, yes.
(10)	Mainly it is considered as a cost.
(11)	GPMB improves its environmental performance by being proactive : sediments management plan, building shelters for birds, bridges for toads, purchasing an innovative LNG dredge…
(12)	-
(13)	-
(14)	-
(15)	-
(16)	-
(17)	-
(18)	Not really.
(19)	Citizens start being worried about pollution due to cruise ships.
(20)	Costs, priorities oriented to the implementation of works
(21)	The sensors implemented in GPMB are related to navigation but not yet to environment.
(22)	"Air quality sensors are implemented by ATMO Nouvelle-Aquitaine but adding some more sensors may be interesting.

A.2.2. SDAG - Port of Monfalcone use-case

As it has been mentioned in section 5, SDAG (partner in PIXEL Consortium) plays an important role in the use-case of Monfalcone, participating in the objectives and being involved in the features to be improved by the project. Thus, SDAG has also been asked to compliment the environmental questionnaire in order to fully describe the use-cases. Here below their answers are attached:

Questions	Answers, if applicable
(1)	Not yet. An ISO 14001 approach has been launched 3 yers ago.
(2)	N/A
(3)	N/A
(4)	Yes (referring to emissions, checks on power systems, checks on wastewater, garbage management, …)
(5)	We have only one person responsible for environmental issues, directly depending on the Sole Administrator
(6)	No but we have a person responsible for environmental issues (directly depending on the Sole Administrator)
(7)	1 (but not only on environment, also security&safety)
(8)	Approx. 1.000.000 Euros
(9)	No
(10)	it is considered an opportunity to reduce costs of infrastructure managing
(11)	Yes, we have a solar power system, we're investing in building and power system efficiency and we are installing a "linear mirrow" system to warm water used by truck drivers to have a shower
(12)	No
(13)	

(14)	Approx. 25.000 Euros
(15)	Not always: if the waste is generated by SDAG customers and collected by the municipality waste management company no, if the waste is directly generated by SDAG yes when it have to de declared and correctly disposed
(16)	if the waste is directly generated by SDAG and have to be disposed we have detailed data on the type of waste
(17)	Approx. 45.000 Euros
(18)	Yes
(19)	No
(20)	Costs, we need public funds to invest on environmental performance
(21)	NA
(22)	NA

A.2.3. Port of Piraeus use-case

Questions	Answers, if applicable
(1)	PPA SA applies an Integrated Quality & Environmental Management System in compliance with the requirements of the ISO 9001:2015 and ISO 14001:2015 standards.
(2)	Piraeus port has been re-certified (for the 3rd time since 2004) for the implementation of the Environmental Management System in line with the principles and requirements of the revised edition of PERS (version 4). PERS (Port Environmental Review System) is an environmental management standard, well-established within the port sector. Developed by ESPO, especially for the port sector, in line with the requirements of other environmental management standards, such as the International Standard ISO 14001 and the Environmental Regulation EMAS.
(3)	PPA's certification commenced against ISO9001 and ISO14001 with LR in 2013, and has been recently been extended to cover the provision of port cruise, ferry, RoRo & container terminal services, as well as the management of a logistics centre, port construction & maintenance projects, therefore demonstrating PPA's strong commitment towards continual improvement and operational excellence across its very broad scope of activity.
(4)	Yes
(5)	An environmental department is integrated in the Works Direction.
(6)	Yes
(7)	2
(8)	80,000.00
(9)	In some cases, yes.
(10)	Asset. As the CEO of PPA indicated: "The port of Piraeus has included in its Strategic Planning the certification of the provided services and the protection of the environment. PPA invests in management systems applied worldwide aiming at continuous improvement of its services".
(11)	PPA is fully committed to meet its customers' needs and expectations, prevent pollution and mitigate any adverse impact its operations may have on the environment, fulfil the compliance obligations and enhance the effectiveness of the applied Integrated Quality & Environmental System.
(12)	-
(13)	-
(14)	-
(15)	-
(16)	-
(17)	-
(18)	Not really.

(19)	Citizens start being worried about pollution due to cruise ships. • Oil Transportation and stevedoring • Dangerous Goods Loading/unloading • Ship generated waste management • Dangerous waste • Noise Monitoring • Dust monitoring • Air emission monitoring
(20)	Costs, priorities oriented to the implementation of works
(21)	The sensors implemented in PPA are related to • Air Quality Monitoring Program (BTEX, SO2 ,CO, NOx, PM10, O3 / 24h) • Noise Monitoring Program (measurements Laeq, Ln, Lae etc) • Sea-water Quality Monitoring Program (pathogens, 0C, pH, TDS, DO, Conductivity, BOD & COD, heavy metals, nutrients, Oil hydrocarbons)
(22)	• Air Quality Monitoring Program (BTEX, SO2 ,CO, NOx, PM10, O3 / 24h) • Noise Monitoring Program (measurements Laeq, Ln, Lae etc)

A.2.4. Port of Thessaloniki use-case

Questions	Answers, if applicable
(1)	Yes, we are accredited according to ISO 14001 since 2015
(2)	ISO 14001
(3)	Yes, from TUV NORD GROUP
(4)	Pending
(5)	Internal Monitoring System for Environmental Terms progress (the “Mechanism”)
(6)	Yes
(7)	2
(8)	Almost €100.000
(9)	In some cases
(10)	We consider it as an important asset to the port operation.
(11)	
(12)	They consider that they do an important work for the port in the new era.
(13)	Pending
(14)	€70.000/per year
(15)	we keep records for all types of waste both from the port and the ships
(16)	We Know the EWC type of waste and the quantities per year
(17)	Almost €30.000/per year
(18)	Only in specific cases
(19)	The citizens and the authorities complain about the dust emissions from the port
(20)	Costs, pressure from the local industry
(21)	The sensors implemented are related to air quality
(22)	The sensors related to PM10 and PM2,5

A.3. Modelling and data analysis questionnaires

A.3.1. Port of Bordeaux use-case

Questions	Answers, if applicable
About the port activities to model and / or analyze	
(1)	The global needs of the GPMB is to model and analyse its energy consumption and production. Modelling and data analysis will be focused on ships operations to predict energy consumptions – both models and predictive algorithms could be used depending on the level of accuracy of the information in possession of GPMB for each case. Another point to focus, is the modelling of the energy production trough solar panels. It is planned (based on scenarios described in D3.4) that simulation will be able to predict, at least: i) energy consumption related to ships operations and involved logistics chain, ii) energy to cover consumption needs of the port (how much green energy the port could provide and anticipate how much will be needed).
(2)	The modelling of these elements partially or completely satisfies 4 needs: o Communicate on the overall energy consumption of the port (regulations and local partners) o Know the respective contributions of the various posts of energy consumption of the port (strategic of investment). o Anticipate the future energy needs of the port, particularly with regard to (i) seasonal fluctuations and (ii) the distribution of the types of ships supported by the port (investment strategy). o Compare the electricity needs of the port to its production capacity by a photovoltaic installation (strategic investment).
(3)	The fourth point is at the heart of a problem of choice of investment under investigation at the GPMB. It is an "optional" need in the sense that the port can continue its activities without responding immediately. But it is a "critical" need in the sense that it is at the heart of the use-case selected for PIXEL.
(4)	There is currently no tool for monitoring energy consumption in the port. Electrical consumption data are available, but they are currently not stored and analyzed. In addition, these data would only partially meet the needs expressed. It is hoped to add to the existing port activity management tools a new feature that can predict energy consumption for loading / unloading operations for each vessel supported for on-port.
(5)	a. Vessel call (n days before loading / unloading operations): i. Through its navigation plan, a vessel announces its intention to call at the port, usually with a delay of anticipation of several days (about 80% of the cases). ii. Through the Port Management Information System (PMS), these characteristics (identifier, goods, request for connection to the power grid of the port ...) are transmitted to the person in charge of loading / unloading operations. iii. Support of the ship (dock allocated, time of arrival (respected within a few minutes in 80% of cases), departure (respected within 2 hours in 80% of cases), type of chain logistics, etc. 8 types of logistics chains can be identified, depending on the nature of the goods to be processed and whether loading or unloading. b. Detailed logistics chain More details will be added later on this point.

(6)	The goal is twofold. On the one hand, predict for each boat declaring his arrival what would be the probable energy consumptions associated. On the other hand, to have a prediction of the overall consumption of the port at a time scale of the hour.
(7)	Historical data on the activity of the port can only partially be used to predict future needs (changes in vessel tonnage, regulatory constraints, machinery and procedures used ...). In addition, it is likely that this data (history of supported ships and electrical consumption) are not enough to allow sufficiently reliable prediction on a time scale from hour to minute. If GPMB had all consumptions from all electricity-consuming equipment, the port would not need a model (because energy consumption will be fully derived from electricity measurement sensors). The main goal here is to take advantage of the electricity consumption available, machine specification, and other contextual information to simulate and optimize the balance between energy produced /energy consumed / energy to be bought / energy to be provided. The component that provides extra value on simulation is also to know how the traffic will be changed, and to know if PIXEL will still be able to model this change and act consequently
(8)	The expected result of the modeling is a predictive quantification of the energy consumption (electricity, gas, diesel) that can carry according to the wishes of the operator on: • Spatial dimension: the entire port, a type of procedural chain, a dock, a material handler, a type of machine or a specific machine. • Time dimension: year, month, week, day, hour, minute, see a time interval between two arbitrary dates.
(9)	Anticipated logistic chains can be modified by various practical constraints (for example according to the meteorological conditions), which the model will have to take into account. However, it is not yet established that the PMS has this information, nor that it is possible to instrument the machines to know their consumption in real time (where even if or not they are in operation.
(10)	A full list of the different stakeholders will be identified later on.
(11)	The model will be used: • by identified port officials to produce reports (monthly and annual) • by the operators of the port to control the daily activity of the port in function of anticipated energy needs on the day. The necessary data will be automatically transmitted by the port management system to the pixel hub. This includes: • the "typical" logistics chain for the ship, • the detailed logistics chain • the energy consumption actually measured • the machine consumption or operating status • the weather conditions
(12)	Entry of a ship call in the PMS => triggers a first estimate of the "average" consumption (associated with the type of vessel and the amount of goods to be treated), which is added to the attributes of the vessel in the PMS.
(13)	For now there is not a clear answer about this.
About the data on the port's activities to be modeled and / or analyzed	

(14)	The following data could be used: • Expected calls and type of cargo: o FAL Forms (date of arrival, date of departure, cargos, dangerous goods…) o Statistics on calls o Characteristics of vessels (specific data on engines must be fetched in Lloyd's registries (IMO number is known)) • Electricity consumption on port premises (every 10 minutes) o Lightning o Building consumption o Reefers consumption • Characteristics of engine • Amount of kWh produced
(15)	Vessels' calls are already available in VigieSIP. Electrical consumption sensors are also available but the data are not stored yet.
About the model ype	
(16)	A statistic analysis of vessels' call. A dynamic prediction of energy consumption and production.
(17)	Starting with a macroscopic approach
(18)	We will focus only on the energy consumption and production that directly depends on the port authority of GPMB. Currently, energy consumption and production of 3rd parties are out of the scope of the modelling and data analysis exercise since GPMB may not be able to have access to their data due to legal issues. Moreover, there is plenty of actors when loading/unloading ships goods
(19)	More a discrete time model

A.3.2. SDAG – Port of Monfalcone use-case

Questions	Answers, if applicable
About the port activities to model and / or analyze	
(1)	The traffic management, in particular to intercept the truck,) for example starting from request to access to the port) and address the path transport in terms of parking area and modal transport, in order to avoid port and urban congestions.
(2)	The need is to improve the monitoring of the traffic in the regional territory, understanding who-where and what the transport in related to, in order to improve the management of the traffic by reducing congestions issues, environmental impact, accident risks and make more efficient the infrastructures available on all regional territory.
(3)	It is critical need, due to the fact that carrier are free to choose the type of transport, the public urban area are free and the risk is that they are used as parking area, without all service needed for a comfortable and sustainable parking.
(4)	The lack is the no connection, in terms of data and decision making, between the regional infrastructures (port and interport)
(5)	An event is when the truck cannot reach the destination during the weekend, due to the ban to circulate, as use urban area to park, impacting on the urban safety and impacting on the environment. What is useful to model is the case of the truck is intercepted and address in appropriate parking area (for example SDAG) or the port authority obligates to use the railwa
(6)	The main problem is to increase the awareness about the transport in the Region and to plan new rules that change transport behaviors of the private sectors, such as the shipping agent.

(7)	The model will help to understand if a different management of the traffic has a positive impact on congestions issues, citizens risk on the road, environmental impact
(8)	This point will be defined later during the execution of WP4.
(9)	This point will be defined later during the execution of WP4.
(10)	The actors of the use case Monfalcone Port: • Carriers (in the use case called Applicant,) • Port Authority; • Intermodal terminal; • Railway company The type of interactions are: • Applicant sends the request to obtain the permission to access to the port using SILI system • Port Authorities verifies all requirements to access to the port • Port Authorities checks the typology of the transport (what, when, where) • SILI system (evoluted by PIXEL) suggests the best modal transport (railway or road transport) and the possible parking area. • Applicant/truck driver is interceted by an app and receive indications. • In case of road transport SILI (integrated with sensoring network) verifies the parking availability o if there is availabilty in the Port area the permission is sent to the applicant o if there is not availability the request is share with SDAG o SDAG accepts the request o Applicant receives indication to go to SDAG o Port Authorities provides the permission to access to the Port for a different date compare to the request. • In case of railway transport, SILI (by PIXEL) shares the information with the railway company in order to manage the transport
(11)	The model will be used by Monfalcone Port,SDAG, the Regional Authority of Trieste Port, the municipality of Monfalcone, the Regional Government, the Regional Environment Agency (ARPA) The data provider will be Monfalcone Port, SDAG…
(12)	The answer is the same of answer n. 10. In addition, the elements that can trigger modeling will be the cooperation of shippers, of the highway operators by providing additional data related to the traffic on the regional territory. The element that can make weak the modeling is the scarcity of data in case of no cooperation with all regional stakeholder (public and private entities). From the modeling results it will be possible to understand what could be the actions, in terms of infrastructures and policies, that can improve the traffic management in the Regional territory.
(13)	This point will be defined later during the execution of WP4.
About the data on the port's activities to be modeled and / or analyzed	
(14)	Monfalcone and SDAG can provide more precise information on that (type of freight, number of truks per period, route,..). However, this point will be defined later during the execution of WP4.
(15)	Not defined at the moment of finishing D3.4. More information detailed to be provided by the port and SDAG for WP4 and WP6.
About the model ype	
(16)	Dynamic (to confirm when T4.3 advances)
(17)	Macroscopic

(18)	Initially, what must be considered is: type of traffic in terms of: freight typology, route, carriers, neighbordhood. However, This point will be more detailed during the execution of WP4.
(19)	Initially, discrete event. This point will be detailed during the execution of WP4.

A.3.3. Port of Piraeus use-case

Questions	Answers, if applicable
About the port activities to model and / or analyze	
(1)	The process that will be modelled is the noise and air emissions from the container terminal and passenger /cruise terminal activities respectively. The PPA port complex is the nation's largest passenger and cruise hub and includes its busiest container port complex. In this research effort, the noise distribution at the port of Piraeus needs to be addressed via modelling the following activities: • Co-evaluate in combination with the results of LAeq indicator measurements in order to have adequate data for noise mapping in the residential area. • Estimate the noise level impact of the Container Terminal in the residential nearby area.
(2)	• Determine the noise levels per activity fluctuation during the period of study. • Overview of the possibilities to attenuate the noise sources with technical solutions. • Assess the key noise source in the area. • Determine the noise levels per activity fluctuation during the period of study. • Estimate the influence of the air emissions related with the port activities (cruise and passenger terminals) at the city. • Have predictions for the effect at the city (emissions alarm mapping) by the air emissions associated with the cruise and passenger Terminal.
(3)	The Port of Piraeus overall use case objective is to create a development strategy that meets the demands on transport in and around the port area while at the same time mitigating the negative impact on the environment and on specific social groups. So, the need to know how pollutants (noise, pollution) affect the city is very important. Moreover, there are legal obligations, pollutants/noise must not exceed the thresholds set by legislation.
(4)	For now, there is some noise and pollution measurements but the port do not have a dispersion map or something similar.
(5)	Cruise and passengers' ships, and the large amount of associated bus and taxi traffic that transport cruise/coastal shipping passengers to and from tourist destinations and islands in the area, are one of the most problematic pollution sources by members of the PPA community.
(6)	The scope of the PPA model is to create a noise model and a pollution model with the establishment of baseline levels for both models
(7)	The problem is that there is a need to understand how noise and pollution produce inside the port affect the city
(8)	Both a dispersion map and a methodology to quantify emissions would be desirable.
(9)	Be able to have accurate measure of noise and pollution level that are emitted inside the port.
(10)	We will focus on cruise and ship passengers' emissions because they are the most problematic pollution sources

(11)	The environmental operator of the port in order to estimate the noise level produced by port activities in the container terminal so that I can have predictions of noise level impact on the city coming from the container terminals. And also, to have predictions of pollution impact on the city coming from cruise and passenger's ships related activity
(12)	To be defined later during WP4 execution.
(13)	Initially, whenever weather conditions are bad. However, periodic running of the model could be envisioned. To be detailed later during WP4 execution.
About the data on the port's activities to be modeled and / or analyzed	
(14)	The data for the modelling needs consist of three main categories: • External data sources: o Meteorological data form: § http://www.meteo.gr/index-en.cfm § https://opendata.ellak.gr/2018/02/06/anichta-meteorologika-dedomena-stin-ellada/ o AIS real time vessel traffic monitoring data (sources: https://www.marinetraffic.com/) o Public transport data from: § http://www.stasy.gr/index.php?id=1&no_cache=1&L=1 § http://www.oasa.gr/?lang=en • PPA IT systems: From the ORAMA ERP and N4 EXPRESS PPA system the following data will become available o Input data of containers, cargo and Ro-Ro; o Output data of containers, cargo and Ro-Ro; o Cruise arrivals/departures; o Cruise planning per date; o All domestic passengers per ship and month; o All vehicles (except commercials) per ship and month; o Ships arrivals and departures; • PPA field measurements: o Air quality data: An Air quality station has been installed and is under full operation in 24/7 mode. The monitoring indicators are: -CO, BTEX, NOx, SO2, PM10 and meteorological data. The monitoring program is been implemented in collaboration with the National Technical University of Athens since 2009. The data are available in excel form (24/7 per month) archives and in annually evaluation report. o Noise data: LAeq indicator, derived from 2 set of measurements per year in 25 spots around the port.
(15)	The former question (14) solves some of these questions. For more detais, WP4 will serve to carve further data needed.
About the model ype	
(16)	More like a static system
(17)	To be detailed later during WP4 execution.
(18)	It will be more a focused model
(19)	More a discrete time model.

A.3.4. Port of Thessaloniki use-case

Questions	Answers, if applicable
About the port activities to model and / or analyze	
(1)	The inbound / outbound of truck flows through Gate 16 (port's entry point) and the extent to which truck traffic contributes to the overall pollution of the city of Thessaloniki.
(2)	Supervision of truck flows (times of congestion, air emissions etc.), identification of issues arising from the activity, assist in the decision making process / optimize the procedure
(3)	Supervision of truck flows (times of congestion, air emissions etc.), identification of issues arising from the activity, assist in the decision making process / optimize the procedure
(4)	Tools for aggregation / integration of data, to gain a unified and more detailed view of how the Port's activities influence its environmental footprint. Some data is already available (e.g. flow of trucks using RFID tags), some isn't (e.g. the City's TMC).
(5)	- Truck entering the port, - laytime in ThPA premises, - exit of truck, - calculation and visualization of emissions caused by it, taking into consideration weather conditions - direction of dispersion of pollutants / contribution of the port to the overall air pollution of the city
(6)	Assumptions need to be made on the type of engines of the trucks, as well as the on the type of fuels and consumption
(7)	To understand, measure / visualize, design, predict and optimize the inbound / outbound flow of trucks, in order to minimize any environmental effects that might occur from the aforementioned operation
(8)	Visualization of the amount of pollutant emissions caused by truck flows, their contribution to the city's pollution, the ability to predict times of day (in regard with weather conditions) that congestion in the Gate occurs, thus higher level of pollution
(9)	Personal data constrictions, consolidation of data.
(10)	The different actors taking part in the activities to be modeled are shipping agents, carriers, port industry customers, truck drivers, mechanical equipment operators, City's TMS, Port Authority, customs agents .A shipping agent is the person (or company) who is responsible of transacts or supervises a ship's business, such as customs and immigration procedures, insurance, or documentation, on behalf of the owner. He is in constant interaction with the Port Authority (for the use of the port's premises, regulations, arrangements, etc.), customs agents, as well as, carriers and truck drivers, in order to arrange the cargo transportation. Carrier, is the person (or company) that undertakes the professional transportation of goods from the point of arrival (port, in our case) to the port industry customers. He interacts with shipping agents (as mentioned above), truck drivers, port industry costumers, Port Authority, mechanical equipment operators • A shipping agent contacts a carrier, in order to arrange the cargo's transportation on the day and time of the arrival of a vessel (or a predefined date, in cases of cargo storage). He interacts with customs agents and the port Authority, to ensure the proper procedure is followed, documentation, etc. • The carrier, in turn, is responsible to make all the transportation arrangements (itineraries), ensure clearance certification, etc. He directly interacts with the Port Authority, truck drivers and customers. • Truck drivers are notified by the carrier for the date and time of the receipt of the cargo. They interact with port Authority employees, in order to enter the port's premises, mechanical equipment operators, who are the responsible for cargo handling, while they can be informed on the traffic of a certain route through the City's TMS. Finally, they interact with customers. • Port Authority, interacts with shipping agents and carriers (as mentioned above), and is responsible for granting access to the truck driver in the port's premises, after verifying all proper documentation. Is in constant communication with customs agents, as well as other public Authorities, involved in port operations (maritime police, etc.). Port Authority is responsible for the assignment of machinery and people, for land operations (loading/unloading, storage).

(11)	Preferably, real time data acquisition (of data coming from GCS - gate control system, weather station etc.) or data entry by accredited ThPA employees (administrators), who will also use the outcome. Results will be evaluated by specialized employees and assist in the decision making process. In the long-term, results will be shared with the city (through an application of free access?)
(12)	From the point of entry until the time the truck leaves the premises. At the same time, visualization of pollutants' dispersion (time correlated). The elements depending on the results is the flow rate at Gate 16 (entry point)
(13)	On a daily basis (if possible real time). This will be further detailed during WP4 execution.
About the data on the port's activities to be modeled and / or analyzed	
(14)	Input: Number of trucks, time of entry/exit, laytime of truck in ThPA premises, weather conditions (wind, temperature, rain), emissions (PM10 particles). Waiting time for trucks. Level Output: Initially, they could be: dispersion of pollution (Decontamination curves), optimum factor of truck flow to emissions caused, prediction of days/times of day to docks that congestion occurs (thus sites of higher levels of pollution). Waiting time for trucks. Level of congestion at the sorroundings of entry gates. This will be detailed further on during WP4 and WP6 (OTools, and Predictive Algorithms).
(15)	a. If yes, are these data already qualified? Not qualified yet. Available data: ThPA's Periodical measurements of PM10, Hourly measurements of PM10 by the Municipality of Thessaloniki, ThPA's meteorological data, Municipality's meteorological data, tonnage, b. In what form and by what means are these data collected today? Hourly measurements of PM10 (and other pollutants) by the Municipality of Thessaloniki (historical, since 1984): .dat files, (opened in excel) Spatial data: .dxf files, .shp files ThPA's meteorological data: half-hourly measurements of Temperature (°C), wind direction (degrees), wind velocity (m/s), relative humidity (%) Municipality's meteorological data: daily measurements of temperature, humidity, rain, wind direction and velocity • Entry / exit of trucks (RFID tags): Relational database (mysql)

	• Wind data (sensor installed inside ThPA): Relational database (SQL Server) • Pollution data #1 (from City's sensors, outside ThPA): http://www.ypeka.gr/Default.aspx?tabid=495&language=el-GR – static files for download in CSV, as far back as 1984 (Which measurements are of interest? PM10 only, or all?). No geo-information • Pollution data #1: PM10 & PM2,5 , from TSI8530 (portable handheld PM analyzer) used inside ThPA. Data downloaded locally in XLSX format. • Pollution data #2: Various pollutants (SO2, NO2, CO, PM10, PM2,5) from meteorological station, gathered 24x7. Sent (via SIM card) to Web logger airmonitors.net (web interface & export, API option mentioned on website). Also installed, a "TECORA echo PM" sampler, 10mins every hour, data gathered once a month, heavy metals in air (mean monthly value) • Temperature, relative humidity (%), wind direction/speed (TY sensor) export, static files in TXT (needs transformation) • Electricity consumption: manual data entry (from monthly electricity bills), for 9 electric substations (mid-voltage). Not all relevant data, only a subset: consumption in KWh, cosine, financial data. Stored in relational database (mysql). • Alternatively, https://meteringnet.deddie.gr (needs credentials), real IoT, sensors on elec meter, consumption every 15' (per substation), 9 substations. Option to download locally in XLS, CSV, PDF. • Real-time fuel consumption. Stored in relational DB & SAP, option to export to static files (CSV,..) • Sea water quality – every six months sampling of four points, mobile sampler, manual data entry of results c. Are there any needs for new sensors to better know the inputs and outputs of the port activities to be modeled? Necessity of new sensors may arise, due to the fact that PM10 particles are not monitored in real-time. d. Is there any key date & factor (regulation, market shift, port infrastructure) to consider that can bring notable discontinuities into historical data. Evolution of energy consumption over the last years, due to improvement of internal combustion engines.
About the model ype	
(16)	A dynamic model that includes a temporal dimension with a focus on the evolution of a system in tim
(17)	A macroscopic vision based on an aggregation of information. The model will be less accurate but also requires less accurate data.
(18)	Focused: targets only a very narrow subset of operations. While modeling, several elements need to be taken into account, such as: the total amounts of pollution caused by port operations, the port's proximity to the city, congestion at the Gate (entry point of the port)
(19)	Continuous: describe the state of a system at any point.

Appendix B – Use case of GPMB

B.1. Global context of the use case

GPMB (Grand Port Maritime de Bordeaux) is located on the Atlantic coast, just outside of Bordeaux, Region Nouvelle-Aquitaine capital whose population will shortly reach 1 million. GPMB is the focal point of a dense network of communication by river and sea, by air, by rail and by road. GPMB is a core port of the TEN-T (Trans-European Network of Transport) and belongs to the Atlantic Corridor.

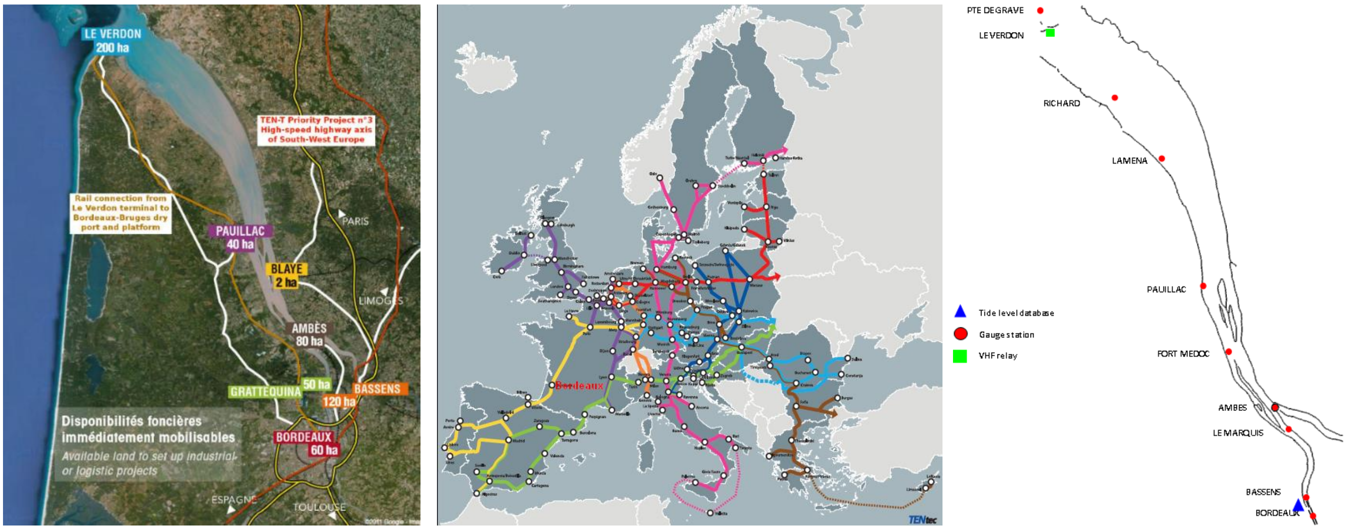

Figure 23. GPMB geographical situation and TEN-T location

GPMB ranks 7th of French ports and is located on the largest Natura 2000 European estuary. It totals 2% of French maritime traffic, i.e. 8 to 9 Mt/year. But this traffic is heavily based on hydrocarbon goods (fuels) and on cereals whose development is impacted by climate change.

Dredging the 120 km-long channel of the Gironde Estuary is one of the main concerns of GPMB. Whereas the trend of maritime shipping is going towards larger and larger vessels, the deepening of the channel faces several phenomena: the decrease of the river flow due to climate change results in less efficient natural dredging, severe environmental regulations lead to demanding operational process and, finally, the financial pressure for the port authority is very strong.

The increase of cruise ships traffic has raised the awareness of citizens about the impact of maritime activities in terms of pollution and health. Although its strategy is in line with the EU's ambition (a secure, competitive and decarbonised transport and energy system in 2050), GPMB has to align its communication and actions with Bordeaux Metropolis "high quality of life" plan.

As a reminder of the key role of the port area, one might notice that its energy consumption reaches 11% of that of Bordeaux Metropolis.

Premises & infrastructure

Concerning the energy field, GPMB is an electricity service supplier to industrialists settled in its land in Bassens. During the energy audit conducted in the frame of PEEPOS[4] Startup project, it has been measured that GPMB bought 3.3 GWh of electricity in 2014 but has consumed itself only 0.5 GWh: 2.8 GWh were delivered to GPMB's clients. GPMB owns several old warehouses whose rooftops area reach about 30000 m². In theory it might be possible to produce enough photovoltaic energy to supply the port needs. But the produced energy

[4] http://www.peepos.eu

must be consumed straight away to avoid expensive storage (batteries) and deep studies need to be conducted to get an optimized electricity network and attractive tariffs to avoid peak consumptions.

Concerning air quality and pollution matters, GPMB has decided to go beyond regulations and has invested 16 M€ to build an innovative water-injection LNG propelled dredge, l'Ostréa. This is an extra 4 M€ investment compared to a classical dredge. Because this dredge will be mainly used in Bordeaux Metropolis, GPMB has anticipated the most severe regulations about the air quality (NOx and SOx emissions). Furthermore, the design of Ostréa should bring enhanced dredging efficiency while reducing sediments movements in the Estuary.

Regulatory context

Grand Port Maritime de Bordeaux (GPMB) is a public company whose unique shareholder is the State. Since the law of 4 July 2008 "*réforme des ports*", its missions are refocused on the state activities (security, safety and port police) and the function of development of the port area. These missions must be done with sustainability, combining economic development, respect for the environment and promotion of a multimodal transport policy. GPMB must ensure its development in harmony with that of the territories on which they are implanted.

To do so, GPMB owns its lands and defines its strategies to attract industries and businesses. It must also ensure the safest conditions to accommodate vessels and logistics activities: dredging, quays maintenance and cleaning are daily tasks.

The Port of Bordeaux doesn't belong to any Sulphur Emission Control Area (SECA[5]). Some local alert procedures about air quality may be put in place especially to monitor SOx emissions in industrial areas such as ports.[6]

More information regarding the European, national and local regulatory context can be found in Annex F.

B.2. Current environmental position

GPMB has an environmental department with 4 people. Their missions are the following:

- Know the environment
  - Monitor the pollution on port land
  - Monitor the port environment (water, air, sediment)
  - Ensure regulatory compliance of the port and its activities
  - Know the natural habitat at the port (plants, wildlife, wetlands)
- Develop the area sustainability
  - Promote the reuse of soil excavated during construction
  - Dispose of excavated soil in accordance with regulations
  - Ensure the hydraulic neutrality of any developments
  - Apply the concept of Avoid, Reduce and Offset to all projects
  - Be exemplary on construction sites
  - Prevent noise pollution arising from port projects
  - Engage in an industrial ecology process
  - Promote rail, inland waterway and maritime transport
  - Have a land use strategy
- Control pollution
  - Prevent pollution of soil and groundwater

[5] Sulphur Emission Control Area
[6] https://www.atmo-nouvelleaquitaine.org/article/dispositifs-prefectoraux-dalerte

  - Promote the in-situ treatment of polluted soil
  - Avoid landfilling whenever possible
  - Manage flood risks
  - Develop alternative solutions for managing storm water
  - Improve water management
  - Limit the impacts of dredging and sediment management
  - Maintain a high level of cleanliness at the terminals
  - Aim towards a target of "zero pesticides" for green spaces, railway tracks, docks.
  - Assess the contribution of the terminals to the quality of the air
  - Assess the noise emissions of the terminals and minimise noise
  - Reduce energy consumption
  - Reduce GHG emissions
  - Develop the use of renewable energy
  - Reduce drinking water consumption
  - Reducing waste at the source
  - Improve waste management
- Inform and educate
  - Educate and inform about the environment internally and externally
  - Publicize the port, its activities and its actions
  - Publicize the key actions of the port's partners

Besides the generic position of the port towards environmental actions[7], it has been particularly relevant for PIXEL the viewpoint and current standing of GPMB with regards to impact measuring, standardization, quantification and, namely, the comparison of their approach with other present initiatives.

In this sense, during the execution of task T3.3, both GPMB and other entities involved in its execution went through a deep research about interesting platforms/initiatives/entities aiming at measuring and controlling the environmental impact associated to port operations.

In the course of the action, three points were finally tracked down. The results of this analysis are depicted in the three tables below. With this task, the Consortium has been able to, somehow, spot the port in the common space of research. Though it is remarkable that nowadays a common methodology for this benchmarking does not exist, both GPMB and other partners in the Consortium (PRO, CERTH) consider this approach valid and accurate.

Firstly, in Table 14 there is a comparison of GPMB's current and future perspective about the most relevant environmental components that compose the impact of the port. We have utilised the reference of Green Marine Program initiative to establish this match.

This program initially catalogues the importance of each impact with a number (1 to 5). In PIXEL we have created a colour-code to depict this approach and to model the relevance for GPMB. Here is the caption:

5	Excellence and leadership
4	Introduction of new technologies
3	Management plan &footprint measurement
2	Systematic use of a defined number of best practices
1	Monitoring of regulations

Finally, the table is the following:

[7] L'environnement, pilier du développement responsable et durable, https://www.bordeaux-port.fr/sites/default/files/images/contenus-site/Port-politiq%20environn-HD-PaP.pdf

Table 14. GPMB's environmental position benchmarking – Green Marine

Potential KPIs for Ports	Current Level	Expected Level (2020)
1. Aquatic invasive secies	1	Maintain the current level
2. Greenhouse gases and air pollutants	1	
3. Spill Prevention	3	
4. Dry bulk handling and storage	2	
5. Community impacts	2	
6. Environmental leadership	4	
7. Waste management	3	
8. Underwater noise	1	

Secondly, the Consortium proceed with a slightly different approach: to use the reference of the ESPO's Port Performance Indicators[8], in the umbrella of the project PPRISM.

PIXEL's approach has been to, drawing from the list of the performance indicators with regards to environment, position our port (GPMB) and to analyse how far are we from achieving measurement of each one of the indicators. This has been done through the following table, indicating next to each KPI the data source needed for the measurement and whether it is available or not in GPMB in this moment of the project.

This will help both WP5 and WP7 in the future to establish sensors needed, data to consider and guidelines on the implementation of the PEI in GPMB.

Table 15. GPMB's environmental position benchmarking - PPRISM

PPRISM KPIs for Ports		Relevance 1:low 2:medium 3:high	DataSource N/A or reference	Automatization Yes/No
Energy & Water	Total energy consumption by annual cargo handled.	3	For Port Authority only	Electricity: Yes
	Total water consumption by annual cargo handled.	3		Other energies: No
	Ratio of renewable energy per total energy consumed	3		Water: Maybe
Emissions to air	Total Greenhouse Gas Emissions	3	Data given by environmental department	Not yet
	NOx, SOx, PM10, VOCs CO, O	3	ATMO N-A ofr PM10	
	Lden (overall day-evening-night noise level)	3	No data	
	Lnight (23:00 - 7:00hrs noise level)	3		
	Compliance with limits at day, evening and night time	3	No data	
Discharges to water	Thermal conditions	3	Sensors may be installed: a study is on-going that may imply installation of sensors.	Yes, in the future (GIRONDE xL 3D program)
	Oxygenation conditions	3		
	Salinity	3		

[8] Port Performance Indicators, Grant Agreement No TREN/09/SUB/G2/170.2009/S12.552637, PPRISM, ESPO

	Nutrient condition	3		
	Turbidity/Transparency	3		
Ecosystems and habitats	Existence of an inventory of environmental Aspects	-	Part of the environmental department activities.	
	Existence of an environmental Monitoring programme	-		
	Number and results of EMS audit/review/certification	-	None	
	Self Diagnostics results (SDM)	-	Green Marine Program on-going	
	Compliance	-	N/A	
	Number of prosecutions for non-compliance	-	N/A	
Transport	CO2 emissions by annual cargo handled (Carbon Footprint)	-	From terminal operators	No

Finally, after the knowledge gained with this activity, the ports created another document. This time it was not a comparison but an indication of environmental KPIs relevant for each port, freely identified and catalogued following similar approach.

Table 16. Potential KPIs for GPMB

Potential KPI for Port	Relevance 1:low 2:medium 3:high	DataSource N/A or reference	Automatization Yes/No
Aquatic invasive secies	2	Report	N/A. Often they are qualitative KPIS.
Greenhouse gases and air pollutants	3		
Spill Prevention	3		
Dry bulk handling and storage	N/A		
Community impacts	3		
Environmental leadership	3		
Waste management	3		
Underwater noise	1		
Parking area occupancy	2		
Local IoT platform implementation	3	KPIs to be assessed by PIXEL	NO
Number of sensors to the local IoT platform	3		
Number of types of data (sensors) connected to the IoT platform	3		
Number of end-users of PIXEL solution	3		

B.3. Technical context

Sensors and existing networks

In order to manage the port activities and especially port calls, GPMB has developed various dedicated solutions such as gauge stations network, vessel traffic systems and radars, and specific devices to control and to secure the "*Pont de Pierre*" crossing by river barges.

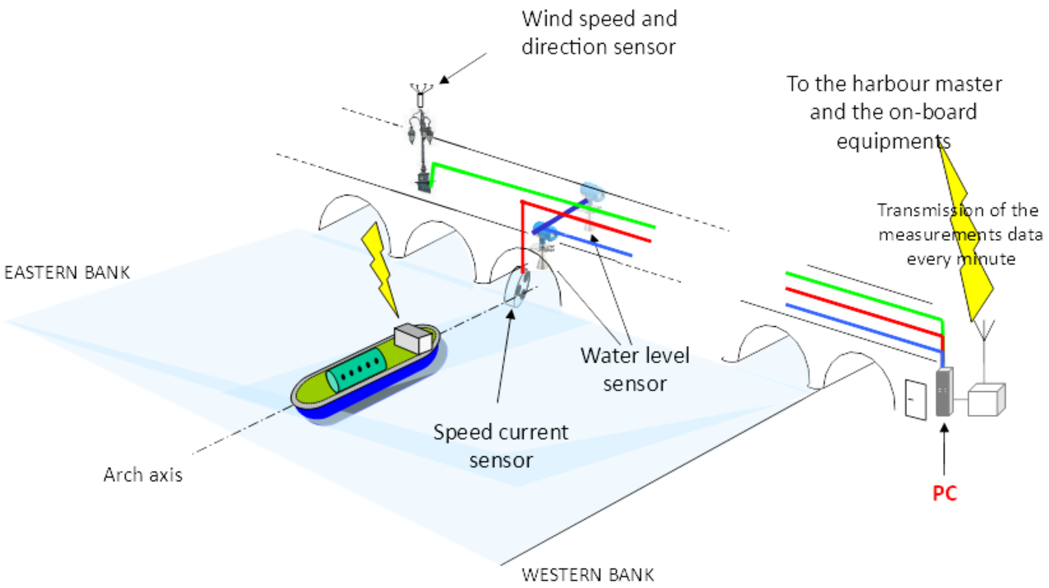

Figure 24. Pont de Pierre crossing structure and network

The architecture chosen by GPMB relies on PC (Personal Computer) motherboards providing serial and parallel connections to sensors, network connections, and calculation power. The PCs collect and store data from sensors, achieve some calculations (for instance filtering data), transmits voice messages to boats (on-board equipment) and send data to GPMB's database servers.

Gauge stations network

Each gauge station sends regularly, via a home-made protocol based on VHF, the level of the water measured. The choice of VHF has been made because there is no 3G-4G services in some areas of the Estuary and because it is the most reliable technology in case of crisis (storm, saturation of mobile communications networks…). Some gauge stations (Laména, Richard) are not connected to the electricity network so they need batteries, solar panels and even fuel cells.

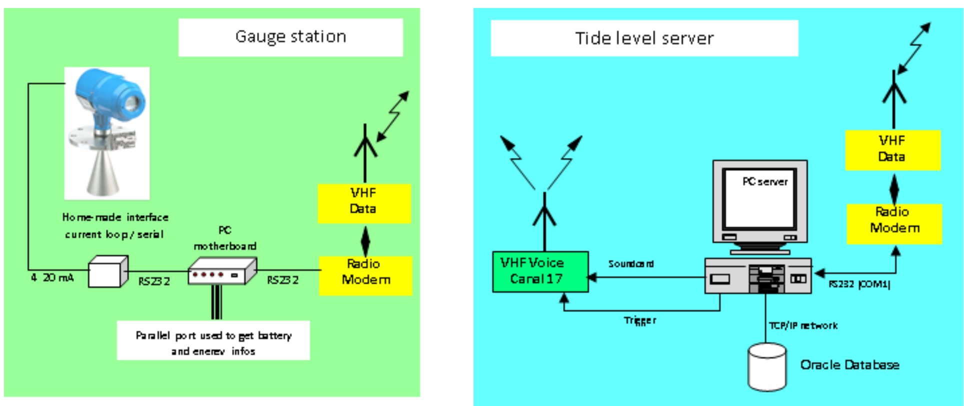

Figure 25. Architecture of gauge station and the tide level server

The "tide level" server collects data from the gauge stations, stores data in a database and generates every five minutes a voice message indicating the tide level of each gauge station. This message is transmitted to vessels navigating on the river by VHF.

The Port of Bordeaux will analyse with CATIE the appropriate IoT platform to be deployed by taking into account the existing equipment and devices. The specificity of GPMB is the existence of an optical fiber network in Bassens: the connection of some sensors or of other IoT components won't need wireless network. Nevertheless, the sensors disseminated along the river Garonne and the Estuary of Gironde would need a major upgrade of their wireless connection (tailor-made protocol based on VHF) to the GPMB's database servers.

Furthermore, during the execution of task T3.3, GPMB (supported by other technical partners of PIXEL) analysed the most affecting parameters in relation to the environment in Bordeaux area. Afterwards, the Consortium made an exercise to identify the type of sensors that could help measuring those. Finally, that information was matched with the existing sensors in GPMB and a "positioning" table was elaborated. The following table will be very useful in forthcoming work packages to know which information is available, which can be reached during PIXEL and how to address different actions (PEI deployment, pilot execution).

Table 17. Relevant environmental measurements and sensors available

Impacts of port activities sensors (to citizens)		**Availability in GPMB**	**Comments**
Air quality	Pollutant particles (Nox, Sox, PM10, PM2.5, ultrafine)	N	Existing data in ATMO N-A network
	Odour (chemical molecules)	N	
Water quality	Temperature	N	
	Oxygene rate	N	
	Salinity	N	
	Turbidity	N	
	Chemical molecules	N	
Noise level		N	
Lighting		N	
Vibrations		N	
Traffic jams	For instance : number of cars/trucks per minute	N	Bordeaux Metropolis may have the data
Energy consumption sensors/data			
Electricity (sensors)		Y	Integrated to GPMB's use-case. Means of transmission TBD
Fuel (quantity/data)		Y	To be typed weekly for dredges
Fuel quality (data)		Y	Typed only once
Environment and navigation sensors			
Tide level		Y	Stored in database
Wind		Y	Stored in database
Current		Y	Stored in database
Weather station	Raining time and sunny time (to predict the PV electricity production)	N	Included in GPMB's use-case

ICT system

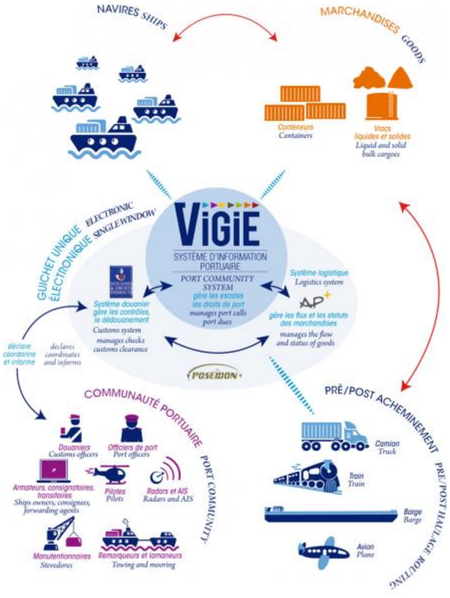

Figure 26. VIGIEsip ICT system

GPMB has also developed its own Port Community System (VIGIEsip) in 2014 to organize port calls, to bring port digital services and to comply with the single window directive[9]. GPMB has chosen to use Open Source technologies to create VIGIEsip.

VIGIEsip is not only exploited by GPMB, but also by 14 other French ports (Bayonne, Brest, Cayenne, Concarneau, Fort de France, Guadeloupe, La Rochelle, Le Légué, Lorient, Port-la-Nouvelle, Port-Vendres, Roscoff, Saint-Malo, Sète). An Economic Interest Grouping has been created in 2017 to gather these ports and to find stronger synergies.

For more details, see https://www.bordeaux-port.fr/en/electronic-port-single-window.

Data availability

Following the scenarios described in **¡Error! No se encuentra el origen de la referencia.** and the currently existing sensor networks the Consortium has established the following table summarising data availability for GPMB use-case:

Table 18. Data availability GPMB use-case

Port Community Systems (VIGIEsip)

Scope of Reporting Formalities Directive (2010/65)	*Availability in GPMB*	*Comments*
FAL Forms	Stored in database	Date of arrival, date of departure, cargos, dangerous goods…
Statistics on calls	Stored in database	
Characteristics of vessels	Stored in database	*But specific data on engines must be fetched in Lloyd's registries (IMO number is known)*
Other functionnalities of VIGIEsip	***Availability in GPMB***	***Comments***
Vessels positions, speed	Stored in database	Data from AIS (MMSI number)
River port dues management	Stored in database	Like maritime traffic (date of arrival, date of departure, cargos…)
CO2 emissions (french regulation)	***Availability in GPMB***	***Comments***
Overall port	Yes	Report

[9] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010L0065&from=EN

City data (open data)	***Availability***	***Comments***
Ex: open/close bridge hours	Open data	Data provider: Bordeaux city
Other data	Open data	Data provider: Bordeaux city

As it can be seen, several heterogeneous data sources are considered for GPMB use case. The project will leverage already existing technological enablers for data integration (VIGEsip entry point, open data with REST API interface) to feed the PIXEL Information Hub. Additionally, other IoT agents will need to be developed in order to integrate different data formats into the PIXEL ICT infrastructure (reports, AIS, etc.).

The stored databases mentioned in the previous table are powered by Oracle or by PostgreSQL and are operated by GPMB. The port currently stores a lot of data concerning maritime traffic during the last 20 years and measurements provided by the different sensors set up (see *Sensors and existing networks in this chapter*). In the next figure, a sample of some data which can be extracted from GPMB's databases is depicted.

Année Statistique	Numéro d'escale	Sens	Poste à quai	Nom Navire	Libellé Type Cargaison	Tonnage définitif	Date de poste à quai	Libellé du type de construction	Code type fiscal Navire	Libellé type fiscal Navire
2010	0003	Entrée	449	SP VIKING		0	1 janv. 10 17:15:00	CARGO DE PLUS DE 500 TJB	06	SOL.V
2010	0003	Sortie	449	SP VIKING	E.MAIS VRAC	4 370	4 janv. 10 19:57:00	CARGO DE PLUS DE 500 TJB	06	SOL.V
2010	0005	Entrée	432	ARKLOW RAIDER	I.UREE VRAC	2 344	2 janv. 10 05:20:00	CARGO DE PLUS DE 500 TJB	06	SOL.V
2010	0005	Sortie	449	ARKLOW RAIDER	E.TRTX TOURNESOL	3 294	15 janv. 10 20:50:00	CARGO DE PLUS DE 500 TJB	06	SOL.V
2010	0006	Entrée	436	STRAITVIEW	I.HUILE COLZA	2 999	2 janv. 10 19:00:00	PRODUITS CHIMIQUES (CHEMICAL)	05	LIQ.V
2010	0006	Sortie	436	STRAITVIEW	E.HUILE COLZA	3 000	8 janv. 10 23:35:00	PRODUITS CHIMIQUES (CHEMICAL)	05	LIQ.V
2010	0007	Entrée	436	LISTRAUM	I.METHANOL	3 432	2 janv. 10 19:25:00	PRODUITS CHIMIQUES (CHEMICAL)	05	LIQ.V
2010	0007	Sortie	436	LISTRAUM		0	3 janv. 10 19:00:00	PRODUITS CHIMIQUES (CHEMICAL)	05	LIQ.V
2010	0008	Entrée	433	ARKLOW RAVEN	I.UREE VRAC	4 123	3 janv. 10 07:55:00	CARGO DE PLUS DE 500 TJB	06	SOL.V
2010	0008	Sortie	449	ARKLOW RAVEN	E.MAIS VRAC	4 151	7 janv. 10 12:10:00	CARGO DE PLUS DE 500 TJB	06	SOL.V
2010	0009	Entrée	431	FEHN CARTAGENA		0	3 janv. 10 19:35:00	CARGO DE MOINS DE 500 TJB	06	SOL.V
2010	0009	Sortie	431	FEHN CARTAGENA	E.TERRE REFRACT.	1 516	5 janv. 10 20:35:00	CARGO DE MOINS DE 500 TJB	06	SOL.V
2010	0014	Entrée	415	KARIN	I.PROD.METALL.AUTRES	1 385	5 janv. 10 09:10:00	CARGO DE PLUS DE 500 TJB	12	AUTRES
2010	0014	Sortie	415	KARIN		0	9 janv. 10 12:10:00	CARGO DE PLUS DE 500 TJB	12	AUTRES
2010	0019	Entrée	433	BRATISLAVA	I.ENGR.MANUF.VRAC	3 300	6 janv. 10 21:45:00	CARGO DE PLUS DE 500 TJB	06	SOL.V
2010	0019	Sortie	433	BRATISLAVA		0	8 janv. 10 12:35:00	CARGO DE PLUS DE 500 TJB	06	SOL.V
2010	0020	Entrée	432	DINA TRADER	I.CONTENEURS	3 376	7 janv. 10 09:15:00	PORTE-CONTENEURS INTEGRAL	09	P.C.
2010	0020	Sortie	432	DINA TRADER	E.CONTENEURS	5 084	8 janv. 10 22:25:00	PORTE-CONTENEURS INTEGRAL	09	P.C.
2010	0021	Entrée	415	MEKHANIK TYULENEV	I.BOIS SCIES DU NORD	1 688	7 janv. 10 10:10:00	CARGO DE PLUS DE 500 TJB	12	AUTRES

Figure 27. GPMB sample data concerning ship statistics

Many parameters are collected when a ship arrives at the GPMB. In this case, it will be possible to analyse, among other things, the notion of seasonality linked to different traffics, or the length of a call per ton of goods.

Additionally, some existing web services have been developed to exchange data with external IT systems (such as Cargo Community Systems, or SafeSeaNet through French single window):

- "Export_demandes": webservice can be reached by URL

vigiesip-webservice-NOMDUPORT/nonauthent/export_demandes.

- "Export_demandes_pilotage": webservice can be reach by URL

vigiesip-webservice-NOMDUPORT/nonauthent/export_demandes_facturation

- "Navire_a_quai": webservice can be reach by URL

vigiesip-webservice-NOMDUPORT/nonauthent/navires_a_quai

B4. Port operations for the use case

The Port of Bordeaux is made up of seven specialized terminals distributed throughout the Gironde estuary. Bassens is the main bulk import-export pole and allows to transit by maritime way a multitude of goods within a radius of 200 to 300 km (depending on the products).

Due to its multi-zone characteristics and its proximity to Bordeaux, the Bassens terminal appears as an ideal test area for PIXEL, easily duplicable to other European terminals.

Moreover, the Bassens terminal is a major logistics center, around a vast industrial-port area. Spread over more than 3 km of wharves, the activities of the site are varied: recycling traffic, cereals, oilseeds, industrial bulk, forest products, heavy packages, containers, liquid chemicals, quartz, aggregates, etc ... It centralizes more than a third of the port traffic (more than 3.2 million tons per year) and has road and rail network facilitating pre-post shipments.

Figure 28. Bassens terminal

A higher definition picture of the scenario represented in Figure 28 can be consulted at : https://www.bordeaux-port.fr/sites/default/files/bassens2013.pdf

For this project, the totality of the goods transiting in Bassens can be defined in five categories of ship handling having different logistic schemes and thus different energy consumptions:

- Imports / Exports of containers
- Imports of handled solid bulks
- Exports of handled solid bulks
- Imports / Exports of non-handled solid bulks
- Imports / Exports of liquid bulks

It will be necessary to study for each model the energy characteristics of each tool necessary for the proper functioning of the supply chain and to associate new entrants (sensors, traffic analysis, etc.) to meet the overall objectives of the project. Maritime traffic entering the port must also be evaluated and predicted in order to know the future use of the various supply chains.

Currently the energy provided to ships and the used for port operations in GPMB is only fuel-based. GPMB wants to become greener and use renewable sources to get electricity to cover their needs. In this regard, currently the Business Model of GPMB is weak.

In this regard, GPMB does not want to invest in machinery, etc. that keeps energy. Generating power peaks is very bad and it must be avoided. This will finally low the price of the electricity in the port. GPMB wants the price of the energy in the port while potentiating Green Port concept as well.

Context:

- GPMB has their own energy network, and customers are connected to the network. In this sense, GPMB has counters on the electricity provided to 3rd parties.
- GPMB needs to lower the costs of getting useful data from the river and from the environment.
- GPMB needs to know in real time, whether when GPMB produces energy it can be consumed to avoid surpluses, because this is very expensive. For this reason, GPMB needs both high frequency and high precision of engine consumption energy.

What GPMB aims at being actually implemented in the pilot is:

- To get the data from the electricity counters.
- To model the port operations processes considering all aspects that affect energy consumption.
- Simulate the electricity that GPMB can produce and needs. To predict what is the amount of electricity needed every day, and how much electricity can be produced. To be able to check if it is feasible and interesting to the investment.
- Number of vessels arriving to the port, the cargo that they have and the operations to do with that cargo, etc.
- To match (and check the balance) among energy to be used / to be produced / to be provided / surpluses.
- To purchase a weather station (to be done during the project) to have precise information of weather to feed the models and the whole PIXEL solution.

The Port of Bordeaux will gather precisely the electricity consumption of five types of logistics grouping all the traffics done at Bassens terminal.

The following illustrations explains the different supply chains depending on the type of cargos.

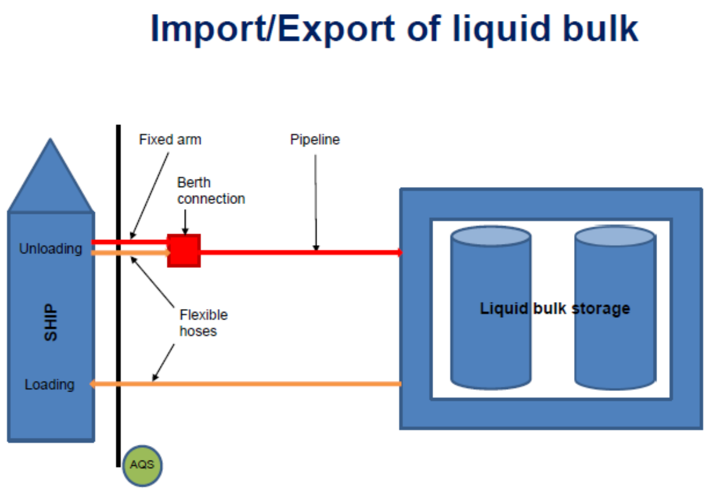

Figure 29. GPMB scenario 1: Import/Export of liquid bulk

Liquid bulk does not require specific handling when the connections between the ships and the dock have been made. Thus, this logistics chain depends essentially on a non-human means that we need to quantify at an energy level. This automation on all the loading / unloading operations should make it possible to reach a high level of precision with regard to the energy consumed.

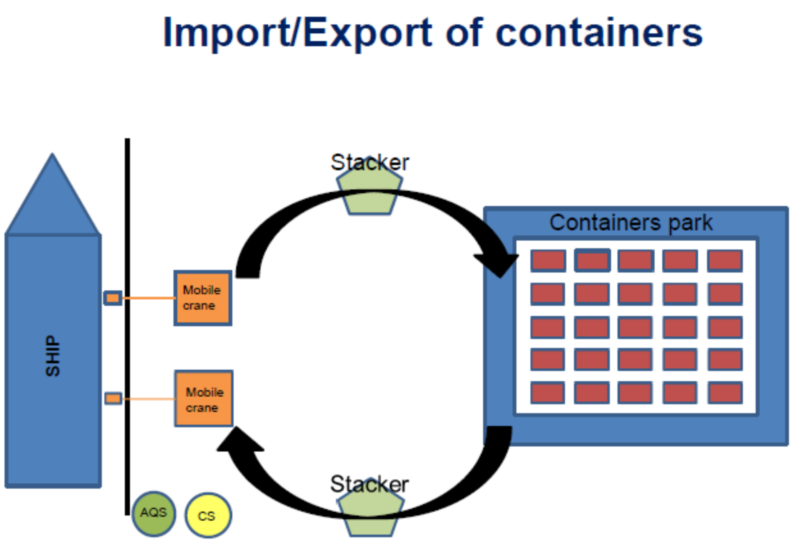

Figure 30. GPMB scenario 2: Import/Export of containers

Containers have a simple loading / unloading logistics model including only mobile cranes (vertical handling) and stackers (horizontal handling). Since this equipment is essentially fuel-based, the electrical energy consumption will be reasonably low. It will be used mainly on lighting equipment (mandatory for port handling and not to be underestimated given the size of the container park).

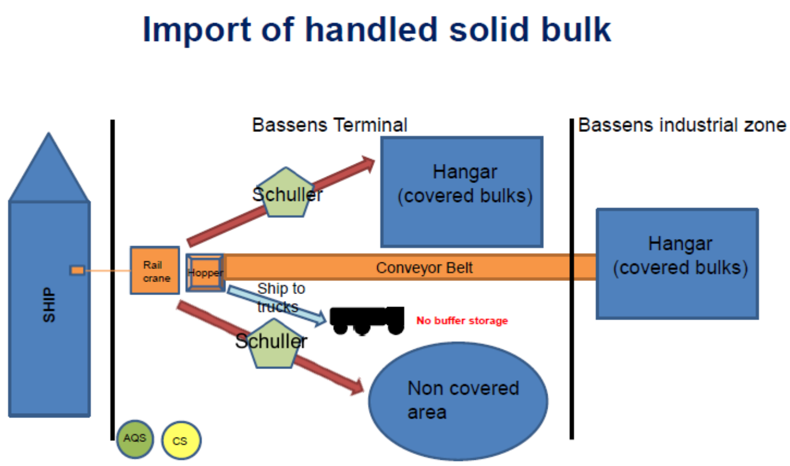

Figure 31. GPMB scenario 3: Import of handled solid bulk

The imports of solid bulk handled is the most difficult part to evaluate because of the multitude of ground transit possibilities available to the handlers. The multiplicity of companies will make it difficult to collect all data but is a potential for strong energy improvement in terms of lighting platform, conveyor belts, covered area, etc ...

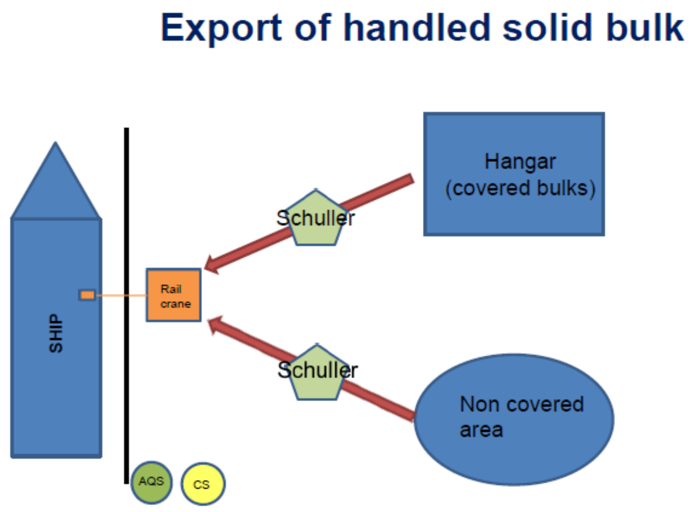

Figure 32. GPMB scenario 4: Export of handled solid bulk

As with container traffic, most logistics operations on this type of cargo will be non-electrical. However, the proximity of sheds makes the case interesting to the extent that the energy potentially produced from photovoltaic panels would be directly nearby.

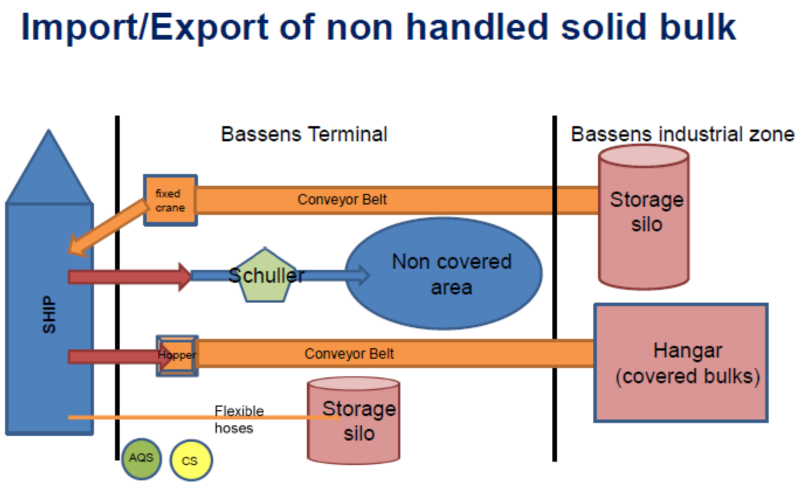

Figure 33. GPMB scenario 5: Import/Export of non-handled solid bulk

This scenario is one of the most energy consuming due to the multitude of automatic electric elements as well as the distance between the ship and the place of storage of the goods. It is a major challenge because the companies involved in these logistics chains are open to use clean energy and less expensive than that of the usual network. However, the powers involved will have to be studied with precision to maintain the rates of loading / unloading.

B.5. Flanking stakeholders

GPMB is characterized by the presence of four sources of actors evolving on the logistic chain. Actors and chains interact together in a mandatory way which means that it will be necessary to involve and coordinate each set.

- **Industrials:** Industrials act directly in the logistics and transit of non-handled goods (self-loading / unloading), needs and means of handling being automated.

  Identified Actors: Foresa France, Michelin, Saipol, Loiret Haentjens, Sea Tank, Silverwood, Imerys, AFM recyclage, SPBL, Invivo

- **Stevedores:** There are two types of handling: vertical and horizontal. Vertical handling occurs in all cases of loading / unloading of solid bulks using cranes. Horizontal handling will be used in all logistics schemes for solid goods, whether or not craned, with the aim of moving bulk goods (or containers) to a predefined storage area.

  Identified Actors: Bordeaux Manutention, Sea Invest, Bordeaux Atlantic Terminal

- **Maritime services**: Maritime services means all the private services required to accommodate a vessel from the point of entry into the port constituency (materialized as BXA) until the berthing of the vessel at the wharf. With the exception of towing, depending on the size of the ship and / or nautical conditions, other services are considered by use as mandatory. The Port of Bordeaux is also part of maritime services because it is in charge of the maintenance of the navigation channel.

  Identified Actors: Ship agents, Boot men, Pilotage, Tug boat assistance, Port of Bordeaux (dredging department)

- **Port Authority**: The Port Authority, namely the Port Authority of Bordeaux, by the Harbor Master's Office and its port officers, hosts, monitors, coordinates and secures the entire process of a call.

  Identified Actors: Grand Port Maritime de Bordeaux (Harbour master office, port officers, etc…)

These stakeholders may intervene in further actions after PIXEL. They can be considered as flanking stakeholder who could play a role in a large-scale deployment of PIXEL in GPMB for all its logistics operations.

Appendix C – Use case of Port of Monfalcone

C.1. Global context of the use case

The Port of Monfalcone is involved in the use case named “intermodal transport use case” which also includes SDAG, Insiel and in general the whole Friuli Venezia Region (FVG).

Friuli Venezia Giulia is the easternmost region of Italy. Geography has located it at the crossroads between the countries facing the Adriatic Sea, those of Central and Eastern Europe and the route connecting the Far East and Europe via the Suez Canal. Two strategic European transport axes, the Mediterranean Corridor and the Adriatic-Baltic corridor, run through the territory.

The ports, Trieste and Monfalcone, are the centre of this multimodal area that encompasses the ports themselves, the airport of Trieste, SDAG, Fernetti and Cervignano intermodal terminals.

Friuli Venezia Giulia has over the years invested and is still investing - with the support of the Italian government and the European Union - on the logistical and infrastructural system to become an ideal logistic hub at the centre of the Mediterranean. Covering an area of almost 8,000 square kilometres, the region is trying to develop the coordination of all its logistics and port hubs to create a quality system able to offer support to manufacturing activities.

The Region is particularly significant for exporting flows but is also one of the preferred door for goods coming from Eastern Europe, in particular raw materials, wood and chemical products, both by rail and by road.

Figure 34. Crucial situation of Friuli Venezia Giulia region

The Port of Monfalcone is the northernmost port in the Adriatic Sea, it is located on the cross flow between the TEN-T Baltic - Adriatic and the Mediterranean corridors. Thanks to its particular position it is one of the most interesting gate to and from the central European market.

Figure 35. Geographical situation of Port of Monfalcone and its associated corridors

The port is specialized in general and dry bulk cargo. The main type of goods handled include: cellulose and timber, steel products, cars, China clay, coal, cereals and project cargo. The main routes of the ships calling upon the Port of Monfalcone touch the principal ports of the Mediterranean and Black Sea, Canada, Chile and Brazil, as well as other ports in the Atlantic and Pacific Oceans. The port area is reached by train as well as by road. The railway line (Tarvisio - Trieste and Venice - Trieste) is directly connected to the Port of Monfalcone through a dedicated junction. Furthermore, the A4 (Venezia-Trieste) and A23 (Austria-Trieste) motorways pass just 1,5 km from the Port and permit direct access to the industrial area through a dedicated road system thus avoiding the urban road system.

SDAG is located 20 km from the Port of Monfalcone, on the border with Slovenia and along the A34 motorway, connecting the Italian and Slovenian motorway networks and can be considered as the inland terminal of the Port.

Premises & infrastructure

The Port of Monfalcone has an operating area of 750.000 square meters, 66.000 sq.m of warehouses and sheds and 480.000 sq.m of open customs storage areas. The port's access canal, with a length of 4,500 meters, has a depth of 11.7 meters. The commercial wharf is 1,500-meter-long, a maximum draft of 10.9 meter and 9 berths. There are two private quays, the first serving a power station and the second for grain silos.

The Port has only one authorized access for conventional traffic, fully equipped with a monitoring system that allows to identify vehicles and persons and check their permits to enter the port (badge reader, barcode reader, cameras with a licence plate number detector).

SDAG covers an area of 600.000 square meters and offers the following services: warehousing (also in cold rooms), intermodal terminal operation managing, managing of areas, premises and services for light and heavy traffic.

SDAG has 550 parking slots for trucks in its areas and offers also other services for truck drivers in order to be considers as a "safe and secure parking area" (for example: video-surveillance 24h). Furthermore, are also offered services to make more comfortable the stay to truck drivers (for example: free WIFI, snack bar, minimarket, infopoint, automatic snack distributors, clean showers and toilets etc.).

The intermodal Terminal, totally managed by SDAG, includes:

- 20.000 sq.m of paved areas

- A 3.000-sqm joint warehouse
- 5 railway tracks
- RO-LA system

Figure 36. Port of Monfalcone

Regulatory context

The Special Agency for the Port of Monfalcone was established in 1975 by the Chamber of Commerce of Gorizia with the aim of fostering and stimulating the development of the Port of Monfalcone and its commercial activities; pursuant to the National Law no. 84/94 and in accordance with the Regional Law n. 12/12, is responsible for the promotion of the port as well as for the implementation of infrastructural interventions and activities consistent with its institutional purposes. It is also owner of approximately 40% of the infrastructure areas of the port as well as various port equipment. From 14 June 2018, thanks to the recent Decree of the President of the Italian Republic n. 57/2018, the Port of Monfalcone merged the Port of Trieste inside the Port Authority System of the Eastern Adriatic Sea.

Actually all the subject involved in the managing of the Port are facing this new legal status and are trying to cope the directions set by the National and Regional Government, as well as by the Port Authority System of the Eastern Adriatic Sea that has become the main Authority of the Port of Monfalcone, with specific competence over the security and safety fields, as well as over the organization of the work and operations inside the port. Therefore, also the SILI system as well as the authority to release the port entry permits will be managed by the Port Authority System of the Eastern Adriatic Sea.

SDAG is a public company whose unique shareholder is the Municipality of Gorizia. Its mission is the management and the development of the intermodal terminal of Gorizia, covering a whole surface of approximately 600,000 square meters. The owner of the areas is the Municipality of Gorizia.

More information regarding the European, national and local regulatory context can be found in Appendix F.

C.2. Current environmental position

Currently, there are no specific actions for environmental management in addition to the limit of emissions required from the national law for the environmental emission in the air or water of the port activities subject to specific authorizations. ARPA is the regional agency for environmental protection and it will be involved in the project to provide and elaborate the data referring to pollution and its connections with port operations, as well as in order to evaluate a port environmental index.

However, during the execution of task T3.3, both ASPM, SDAG and other entities involved in its execution went through a deep research about interesting platforms/initiatives/entities aiming at measuring and controlling the environmental impact associated to port operations.

In the course of the action, three points were finally tracked down. The results of this analysis are depicted in the three tables below. With this task, the Consortium has been able to, somehow, spot the port in the common space of research. Though it is remarkable that nowadays a common methodology for this benchmarking does not exist, both ASPM and other partners in the Consortium (PRO, CERTH) consider this approach valid and accurate.

Firstly, in Table 19 there is a comparison of GPMB's current and future perspective about the most relevant environmental components that compose the impact of the port. We have utilised the reference of Green Marine Program initiative to establish this match. The colour-code and numbering for this table is the same than the utilised in the previous Appendix B for GPMB's benchmarking.

Table 19. ASPM'S environmental position benchmarking – Green Marine

Potential KPIs for Ports	Current Level	Expected Level (2020)
1. Aquatic invasive secies	1	2
2. Greenhouse gases and air pollutants	2	3
3. Spill Prevention	2	3
4. Dry bulk handling and storage	2	2
5. Community impacts	1	2
6. Environmental leadership	3	3
7. Waste management	3	3
8. Underwater noise	1	1

Secondly, the Consortium proceed with a slightly different approach: to use the reference of the ESPO's Port Performance Indicators, in the umbrella of the project PPRISM.

PIXEL's approach has been to, drawing from the list of the performance indicators with regards to environment, position the port of Monfalcone and to analyse how far the project is from achieving measurement of each one of the indicators. This has been done through the following table, indicating next to each KPI the data source needed for the measurement and whether it is available or not in ASPM in this moment of the project.

This will help both WP5 and WP7 in the future to establish sensors needed, data to consider and guidelines on the implementation of the PEI in ASPM.

Table 20. ASPM's environmental position benchmarking - PPRISM

	PPRISM KPIs for Ports	Relevance 1:low 2:medium 3:high	DataSource N/A or reference	Automatization Yes/No
Energy & Water	Total energy consumption by annual cargo handled.	2	N/A - But can be collected	NO

	Total water consumption by annual cargo handled.	2	N/A - But can be collected	NO
	Ratio of renewable energy per total energy consumed	2	N/A - But can be collected	NO
Emissions to air	Total Greenhouse Gas Emissions	2	To be collected	NO
	NOx, SOx, PM10, VOCs CO, O	2	To be collected	NO
	Lden (overall day-evening-night noise level)	2	To be collected	NO
	Lnight (23:00 - 7:00hrs noise level)	2	To be collected	NO
	Compliance with limits at day, evening and night time	2	To be collected	NO
Discharges to water	Thermal conditions	2	Yes, periodically	NO
	Oxygenation conditions	2	Yes, periodically	NO
	Salinity	2	Yes, periodically	NO
	Nutrient condition	2	Yes, periodically	NO
	Turbidity/Transparency	2	Yes, periodically	NO
Ecosystems and habitats	Existence of an inventory of environmental Aspects	2	N/A	NO
	Existence of an environmental Monitoring programme	2	N/A	NO
	Number and results of EMS audit/review/certification	2	N/A	NO
	Self Diagnostics results (SDM)	2	N/A	NO
	Compliance	2	N/A	NO
	Number of prosecutions for non-compliance	2	N/A	NO
Transport	CO2 emissions by annual cargo handled (Carbon Footprint)	3	N/A	NO

Finally, after the knowledge gained with this activity, the ports created another document. This time it was not a comparison but an indication of environmental KPIs relevant for each port, freely identified and catalogued following similar approach:

Table 21. Potential KPIs for ASPM

Potential KPI for Port	Relevance 1:low 2:medium 3:high	DataSource N/A or reference	Automatization Yes/No
Aquatic invasive secies	1	N/A	No
Greenhouse gases and air pollutants	3		No
Spill Prevention	3	Harbour master	No
Dry bulk handling and storage	3	ASPM	No

Community impacts	3	Not evaluated	No
Environmental leadership	3	Monitoring	No
Waste management	3	In accordance to law	No
Underwater noise	1	N/A	No
Parking area occupancy	3	To be implemented through PIXEL	Yes
Local IoT platform implementation	2	To be implemented through PIXEL	Yes
Number of sensors to the local IoT platform	2	To be implemented through PIXEL	Yes
Number of types of data (sensors) connected to the IoT platform	2	To be implemented through PIXEL	Yes
Number of end-users of PIXEL solution	2	To be implemented through PIXEL	Yes

C.3. Technical context

Sensors and existing networks

Each lane of the entry gate of the Port of Monfalcone has an optical and magnetic sensor to read the tickets and badges used to access to the Port. There are also cameras equipped with a licence plate number detector in order to collect the data. The data referring to the users and their licence plate that pass through the gate are collected and can be shared in compliance with privacy regulations.

Figure 37. Sensoring and station on port access – Port of Monfalcone

All entry points of SDAG parking areas are equipped with a video-surveillance and access control system, also able to read plates and Kemler codes to detect the type of dangerous goods transported. These data can be shared by web, in compliance with privacy regulations.

Furthermore, during the execution of task T3.3, ASPM and SDAG (supported by other technical partners of PIXEL) analysed the most affecting parameters in relation to the environment in Monfalcone area. Afterwards, the Consortium made an exercise to identify the type of sensors that could help measuring those.

Finally, that information was matched with the existing sensors in ASPM and the following conclusion was reached. During the execution of WP4, a thorough specification of the sensors needed to deploy all the scenarios envisioned will be done. Currently, the most compelling need detected has been to purchase a video camera-based surveillance system in order to provide continuous information about parkin occupancy.

What is currently implemented is a video camera system that counts the trucks that are in the area, the ones that are in the area and calculates the occupancy. The video system can also set an area to tell if there is something in that area and if is stopped more time than a parameter

ICT systems

The existing information system, called SILI, has been developed by FVG region within the project SEC - Safe and Efficient Cargo. The system allows to manage the access to the ports, Monfalcone and Trieste, and to monitor the traffic in different zones of the regional territory of Friuli Venezia Giulia, with the special function to detect the traffic of dangerous freights ADR. In detail, SILI is composed of a web platform where it is possible to require the permission to access to the port, providing a set of data, so the logistics operators have to require the permission on this website.

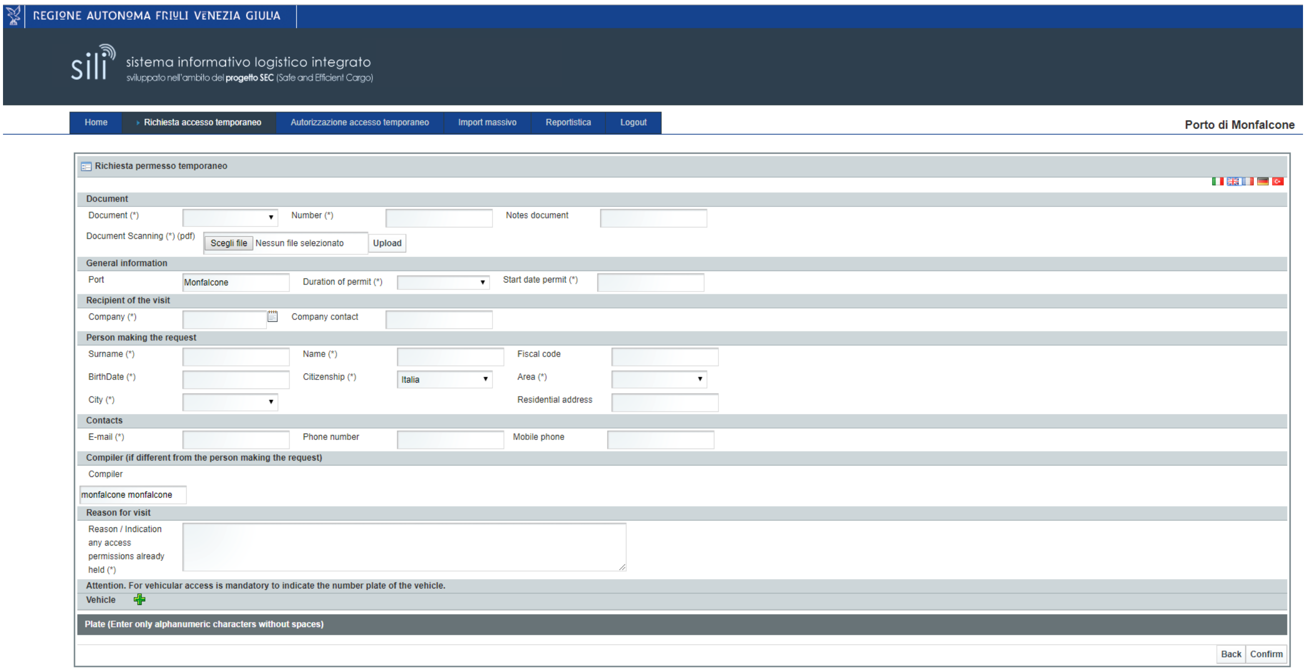

Figure 38. SILI program – ICT system to interact with PIXEL

In case of temporary authorization, the form used is a web ticket with a barcode, in case or periodic authorization the form used is a badge.


PERMESSO DI ACCESSO AL PORTO
ACCESS PERMISSION TO THE PORT
Monfalcone

Dati Personali / Personal Details

Nome / First Name	Cognome / Last Name	Numero Documento / Document Number
Xxxx	Xxxxx	CI xxx

Dati Permesso / Data Permission

Tipo Permesso / Permission Type	Durata Permesso / Authorization Period	Data inizio validita' / Start date	Approvatore / Approver
Permesso per l'ingresso al porto.	20 giorni	25/12/2014	Azienda Speciale per il porto di Monfalcone

Motivo / Reason: Free Pass

Zone / Zones: Zona Monfalcone

Veicoli / Vehicles: BD 141 GA

Il codice a barre di accesso va avvicinato al lettore barcode presente sulle colonnine dei varchi portuali
The barcode must be kept close to the reader at the automatic barrier gate

Figure 39. Web ticket with bar code – SILI -Port of Monfalcone

The authorities of the Port of Monfalcone use the SILI back office to release the authorization to access to the Port. The process to give permission to access to the Ports involves different actors, such as:

- Host company
- Border Police
- Maritime Authority (at national level)
- Port authority

The authorizations, both as ticket and as badge, are checked by the readers located at the Port entrance.

Concerning the data management SILI allows to:

- Receive and save all traffic transits of car and truck
- Identify the vehicle transit, saving number plate, date, time, transit location,
- Detect and identify the type of dangerous freight (material code, danger code)
- Track all vehicles that transit in the monitoring points and identify those transporting dangerous freights
- Manage the database of dangerous freights transport
- Analysis and statistic of traffic data

In Figure 40**¡Error! No se encuentra el origen de la referencia.**, some results generated from SILI regarding vehicle entrance to Port of Monfalcone are shown.

Regarding the current use and deployment of SILI in the use-case relevant for PIXEL: SILI is a system that is implemented by INSIEL in SDAG and ASPM:

- SILI has a DB with drivers that operate in the ports, contact data of these people, ability to monitor the traffic flows, also historic data from SILI.
- SILI has a record of every transit. If there is a congestion in the street, it can be identified out of SILI datacenter information.
- SILI has other sensors that control the congestion, so interacting with it would be also an output from PIXEL. This would help to address several challenges faced currently by ASPM.
- SILI is also implemented in SDAG, with existing real sensors -- gate sensors. It monitors the presence of hazardous goods and how trucks flow.

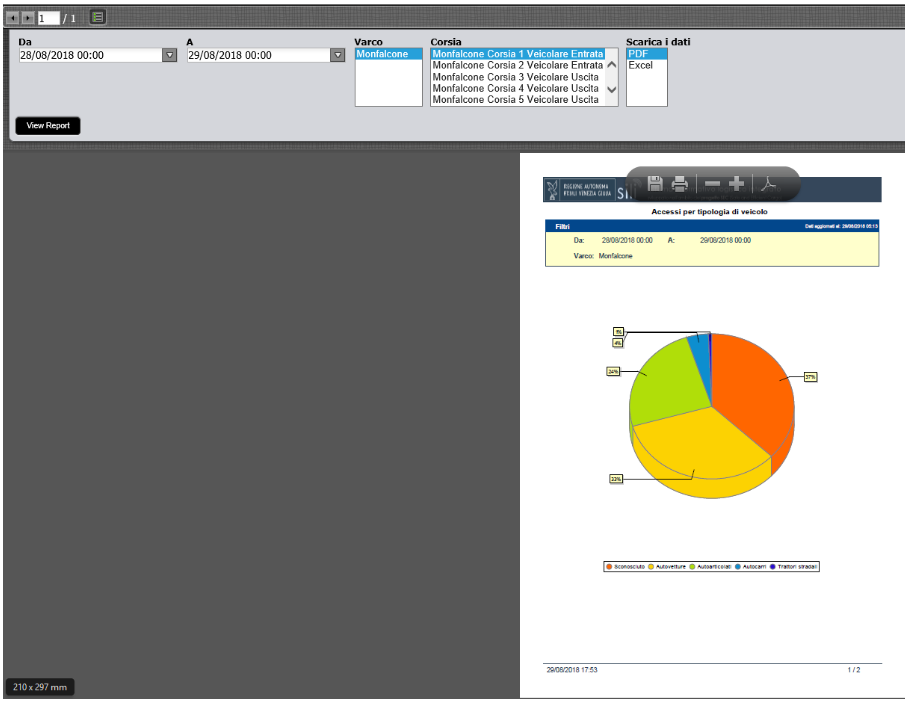

Figure 40. SILI system - vehicle entrance

Data availability

Following the scenarios described for the Port of Monfalcone and SDAG, and the currently existing sensor networks the Consortium has established the following table summarising data availability for ASPM use-case:

Table 22. Data availability ASPM use-case

Port Management Information System (PMIS)		
Scope of Reporting Formalities Directive (2010/65)	***Availability in ASPM***	***Comments***
FAL Forms	Yes, under authorization	Not managed by ASPM
ETA, ETD of vessels to the port	Yes, under authorization	Not managed by ASPM
Traffic statistics	Yes, under authorization	Not managed by ASPM
Other information		
Videocamera for parking occupancy	Yes	To be purchased during PIXEL
Historical data related to arrivals and departure of vessels	Yes, under authorization	Not managed by ASPM
Traffic/congestion information of road network	Open data	Autovie Venete
Emissions? Environmental info?		
Weather information- OSMER data	Open data	http://www.osmer.fvg.it/mare.php?ln=#/
SDAG Data	***Availability***	

Type of cargo of trucks diverted to SDAG (for ex. ADR)	Yes	Video-surveillance system in SDAG detects type
Number of free parking slots in SDAG	Yes - depends on supplier	SDAG access control system at the entrance of parking area
Historical data of parking slots	Yes	SDAG internal system – Manual system to get the information (not automatized)
SILI System data	***Availability in ASPM***	***Comments***
Current and historical traffic data through access gate	Yes	SILI System - Camera installed over port's gate
Truck company contact data	Yes	SILI System

As it can be seen, several heterogeneous data sources are considered for ASPM use case. The project will leverage already existing technological enablers for data integration (SILI System, open data with REST API interface) to feed the PIXEL Information Hub. Additionally, other IoT agents will need to be developed in order to integrate different data formats into the PIXEL ICT infrastructure.

Particularly, the SILI system allows to have the following data per each access point, including Monfalcone Port access:

- Number of passages
- Passages classified by nationality
- Average number of passages classified by nationality and day of the week
- Number of vehicle transits and pedestrian transits
- Average stay time
- Number of accesses by time slot
- Number and type of transits of dangerous freights

The data collected by SILI are stored in the INSIEL datacentre and are used to statistics analysis and results required by Trieste Port or Regional Administration.

SDAG doesn't have the aforementioned data, due to the fact that SILI has not been deployed to SDAG, the only data available for SDAG are the data recorded by the camera positioned over one of the lanes of the A34 motorway, close to the border between Italy and Slovenia. The camera monitors light and heavy traffic, with a focus on trucks of dangerous goods, entering Italy from Slovenia directed to the urban roads of Gorizia. The other flows are not considered. Other cameras having the same "task" are positioned along the regional road network and on the other main borders with Slovenia.

In particular, there are two systems:

- Truck flows management – the system is composed by an entrance "station" for the entrance tickets, the management of the already parking subscribers or the acceptance of the booking code of the slots, and finally it is composed also by an exit "tation" that monitors the payments or the registration of the subscribers exit.

  There is also an automatic payment machine for the parking slots and for the prepaid cards. This system is network connected with SDAG server.

- Video Surveillance system for License plates and Kemler codes reading – The cameras are positioned in the entrance and in the exit in order to be able to read the plates and Kemler codes in both sides. Kemler codes are referred to ADR (dangerous) goods transport. The system is network connected with SDAG server.

Environmental management

Currently, there are no specific actions for environmental management in addition to the limit of emissions required from the national law for the environmental emission in the air or water of the port activities subject to specific authorizations. ARPA is the regional agency for environmental protection and it will be involved in the project to provide and elaborate the data referring to pollution and its connections with port operations, as well as in order to evaluate a port environmental index.

C.4. Port operations for the use case

Enabling the IoT platform

The Port of Monfalcone will analyse with the technical partners in the PIXEL Consortium the appropriate IoT platform to be deployed by taking into account the existing equipment and devices and evaluate possible additional sensors needed to fulfil the use case.

Basic port access operation

The use case involves flows of heavy vehicles entering the Port of Monfalcone. They can be full or empty, this doesn't impact on the target scenarios. In Figure 41 the desired port access operation of the Port of Monfalcone use-case is depicted:

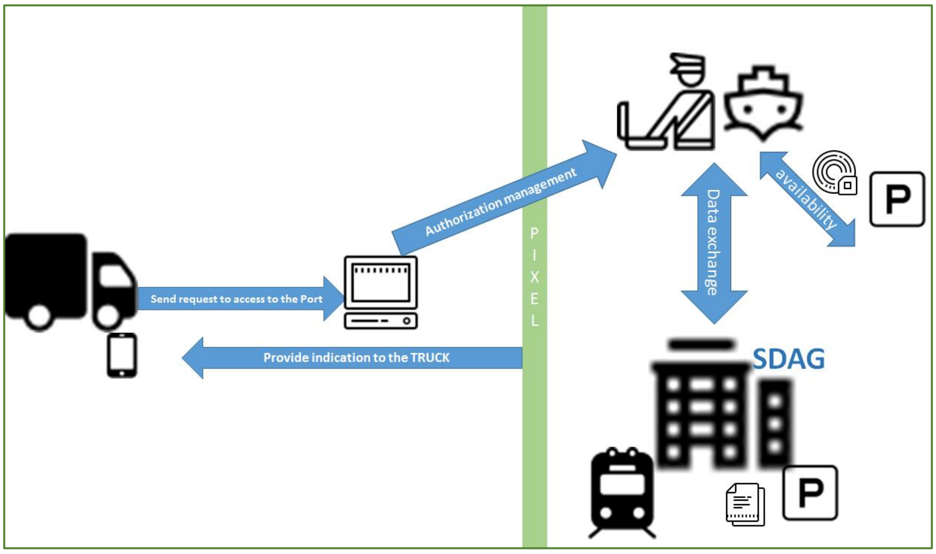

Figure 41. Port of Monfalcone general scenario

- If the trucks entering to the Port are not registered with the annual permit yet, they need to be authorized by the SILI system. This is already available.
- The SILI system requires to fill in the query with the personal data of the user, the licence plate number of the vehicle and the period of time for which they ask the port entry permit. This is already available.
- With these information, as well as the data from the parking sensors to be installed, the system will provide data about the availability of parking lots in Monfalcone as well as forecast expected peak of traffic. This has to be developed in PIXEL.
- The model to be developed will have the aim to re-route the trucks towards SDAG, adding also the possibility for trucks to automatically book the plot, or trigger an automated re-routing with different logistic solutions in the case of serious congestions. This is the main contribution from PIXEL in this use case.

The possible sub-scenarios emanating from this generic approach are:

a) The parking area of Monfalcone is free, the carrier receives the authorization to access to the port area. This will be the normal situation under no congestion.

b) The parking area of Monfalcone is full, and the system reveals or forecasts congestions in the port surrounding area: information is sent by a sensoring network, so the query for the port entry permit is shared with SDAG in order to reroute the truck towards an alternative solution avoiding the congestion of the port and of the surrounding area. This should be the normal behaviour under congestion thanks to the PIXEL solution.

   At the same time the information is shared with other truck companies already authorized and propose analogue solutions- the PIXEL solution will provide a subscription model in order to receive alerts when congestion is detected.

c) The truck is intercepted in order to understand what are its needs and it is rerouted towards a different terminal in the regional territory and/or towards intermodal transport triggering the use of the railway.

Equipment

It would be probably required to purchase one or more parking sensors to identify the number of parking lots in the parking area before the main entrance to the port. The parking area has 50 defined parking lots but can accept further vehicles as a buffer before becoming congested.

In the figure below, a satellite image can be observed showing Monfalcone parking area. It will be within this enclosure where the equipment to be acquired will be incorporated:

Figure 42. Monfalcone parking area

System Integration for the generic flow

The main integration between the SILI system (integrated with parking sensors) and the PIXEL platform should encompass the following interaction:

- Applicant (truck driver/carrier) sends the request to obtain the permission to access to the port using the SILI system
- Port Authorities verifies all requirements to access to the port
- The SILI system (integrated with PIXEL and therefore increasing its functionalities) suggests the best modal transport (railway or road transport) and the possible parking area.

- Applicant/truck driver is intercepted by an app and receives indications.

In case of road transport SILI (integrated with sensoring network) verifies the parking availability

a) If there is availability in the Port area the permission is sent to the applicant
b) If there is no availability the request is shared with SDAG
   I. The PIXEL platform sends an availability request to the SDAG system.
   II. The SDAG system gives the n° of free lots to PIXEL platform. If there is availability in SDAG: accepts the request and sends to the PIXEL platform a booking request
c) Ones the booking is made, SDAG sends the confirmation
d) Applicant receives indication to go to SDAG and the n° of the reservation
e) Once the truck enters to SDAG parking, a notification is sent to the PIXEL platform
f) Port Authorities provides the permission to access to the Port for a different date compared to the request.
g) When the truck exits from SDAG parking area, a notification is made to the PIXEL platform

In case of railway transport, SILI (by PIXEL) shares the information with the railway company in order to manage the transport.

PEI Implementation

In the use case the environmental impact of port operations cannot be measured; however, it would be possible to calculate the reduction of environmental impact deriving from the automated re-routing of trucks and the implementation of rail services.

C.5. Flanking stakeholders

The external stakeholders identified to be considered in ASPM’s use case are:

- **Carriers and drivers**: they need to use SILI to request for authorization to enter the Port of Monfalcone; they interact with
  a. Shipping companies located within the Port to know when their services are required (loading or unloading from the truck);
  b. ASPM and Public authorities working at the port to receive authorization to enter
  c. SDAG in the case they are re-routed to its premises
- **Public authorities** working at Port of Monfalcone: they interact with ASPM and shipping companies located within the Port
- **Shipping companies** located within the Port of Monfalcone: they interact with ASPM, other shipping companies located within the Port and carriers/drivers to arrange for loading/unloading operations
- **Rail operators**: they interact with drivers/carriers and SDAG to arrange for shuttle-rail services
- **Road network managers**: they interact directly with the PIXEL platform to provide data about congestions
- **FVG Region and Environment and Health Observatory**: they interact directly with ASPM, SDAG and the PIXEL platform to analyse the data collected referring to the surrounding environment.
- **The owner of the SILI system** (Region Friuli Venezia Giulia). It is providing the management of the data to ASPM actually. Data of network congestion, SILI, etc. is property of the region.
- **Central Government** (ships data). Data coming through Port Authorities, then goes to Maritime Authority.

Appendix D – Use case of the Port of Piraeus

D.1. Global context of the use case

The port of Piraeus is the main sea gateway of Greece and one of the busiest ports in the Mediterranean. The location of the port makes it a hub port for international trade and a focal link between the Greek islands and the mainland as well as a cruise centre. The PPA functions as a development lever for the local and national economy and plays a significant role in the development of the shipping, tourism and international trade clusters.

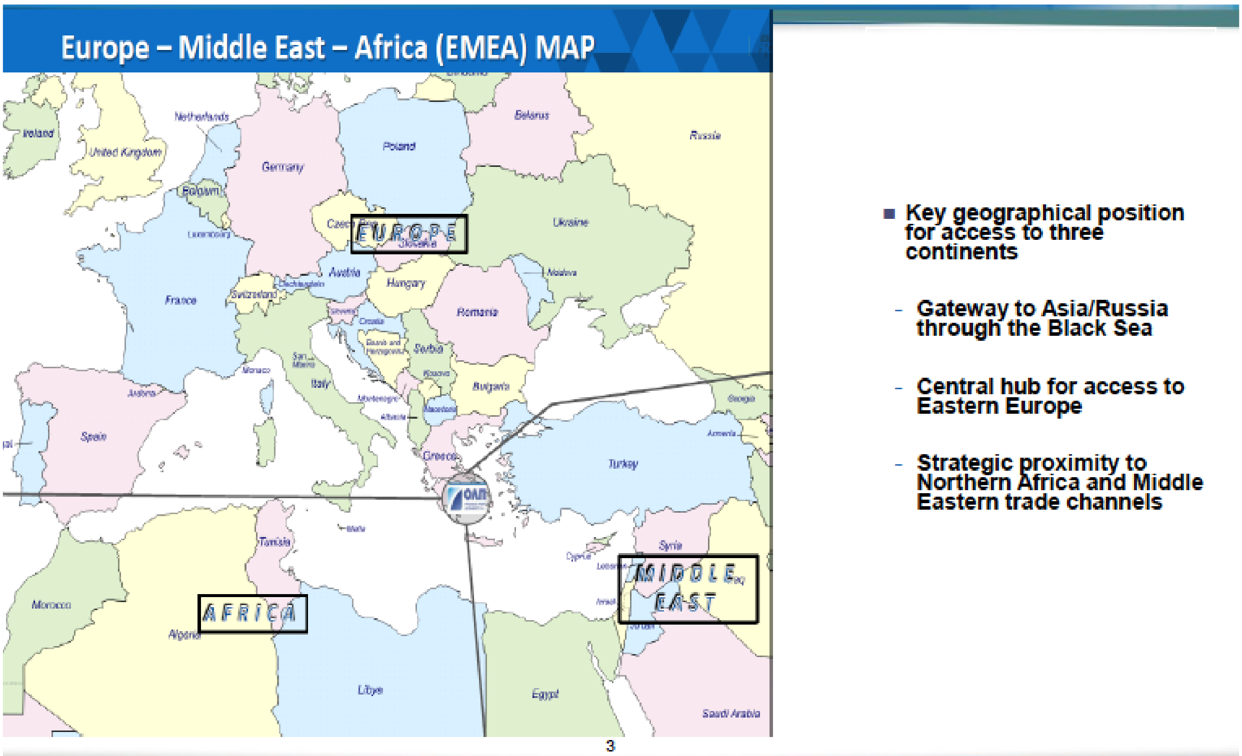

Figure 43. Geographical situation Port of Piraeus

Piraeus Port offers unique advantages because of its strategic location and its infrastructure. It is the natural port of Athens just 10km away from the Athens' Center. Piraeus is the country's main import and export gateway. It is the first European westbound port after crossing Suez Canal with the suitable infrastructure to serve international trade and landside transportation.

The Port of Piraeus is confronted with accessibility and connection problems, both between the port area and the greater Athens and Piraeus cities. Moreover, the development of economic activity, the growth of tourism and the rise in movements of goods and passengers puts a high level of pressure on both the coastal and urban area and on the main transport corridors.

The Piraeus port is composed by two terminals: cargo terminal (owned by COSTCO Shipping) and passengers' terminal - coastal terminal (owned by COSTCO Shipping).

This following diagram shows the leading Mediterranean cruise ports in 2017, by passenger numbers. Both Barcelona and Civitavecchia saw more than two million cruise passengers in 2017, overtaking all other Mediterranean cruise ports.

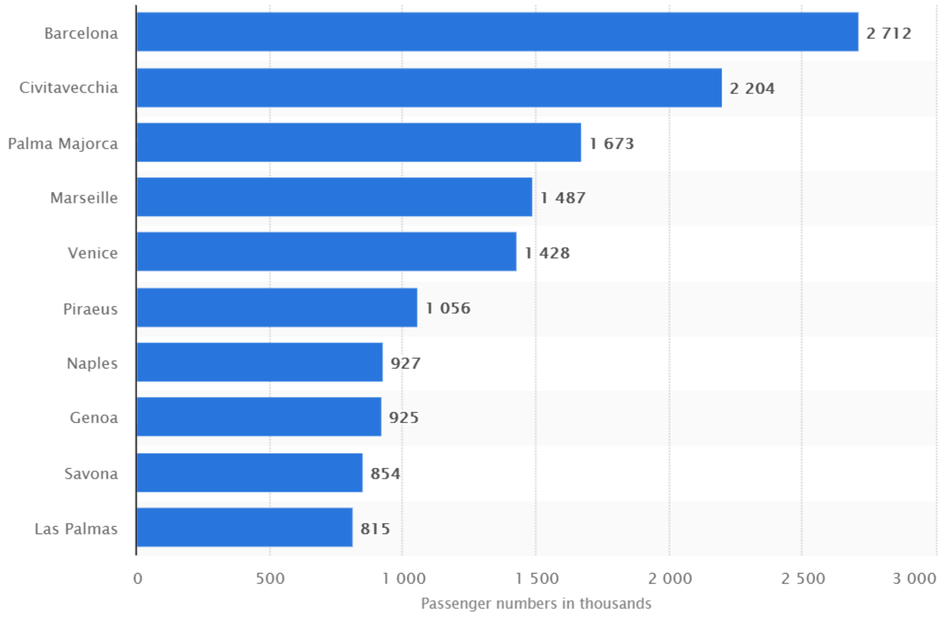

Figure 44. Most passenger-volume European ports 2017

Premises & infrastructure

The Piraeus Port area map is shown in Figure 45 exhibiting the port terminal locations

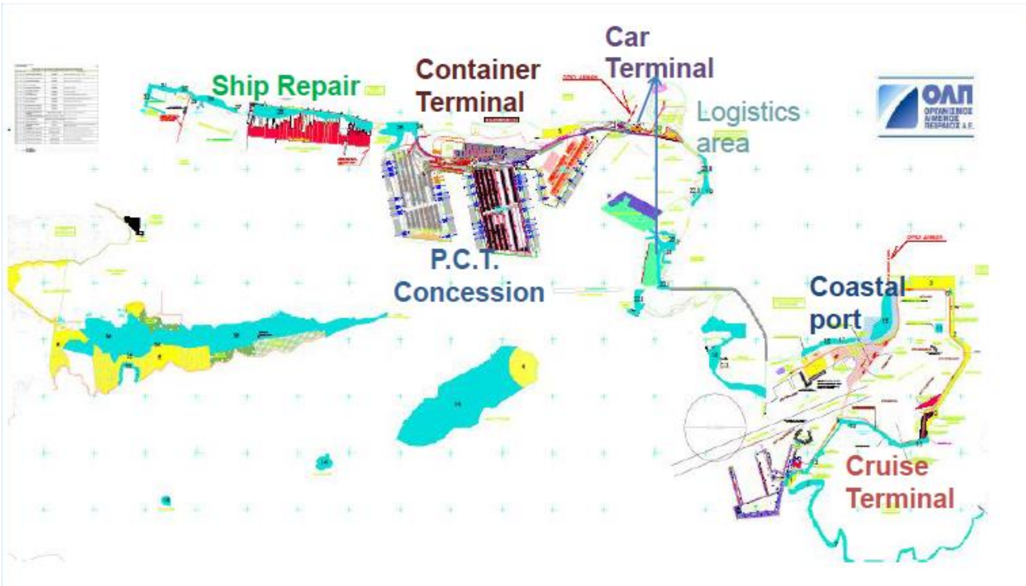

Figure 45. Piraeus port area map

The basic terminal infrastructure is as follows:

Container Terminals

- Top 10 largest container ports in Europe (in terms of throughput)
- Hub for transhipment in the Mediterranean and Black Sea
- Ideal gateway to the East Mediterranean

- Serves the largest shipping companies and has robust infrastructure capable of serving the largest container carriers
- Provides rail connection to central Europe and the Balkans
- Operates (24x7)
- Offers a full array of port facilities
- Piers 2 & 3 under concession by P.C.T.

Car Terminal

- Multiple Hub Car terminal in Eastern Europe
- Currently operates 2 terminals of approximately 190,000 m2 and 1.5 km of quay wall
- Railway connection
- Operates (24x7) surveillance cameras
- Offers a full array of port facilities
- Close to zero damage record

Cruise

- The centre of the Mediterranean cruise experience
- Close proximity to tourist destinations in the Aegean
- Athens being the historical capital of Europe is amongst the top tourist attractions in Greece
- Total quay length of 2.8 km and draft of up to 11m
- Comprises slots for coaches and provides a helipad for VIPs
- Operates (24x7) 2 passenger stations (10,000 m2) and offers free shuttle bus service around the cruise port
- 9-11 simultaneous berthing places including 2-3 berths for new generations vessels
- Offers a full array of port facilities

Coastal

- The largest passenger port in Europe
- Total quay length of 2.8 km and draft of up to 11 m
- 2.5 MM vehicle traffic
- Provides access to key tourist destinations in Athens within 30 minutes
- Operates multiple daily coastal connections to most of the Aegean islands
- Offers free shuttle bus service around the coastal port
- Offers a full array of port facilities

Regulatory context

The Greek port industry is characterized by the dominance of the public sector in port activities. The ownership of port assets, corporate port governance and services provision develop under strict, direct or indirect state (ministerial) control. As a result, Greece stands among the few countries in which the port industry is fully controlled by the public sector. Yet, the context, in which contemporary ports operate impels for greater flexibility in port operations. Several countries worldwide have responded implementing port devolution programs. The latter have been accompanied by an increasing participation of the private sector in port operations. In several EU countries several port reforms devolved the port industry, allowing for the participation of private companies.

“Piraeus Port Authority S.A.” (“PPA S.A.” or “Company”) was established in 1930 as Civil Law Legal Corporation (C.L.L.C.) by Law 4748/1930, which was revised by L.1559/1950 and was ratified by L.1630/1951 and converted into a Societé Anonyme (S.A.) by Law 2688/1999. The Company is located at Municipality of Piraeus, at 10 Akti Miaouli street.

The Company is governed by the principles of Company Law 2190/1920 and the founding Law 2688/1999, as amended by Law 2881/2001 and Law 4404/2016.

The duration period of the Company is one hundred (100) years from the effective date of Law 2688/1999. This period may be extended by special resolution of the shareholders general meeting.

The Company is a subsidiary of COSCO SHIPPING (Hong Kong) Limited which controls 51,00% of the voting rights, with date of transfer of such rights on 10 August 2016. COSCO SHIPPING (Hong Kong) Limited is 100% held by China Ocean Shipping (Group) Company, which is 100% held by China COSCO SHIPPING Corporation Limited, a Chinese state-owned company. As a result, China COSCO SHIPPING Corporation Limited, by indirectly holding 100% of COSCO SHIPPING (Hong Kong) Limited, indirectly holds 51% of the voting rights in PPA.

PPA SA, operating according to the provisions of the Protocol on Preparedness, Response and Co-operation to pollution incidents by Hazardous and Noxious Substances, as to the OPRC Convention and to the Greek legislation, has adopted and implements a Marine Pollution Contingency Plan for oil, hazardous and noxious substances, approved by the local Port State for the preparedness and response to oil, hazardous and noxious substances marine pollution incidents from shipping and offshore installations within the PPA SA port area. This Plan is in line with the National Legislation and compatible with the Local Contingency Plan of the local Port State and the National Contingency Plan, as well[10].

PPA SA has elaborated and implements a Ship-generated Waste Management Plan, in line with the European Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues, as embodied in Greek Legislation, as well as according to the International Convention Marpol 73/78 for the Prevention of Pollution from Ships[11].

PPA SA implements environmental quality monitoring programs in collaboration with universities and external experts. Monitoring results may indicate special areas and issues of concern, needing improvement. Thus, PPA SA can evaluate its environmental performance and take proper corrective measures when necessary. In particular, PPA SA focuses on the following issues: Seawater quality, Noise quality, Air quality, Landscape, Energy management and On-shore generated Waste management[12]

Regarding **ISO certification,** PPA SA applies an Integrated Quality & Environmental Management System in compliance with the requirements of the ISO 9001:2015 and ISO 14001:2015 standards.

Regarding **Quality control,** PPA SA has been awarded double certification against ISO 9001:2015 for Quality Management and ISO 14001:2015 for Environmental Management by Lloyd's Register (LR).

At the present the Manager of each PPA Department is in the process to appoint one person who will be responsible for the implementation of the Project "PPA GDPR Policies and Procedures" related to Article 29 of Directive 95/46/EC.

More information regarding the European, national and local regulatory context can be found in Annex F.

D.2. Current environmental position

Currently, PPA counts with an Environmental Department formed by 4 people. Their role is to run and supervise the following functions:

a) Environmental Management System (Environmental Policy and the PERS Certificate requirements.

[10] http://www.olp.gr/en/nature-protection/tackling-marine-pollution-emergency
[11] http://www.olp.gr/en/nature-protection/ship-waste-management-plan
[12] http://www.olp.gr/en/nature-protection/nature-quality

b) Environmental Quality:
   1. Marine Environment Quality
   2. Quality of acoustic environment
   3. Quality of atmospheric environment
   4. Landscape Shaping land area
   5. Energy management
   6. Waste Management

c) Ship Waste Management Plan

Apart from the generic position of the port towards environmental actions, it has been particularly relevant for PIXEL the viewpoint and current standing of PPA with regards to impact measuring, standardization, quantification and, namely, the comparison of their approach with other present initiatives.

In this sense, during the execution of task T3.3, both PPA and other entities involved in its execution went through a deep research about interesting platforms/initiatives/entities aiming at measuring and controlling the environmental impact associated to port operations. Similar to the other ports involved in PIXEL (check Appendix B or Appendix C) three points were tracked down. The results of this analysis are depicted in the three tables below.

Firstly, in Table 23 there is a comparison of PPA's current and future perspective about the most relevant environmental components that compose the impact of the port. We have utilised the reference of Green Marine Program initiative to establish this match. This program initially catalogues the importance of each impact with a number (1 to 5). The colour-code is the same that has been used for the other use-cases.

Table 23. PPA's environmental position benchmarking – Green Marine

Potential KPIs for Ports	Current Level			Expected Level (2020)				
1. Aquatic invasive secies	1	2		1	2			
2. Greenhouse gases and air pollutants	3	1	2	1	2	3	4	5
3. Spill Prevention	1	2		1	2	3	4	
4. Dry bulk handling and storage	1			1				
5. Community impacts	3	1	2	1	2	3	4	5
6. Environmental leadership	3	1	2	1	2	3	4	5
7. Waste management	3	1	2	1	2	3	4	5
8. Underwater noise	N/A			N/A				

Secondly, the Consortium proceed with a slightly different approach: to use the reference of the ESPO's Port Performance Indicators, in the umbrella of the project PPRISM. ESPO is being a "reference" entity for PIXEL during the project. From WP9 (Communication, Dissemination and Exploitation), the Consortium is trying to be as engaged as possible in different events organised by this group. Besides, their closeness with EC's view with regards to environmental concerns for ports make them play a key role in the field of action of PIXEL. That is why we have chosen to compare the current situation of the ports in the project with the KPIs established currently by the ESPO.

In the next table, PIXEL's approach has been to, drawing from the list of the performance indicators with regards to environment, make an effort to spot PPA and to analyse how far are we from achieving measurement of each one of the indicators. Furthermore, the data source needed for the measurement of each KPI and its current availability in PPA has been depicted.

This will help both WP5 and WP7 in the future to establish sensors needed, data to consider and guidelines on the implementation of the PEI in PPA.

Table 24. PPA's environmental position benchmarking - PPRISM

PPRISM KPIs for Ports		Relevance 1:low 2:medium 3:high	DataSource N/A or reference	Automatization Yes/No
Energy & Water	Total energy consumption by annual cargo handled.	3	System (DB)	No
	Total water consumption by annual cargo handled.	1	N/A	No
	Ratio of renewable energy per total energy consumed	3	Measurements	No
Emissions to air	Total Greenhouse Gas Emissions	3	Studies and measurements	Yes
	NOx, SOx, PM10, VOCs CO, O	3	Studies and measurements	Yes
	Lden (overall day-evening-night noise level)	3	Studies and measurements	No
	Lnight (23:00 - 7:00hrs noise level)	3	Studies and measurements	No
	Compliance with limits at day, evening and night time	3	Studies and measurements	No
Discharges to water	Thermal conditions	1	N/A	No
	Oxygenation conditions	1	N/A	No
	Salinity	1	N/A	No
	Nutrient condition	1	N/A	No
	Turbidity/Transparency	1	N/A	No
Ecosystems and habitats	Existence of an inventory of environmental Aspects	3	Yes (measurements)	No
	Existence of an environmental Monitoring programme	3	Yes	Yes
	Number and results of EMS audit/review/certification	3	Yes (studies and measurements)	No
	Self Diagnostics results (SDM)	3	N/A	No
	Compliance	3	Certifications (ISO)	No
	Number of prosecutions for non-compliance	3	N/A	No
Transport	CO2 emissions by annual cargo handled (Carbon Footprint)	3	N/A	No

Finally, after the knowledge gained with this activity, PPA created another document, similar to the action done by the rest of the ports in PIXEL (check Appendix B, C and E). This time it was not a comparison but an indication of environmental KPIs relevant for each port, freely identified and catalogued following a similar approach.

Table 25. Potential KPIs for PPA

Potential KPI for Port	Relevance 1:low 2:medium 3:high	DataSource N/A or reference	Automatization Yes/No
Aquatic invasive secies	2	N/A	No
Greenhouse gases and air pollutants	3	Studies and measurements	Yes
Spill Prevention	2	N/A	No
Dry bulk handling and storage	1	Measurements	No
Community impacts	3	Studies	No
Environmental leadership	3	Studies and measurements	No
Waste management	3	Studies and measurements	Yes
Underwater noise	1	N/A	No
Parking area occupancy	2	Daily measurements	No
Local IoT platform implementation	2	N/A	No
Number of sensors to the local IoT platform	3	N/A	No
Number of types of data (sensors) connected to the IoT platform	3	N/A	

D.3. Technical context

Sensors and existing networks

PPA SA is a member of the European EcoPorts network and in this framework a Self Diagnosis Method report (SDM) has been elaborated and updated every two years.

Furthermore, PPA implements an integrated environmental management certified according to the European Environmental System focused in port sector: PERS (Port Environmental Review System).

In the scope of the environmental management system PERS and EcoPorts network membership, PPA SA has elaborated and implements specific environmental policy, procedures of implementation and updates in permanent base record of environmental parameters associated with all the activities, while it aims at continuous improvement of its environmental performance, following the European and international standards and aiming to protect the environment and conserve natural resources for future generations.

Thus Piraeus port is committed to the principles of the ESPO Green Guide and establishes objectives and targets to achieve performance improvement.

As part of implementation of PERS environmental management system and in accordance with the Environmental Terms of port’s operation, PPA SA has developed and implements the following procedures for the prevention and control of pollution and environmental impacts:

- **Environmental quality monitoring program on air quality**, in order to identify, assess and quantify port’s significant air emissions and develop appropriate actions and operational techniques to protect and improve air quality within the port area. Since 2009 PPA applies a comprehensive program to monitor atmospheric pollution, through a specialized monitoring station and identifies, where appropriate, mitigation measures. The parameters of environmental that are measured and monitored are: NO_x, SO_2, CO, O_3, PM_{10}, BTEX.
- **Environmental quality monitoring program on acoustic environment**. PPA implements, in collaboration with an external consultant, an integrated monitoring programme of noise, covering the entire port area and focusing on the reduction of noise levels from sources related to container terminal

operations, construction works, vehicles movements. The LAeq indicator is measured and monitored throughout the port area of PPA SA, twice per year.

The network infrastructure currently available is depicted in Figure 46. With regard to the sensors that are installed and functioned nowadays in the Port of Piraeus (and that will be of relevance for PIXEL) are two-fold: air-quality related and noise-quality related sensors, which will be described below.

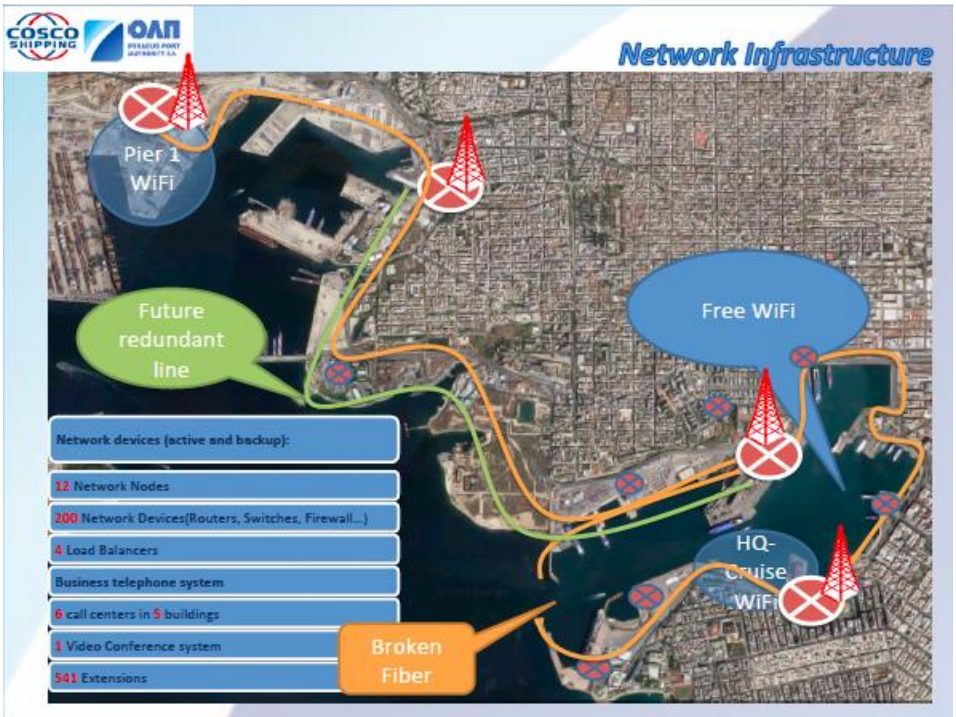

Figure 46. Port of Piraeus network infrastructure

Air quality

An Air quality station has been installed and is under full operation in 24/7 mode. The monitoring indicators are: CO, BTEX, NOx, SO2, PM10 and meteorological data. The above air quality monitoring program is being implemented in collaboration with National Technical University of Athens since 2009. The data are available in Excel form (24/7 per month) archives and in annually evaluation reports

The air quality station has been installed in the port's N-NW zone (next to the passenger and cruise ship terminal), in collaboration with the Technical University of Athens. This station continuously collects data on the concentrations of certain parameters (BTEX, CO NOx, SO2, O3, PM10). This information is very useful when determining the levels of certain contaminants in the port area, and also when trying to identify possible pollution sources. Climate change and greenhouse effect are major issues that concern our society. Anthropogenic activities are regarded as the main source of CO2 emissions, which contribute to the greenhouse effect and solutions that will lead to the effective mitigation of this problem, are sought.

PPA SA, acknowledging the severity of this issue and although its activities do not relate directly to it, has initiated and implements a pilot quality monitoring program of the atmospheric environment in the port area, taking into consideration both direct and indirect port activities.

Figure 47. The Air Quality Monitoring Station in PPA SA port area.

Noise quality

In regards to noise levels there is no permanent network operated. The noise measurements are available in semiannually base through 2 set of measurements per year in 25 spots around the port. Port of Piraeus operates within strict noise limits and is continuously working hard to identify and reduce causes of noise, taking into account that it is embraced by the urban area of the city.

PPA SA implements an acoustic environment quality-monitoring program for its entire port area. PPA SA has undertaken corrective actions considering the evaluation of the results from noise level measurements and relevant noise studies. Such an action is the installation of noise barriers along the borders of a school in Perama area, located at close proximity to the port. In parallel, the enhancement of the plantation, which takes place in the port's surrounding area, not only improves the area's aesthetics, but also contributes to noise absorption, even in places that are indirectly affected by noise caused by port activities.

Figure 48. Noise measurements at PPA SA container stevedoring area

Furthermore, during the execution of task T3.3, PPA (supported by other technical partners of PIXEL) analysed the most affecting parameters in relation to the environment in Bordeaux area. Afterwards, the Consortium made an exercise to identify the type of sensors that could help measuring those. Finally, that information was matched with the existing sensors in PPA and a "positioning" table was elaborated. The following table will be very useful in forthcoming work packages to know which information is available, which can be reached during PIXEL and how to address different actions (PEI deployment, pilot execution).

Table 26. Relevant environmental measurements and sensors available - PPA

Impacts of port activities sensors		**Availability in PPA**	**Comments**
Air quality	Pollutant particles (NOx, SO2, CO, O3, PM10, BTEX)	Y	Within a program in collaboration with NTUA, since 2009.
Acoustic Noise	LAeq indicator	Y	In collaboration with external consultant. Monitored throughout the port area of PPA

ICT systems

The PPA ICT system consists of the Port Management Information System (PMIS). The information system currently supporting the functions of the terminal, both on an administrative-economic level and on an operational level, is the system SPARCS N4 of the company NAVIS. This system currently operates in many ports around the world.

Figure 49. Port Management Information System of Port of Piraeus

PPA terminals have to plan their service activities based on many interrelated (and in many cases conflicting) factors.

The cruise terminal provides an excellent example of the integration of the various Information Systems and Control Engineering applications in an overall Port Information System (PMIS) architecture that incorporates the vessel traffic management, the sea yard and freight station planning operations, the administrative and financial management, the management and control of the handling activities, the cargo consolidation/warehouse services, the gate inspections and the equipment maintenance.

Port of Piraeus PMIS operational environment incorporates numerous management activities that can be distinguished into three groups:

1. Planning operations, such as yard planning (dynamic storage area allocation), berth planning (berth allocation to vessel and crane allocation to berths), ship planning (loading &unloading plan optimization with respect to cargo compatibility and stability limitations) as well as Container Freight Station and rail-terminal operations planning

2. Management and control of the actual ship/train/truck handling activities, including personnel and equipment guidance and command (and computerized equipment control - where applicable) as well as monitoring supervision of the reefer container, dangerous cargoes and high value cargo related activities.

3. Administrative/financial management that includes container invoicing, custom clearance, sanitary checks and port communication with shipping lines/shipbrokers, stevedores and clients.

The general principles that guide the Architecture Design of the PMIS storage structure are as follows:

- **Security:** The design of the data centre should ensure the utmost protection of the confidentiality, integrity and availability of the PPA's data and information.
- **Virtual Infrastructure:** For achieving the required flexibility, all systems are deployed in virtual machine environments. The rule excludes the production database servers of NAVIS, Express_J, HRM and Orama_ERP as well as the backup server.
- **Using Open Standards and Protocols:** Open standards are used wherever possible to implement the Project to facilitate and ensure smooth operation / communication between individual hardware and software systems.
- **Availability:** The Architecture Design of the storage structure ensures high availability of PPA's systems / applications. For this reason, the architecture of the solution is in a high availability active - and / or active - standby configuration.

- **Load balancing:** Load balancing techniques are used as a minimum for systems that have this architecture in the current situation.
- **Interconnectivity / compatibility with existing infrastructure:** The Architecture Design of the storage structure ensures a smooth communication between the new features offered to each other and the existing infrastructure of the company.

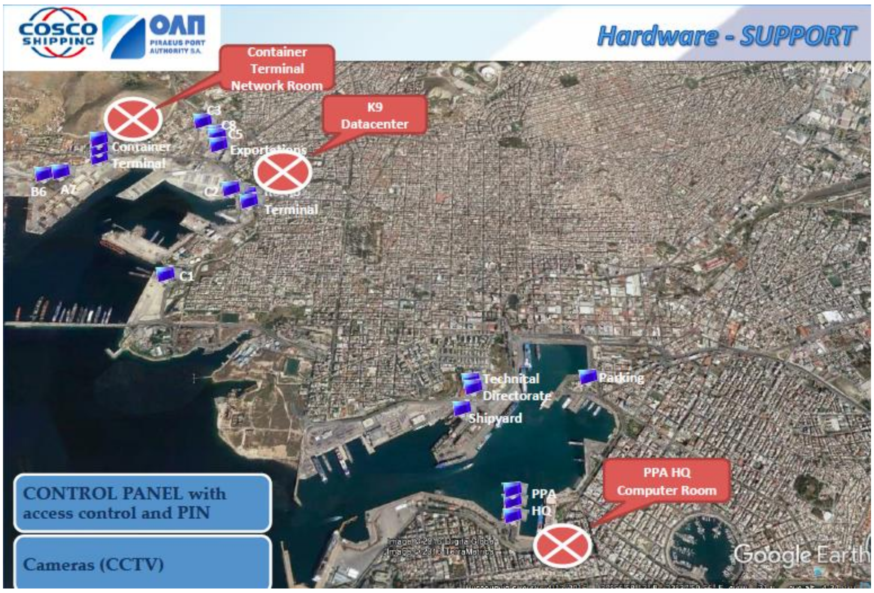

Figure 50. Port of Piraeus PMIS' features (3) – Hardware support

Data availability

Data is maintained in a network of more than 100 servers. A brief overview is depicted in Figure 51.

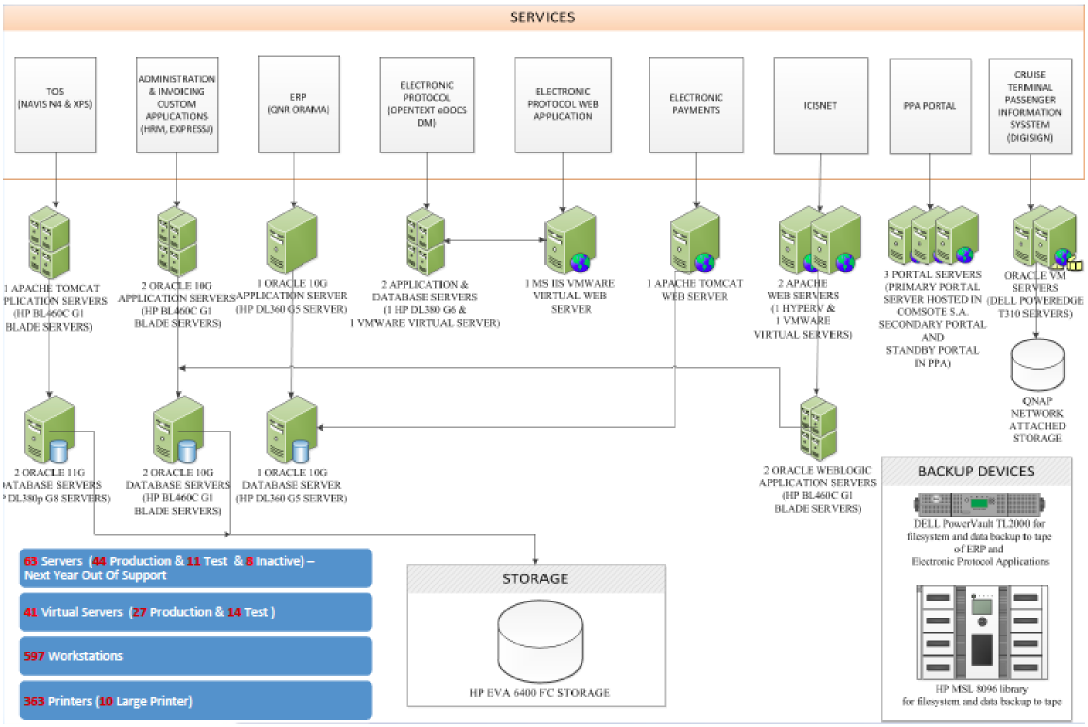

Figure 51. Server and storage structure in Port of Piraeus network

The data that will become available to the PIXEL Hub will come from the following sources:

1**. External data sources:**

- Meteorological data form http://www.meteo.gr/index-en.cfm
- AIS real time vessel traffic monitoring data (sources: https://www.marinetraffic.com/)
- Public transport data from http://www.stasy.gr/index.php?id=1&no_cache=1&L=1 and http://www.oasa.gr/?lang=en

2. PPA IT systems:

From the ORAMA ERP and N4 EXPRESS PPA system the following data will become available:

- Input Data of Containers, Cargo and Roro
- Output Data of Containers, Cargo and Roro
- Cruise Arrivals/Departures
- Cruise Planning Per Date
- All Domestic Passengers Per Ship & Month
- All Vehicles (Except Commercials) Per Ship & Month
- Ships Arrivals and Departures
- Ships Arrivals and Departures

3. PPA field measurements:

Air quality data

An Air quality station has been installed and is under full operation in 24/7mode.The monitoring indicators are: CO, BTEX, NOx, SO2, PM10 and meteorological data. This has been already commented previously. The following are sample data outputs from the Air Quality Monitoring station:

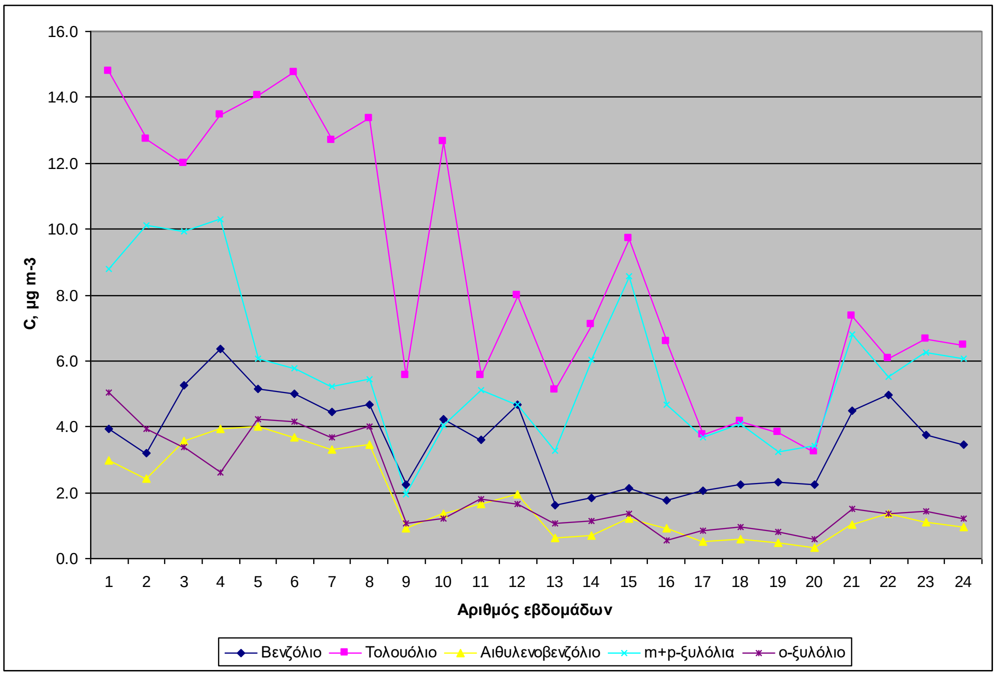

Figure 52. Number of weeks and pollutants variations((x: week number, y: amount of pollutant) blue: benzene, pink: toluene, yellow: ethylbenzene, lightblue: m+p xylene ,brown: oxylene

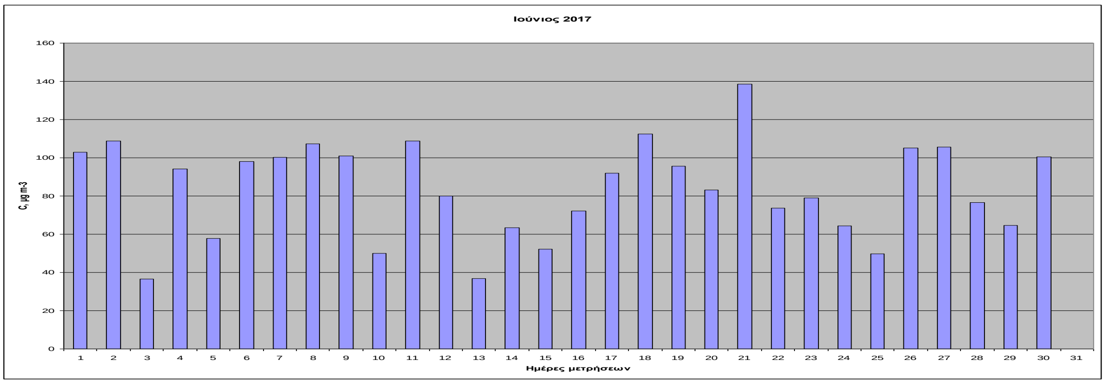

Figure 53. Measurements of NO levels(June 2017 x:days of measurements, y:amount of pollutant)

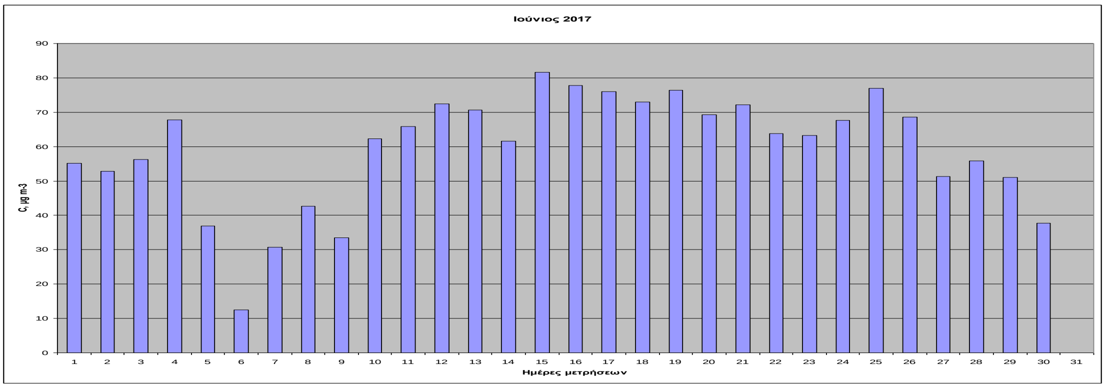

Figure 54. Measurements of NO2 levels. (June 2017 x: days of measurements, y:amount of pollutant)

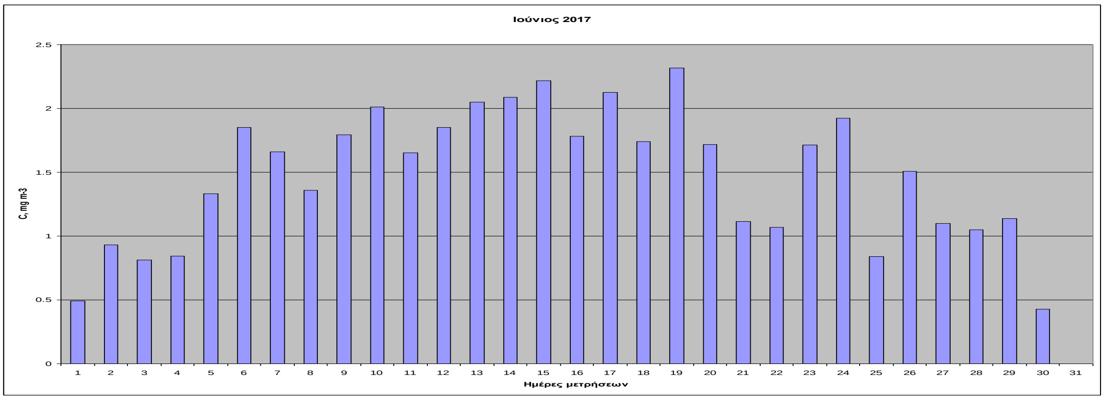

Figure 55. Measurements of CO levels. (June 2017 x: days of measurements, y:amount of pollutant)

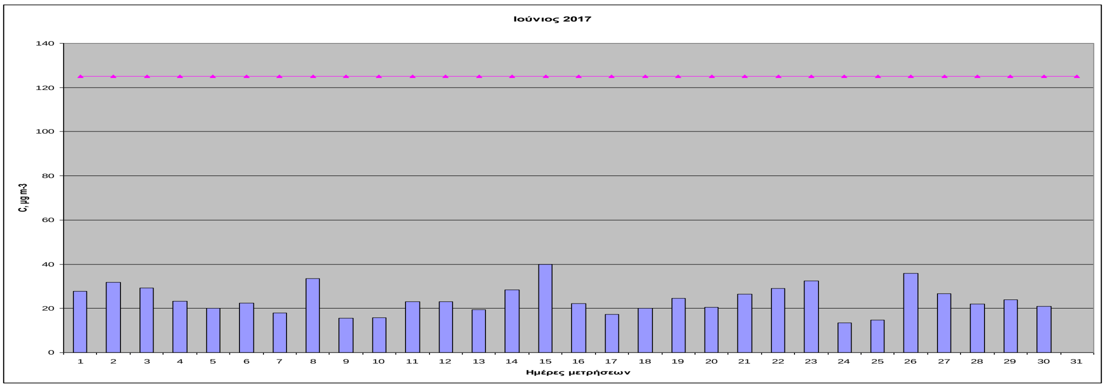

Figure 56. Measurements of SO2 levels. (June 2017 x: days of measurements, y:amount of pollutant)

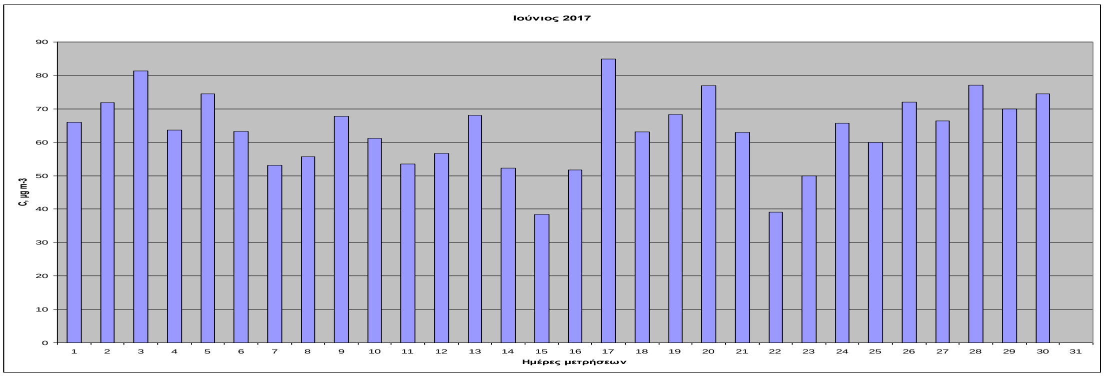

Figure 57. Measurements of O3 levels. levels(June 2017 x:days of measurements, y:amount of pollutant)

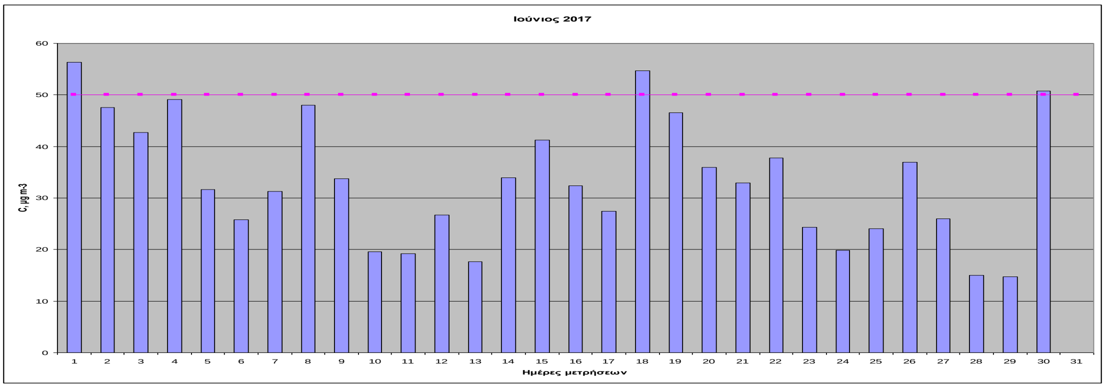

Figure 58. Measurements of PM10 levels (June 2017 x:days of measurements, y:amount of pollutant)

Table 27. Table of overlaps in the Piraeus port (annual)

Air emission parameter	No of overlaps	No of limit overlaps
NO	-	-
NO2	**0** (200 $\mu g\ m^{-3}$) [1]	**-** (40 $\mu g\ m^{-3}$) [4]
SO2	**0** (350 $\mu g\ m^{-3}$) [1]	**0** (125 $\mu g\ m^{-3}$) [3]
CO	**0** (10 $mg\ m^{-3}$) [2]	**-**
O3	**0** (180 $\mu g\ m^{-3}$) [1*]	**1** (120 $\mu g\ m^{-3}$) [2]
PM10	**22** (50 $\mu g\ m^{-3}$) [3]	**-** (40 $\mu g\ m^{-3}$) [4]
Benzene	-	**-** (5 $\mu g\ m^{-3}$) [4]

Noise data

An integrated noise quality monitoring program is implemented covering measurements in 25 spots across the total port area The following parameters are monitored: LAeq, Leq, Lfmax, Lfmin, L5, L10, L50, L90, L95, Lae.are monitored through the collaboration with an external consulting company. The future planning includes the establishment of a monitoring network consisting of suitable sensors for measurements of Lden and LAeq indicator. The LAeq indicator is derived from 2 set of measurements per year in 25 spots around the port as shown in the figure below. The data are available in the form of semi-annual reports (word forms)

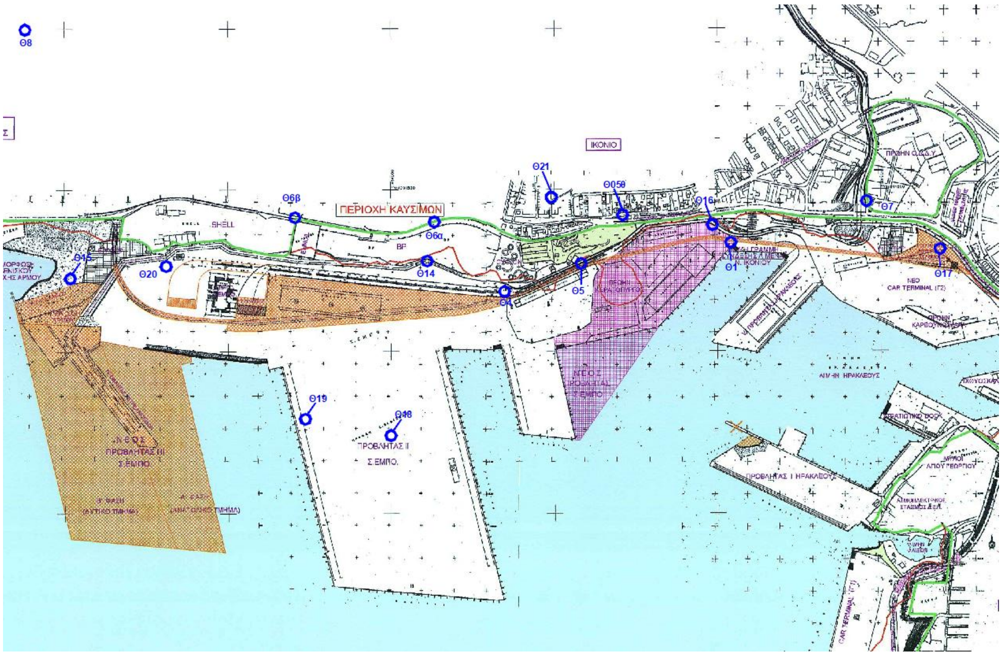

Figure 59. Noise measurements spots in the port of Piraeus

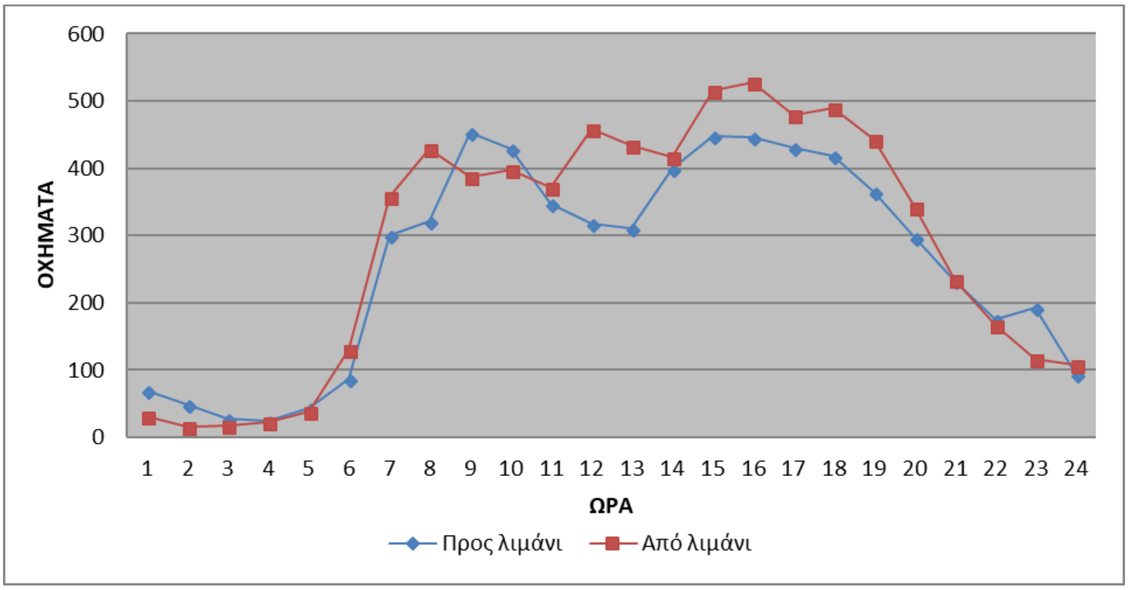

Figure 60. Noise distribution per hour (Vehicles)

Table 28. Output from the noise measurement position report

α/α	Περιγραφή θέσης μέτρησης	ΘΕΡΙΝΗ ΠΕΡΙΟΔΟΣ Leq [dB(A)]	ΘΕΡΙΝΗ ΠΕΡΙΟΔΟΣ L95 [dB(A)]	Κύρια πηγή θορύβου από ΟΛΠ
Θ01	Είσοδος – Έξοδος προβλήτα Ι ΟΛΠ Α.Ε.	70,3	67,1	ΝΑΙ
Θ04	Όριο ιδιοκτησίας πλησίον οδικού άξονα προς είσοδο ΣΕΠ	70,8	51,6	ΝΑΙ
Θ05α	Όριο ιδιοκτησίας ΟΛΠ πλησίον Σχολείου	71,5	60,2	ΝΑΙ
Θ05β	Όπισθεν πετάσματος στο προαύλιο του σχολείου	60,0	56,1	ΝΑΙ
Θ14	Όριο ιδιοκτησίας πλησίον εισόδου ΣΕΠ	63,8	57,1	ΝΑΙ
Θ15	Όριο ιδιοκτησίας πλησίον Λιμενίσκου περιοχής Αρμού	54,8	51,8	ΝΑΙ
Θ16	Όριο ιδιοκτησίας επί πύλης εισόδου ΣΕΠ	73,3	62,3	ΝΑΙ
Θ17	Όριο ιδιοκτησίας στο Car Terminal	60,8	57,9	ΟΧΙ
Θ20	Όριο ιδιοκτησίας πλησίον εισόδου ΣΕΠ	65,5	56,4	ΝΑΙ

Following the scenarios described in **¡Error! No se encuentra el origen de la referencia.**, the information depicted in this section, the data gathered for deliverable D4.1 and the knowledge gained by technical partners in the Consortium, a summary table has been created to summarize the available data for this use-case.

Table 29. Data availability PPA use-case

Software system (ORAMA ERP and N4 EXPRESS PPA)

Use-case relevant information	**Availability in PPA**	**Comments**
FAL Forms (ship arrivals and departures)	Yes (ERP)	Near real time
Input data of containers, cargo and Ro-Ro	Yes (Excel file)	Cargo for the following month
Output data of containers, cargo and Ro-RO	Yes (Excel file)	Cargo for the following month
Cruise arrivals and departures	Yes (ERP)	Cruises for the following month
Cruise planning per date	Yes (ERP)	A year in advance
Other information		
Waste management	Yes	Studies and measurements
All domestic passengers per ship and month	Yes (GDPR compliant in PIXEL)	ERP. Following month.
All vehicles (except commercials)	Yes	Per ship and month
Environmental data (field measurements)	**Availability in PPA**	**Comments**
NOx, SO2, CO, O3, PM10, BTEX	Yes (Air quality station)	24/7 Excel file and annual report.

LAeq indicator (container terminal)	Yes	2 values per year. Word files.
Total Greenhouse Gas emissions	Yes	Studies and measurements
External data sources	**Metropolis of Piraeus**	**Comments**
Meteorological data form	Open data	http://www.meteo.gr/index-en.cfm
Meteorological data form (ellak.gr)	Open data	https://opendata.ellak.gr
AIS real time vessel monitoring data	Open data	MarineTraffic
Public transport data	Open data	http://www.stasy.gr
Public transport data	Open data	http://www.oasa.gr

Moreover, the whole report of data available will always be part of the requirements that are being introduced in the JIRA platform enabled for PIXEL. This report will be updated periodically, supporting both actions in WP4 (for precise modelling and predictive algorithms), in WP5 (including this data, if proceeds, into the calculation of the PEI) and in WP6 (to create interfaces to gather the data and common technology for embedding every data available into the PIXEL ICT solution).

D.4. Operational details of the use-case

Enabling the IoT platform

The Port of Piraeus will analyse with technical partners of the Consortium the appropriate IoT platform to be deployed by taking into account the existing equipment and devices. In particular, PIXEL will enable the end-to-end visibility of the port's operations that relate to the cruises operations and capacity resources, mainly focusing on passengers and barge transportation plans and execution monitoring, delivering state of the art Planning as a Service, facilitating online access to schedules and allowing PPA to accurately plan, and inform on goods and capacities to their existing and new clients. Furthermore, it will enable the development of simulation modelling tools for detailed analysis and predictions on passenger flows (per transport mode), including their emissions, port turnaround times, emissions in port operations, etc.

Scenario roadmap

In order to deliver a successful use case in the port of Piraeus, a set of action items/steps have been foreseen which relate to activities (tasks) performed in the project:

- **Formation of the PIXEL Mobility Case (MC) Work Group**: Drawing up of an organizational chart of the parties involved, together with their interactions and interdependencies. The members of the Work Group will participate in the PIXEL activities and will come from the divisions of the Port management, the cruise sector, the Port Security, Safety & Environmental Protection Department, the Division of works and the IT & BPS Department. PPA will be in charge of addressing the port agents/stakeholders.
- **Work Group workshops to establish the PPA Mobility Case (MC)**: It aims to improve the conditions of implementation of the PIXEL MC through the application of SWOT analysis and the incorporation of the PIXEL tools. It will review the analysis of the port of Piraeus situation, the objectives of the MC and identify the factors to achieve the expected result on the defined KPIs. The workshop will be scheduled with any other relevant workshops in PIXEL, if possible.
- **Development of the PIXEL MC action plan**: Assessment of the existing port of Piraeus structures and development of a tailor made action Plan for creating and managing a viable port MC that can play a key-

role in the advancement of effective mobility measures in the Port of Piraeus on the basis of the PIXEL framework. PPA is the best suited for aligning PIXEL developments with port strategy.

- **Deployment of the PEI:** Data gathering, analysis of barriers to PEI implementation and corrective actions will be sought.
- **Collaborating with other PIXEL pilots**: Not only through the PEI cross use-case, but it is important to make the PPA pilot case experiences available to other PIXEL pilots.
- **PPA pilot execution results generalization**: Standardized reporting for the transferability of the PPA pilot case to other ports will be performed.
- **MC assessment**: Evaluation report on the technical performance, the investment and operational costs, the user acceptance, information security and robustness. A similar report will apply for business and economic impact.

Equipment

Some necessary equipment has been already identified and will be purchased before the implementation phase:

- One compact mobile air pollution station with sensors in the ship terminal to control air quality and collect data on the concentrations of certain parameters (BTEX, COx, NOx, SO_2, O_3, PM_{10}).
- One permanent noise monitoring network with suitable sensors for24/7 measurements of Lden indicator in the Container Terminal area.

System Integration

The integration of the PMIS of Port of Piraeus (ORAMA ERP and N4 EXPRESS) with PIXEL will be determined together with the technology partners later in the project, when the exact scope and methodology of integration is decided.

The measurements coming from the existing sensors and potential new ones should be sent to the PIXEL platform. Data exchange protocols need to be defined and then implemented.

PEI Implementation

PPA will provide to PIXEL the relevant environmental parameters of its port operations so that they can be integrated into the PEI. The use case in Port of Piraeus will focus on how air and noise pollution impact on the PEI and the employed models may provide hints to foresee pre-emptive actions to reduce its value.

D.5. Flanking stakeholders

The port operator (PPA Authority) can enhance the relationship with the city and collaborate with the municipality and the region on strategic planning level for the upgrade of the environmental quality.

Cruise and passenger's ships, and the large amount of associated bus and taxi traffic that transport cruise/coastal shipping passengers to and from tourist destinations and islands in the area, are considered to be one of the most problematic pollution sources by members of the PPA community. In addition, the operator can leverage the monitoring via sensors in order to explore whether the contribution of cruise ship emissions could be observed in the measured levels. While there are a variety of emissions sources in the PPA region, most maintain relatively constant schedules over time, with the exception of cruise ships and their associated bus traffic.

The list of actors identified in this use-case is (see Figure 61) :

- Piraeus Port Authority (www.olp.gr) : IT & BPS Department, Port Security, Safety & Environmental Protection Department, Strategic Planning and Marketing Department, Port Passenger Terminal, Port Cruise Terminal
- Ministry of Environment And Energy (http://www.ypeka.gr)
- Hellenic Data Protection Authority (HDPA). http://www.dpa.gr
- Ministry of Shipping & Island Policy (https://www.yen.gr/)
- Hellenic Ministry of Infrastructure, Transport and Networks (http://www.yme.gr)

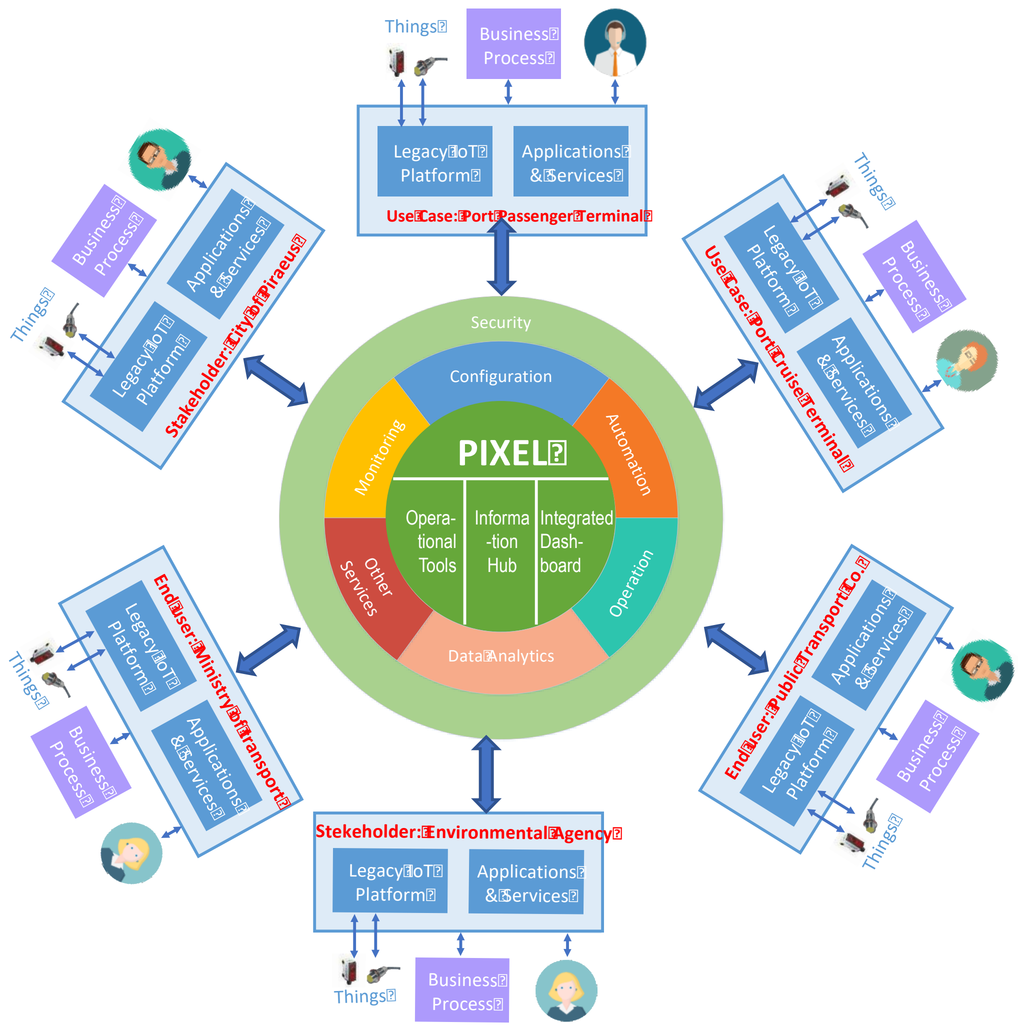

Figure 61. PPA use-case actors and interactions

Appendix E – Use case of the Port of Thessaloniki

E.1. Global context of the use case

Thessaloniki is the major port for northern Greece (2nd nationally) and is considered to be an ideal transit Gateway for the southern Balkans and South Eastern Europe. It is located on the inner part of the Bay of Thermaicos, on the northern section of the Eastern Mediterranean Sea, to the west of the center of the city of Thessaloniki. The port of Thessaloniki is part of the Trans -European Core Transport Network (Trans-European Corridor Orient/ East Med, Pan European Corridors IV & X) and is located on an advantageous position, lined to the maritime transportation network of the Balkans and Black Sea countries, but also in the cross-European and national land transportation network.

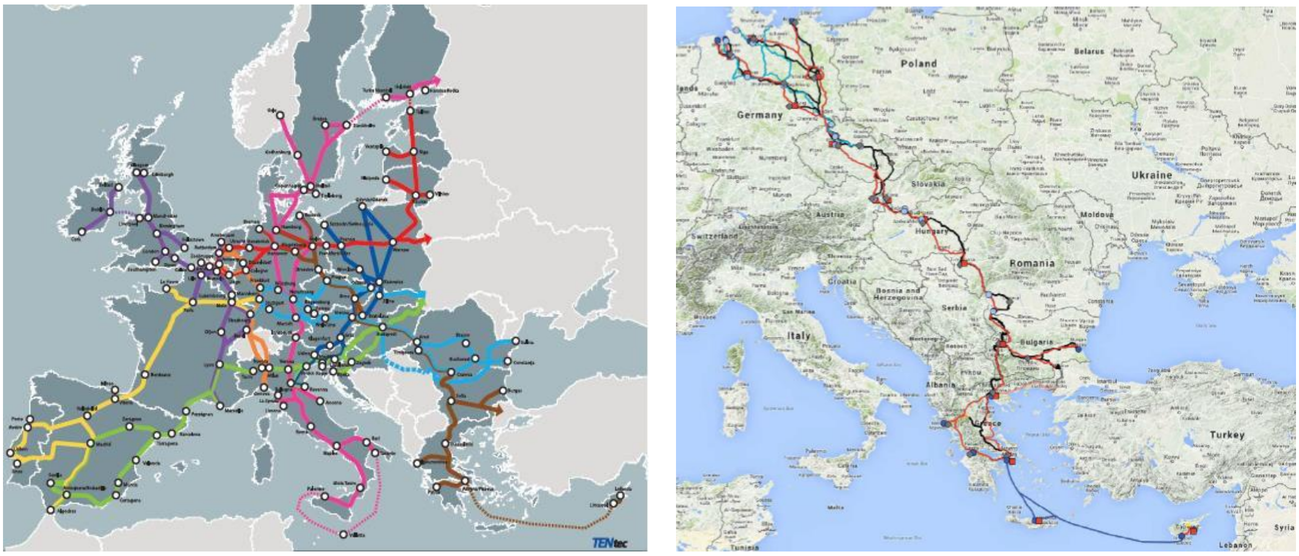

Figure 62. Port of Thessaloniki geographical and TEN-T position

The land port zone of ThPA S.A. covers an area of 1.55 million sqm. and extends along 3.5 km, located close to the industrial area and the logistic centers of the city. The infrastructure includes 6 piers (27 docks) spreading on 6,200 meters and berth depth up to 12 meters. Approach of the vessels, is accomplished through a natural channel (sea basin of 775 ha) of substantial depth, while from land, is easily accessed by rail and road.

ThPA SA is the sole port operator and port services provider of the port of Thessaloniki, with the exclusive right to possess, use, manage, maintain, improve and exploit all port premises, under a Concession agreement with the Greek State, with the State’s supervision. As Port Operator, THPA SA, serves ships and offers a wide range of cargo handling (Containerized cargoes, Dry and liquid bulk cargoes, General cargoes, Ro-Ro) and passengers (Ferry & Cruise). The main types of cargoes handled are: steel products, fodder, cereal, scrap, cars, ores and minerals. Six to seven million tons of cargo are transported on an annual basis from the port facilities, mainly by trucks via Egnatia and PATHE. The inbound traffic of the port on a daily basis exceeds 1.000 trucks. In 2017, transit goods represented the 28% of total conventional port traffic (45% vessel discharged goods, 6,5% vessel loaded goods).

Table 30. Annual throughput of the Port of Thessaloniki

	2015	2016	2017	Difference % 2015-2017	Difference % 2016-2017
Total throughput in tons	6.904.174	6.110.230	6.905.294	0,02%	13,01%
Liquid Bulk	51.516	32.408	54.890	6,55%	69,37%
Dry Bulk	3.589.534	2.766.172	2.996.715	-16,52%	8,33%
General Cargo	415.790	513.947	546.588	31,46%	6,35%
Ro Ro	67.400	62.720	93.688	39,00%	49,38%
Containers*	2.779.934	2.734.983	3.213.413	15,59%	17,49%
No of Containers in TEUs	351.741	344.316	401.947	14,27%	16,74%

ThPA SA, ensures that all works commissioned by it and conducted within the Port of Thessaloniki, comply with any and all applicable standards, specifications, safety, security and environmental requirements. ThPA SA has adopted all national and EU regulations concerning environmental issues. The Decision approving the environmental terms for the operation of the Port of Thessaloniki, includes all regulations which should be followed and the relevant rules and limits.

Premises & infrastructure

The Port Land Zone is the total sheltered and outdoors terrestrial areas within the Port Area. By reference to the different operations and activities accommodated in the Port, the Port Land Zone can be divided into ten distinct sectors. Five of which, from Pier 3 to Pier 6, accommodate the various activities of the core port business.

Container Terminal – Pier 6

It occupies the western part of Pier 6 (Quay 26) and offers a variety of services for competitive fees, including loading/unloading, quayside handling, container storage, reefer containers, inspection and rail handling. Operations are carried out 365 days a year with flat rates, with no interruption, including customs formalities.

- Characteristics: quay length of 570 meters and 12 meters' berth depth, with maximum vessel draft of 10.8m. The total surface of the terminal is 317.000 sq. m. area, with a capacity of approximately 440.000 TEUs.
- Main equipment includes: 4 gantry cranes (2 post-panamax, 2 panamax), 16 straddle carriers, 1 transtainer, reach-stackers, as well as various other container handling equipment (tractors, front lifts, trailers, forklifts etc).

It must be noted here, that under ThPA' s investment plans and due to the forecasts on future expected throughput, the Container Terminal will be expanded and its rail network will be modernized.

Conventional Cargo – Piers 4,5 and eastern part of 6

It offers quayside handling, loading/unloading services and storage facilities, mostly of dry bulk cargo (ores, minerals) and steel product handling. Operations take place in 2 shifts at flat rates and overtime upon request

- Berth depth of up to 12m and max vessel draft 11.1m
- Rail connection to all berths
- Annual throughput of about 4mil tones
- 32 rail-mounted cranes up to 40 ton lifting capacity. 2 new heavy duty rail-mounted cranes of 100 tones / 17m capacity, 2 Mobile Harbor Cranes of 100 ton lifting capacity, 2 Mobile telescopic cranes of 120 ton & 150 ton lifting capacity, Forklifts (lifting capacity up to 37tn), Loaders, Excavators, Road/rail shunting locomotives and other cargo handling equipment.

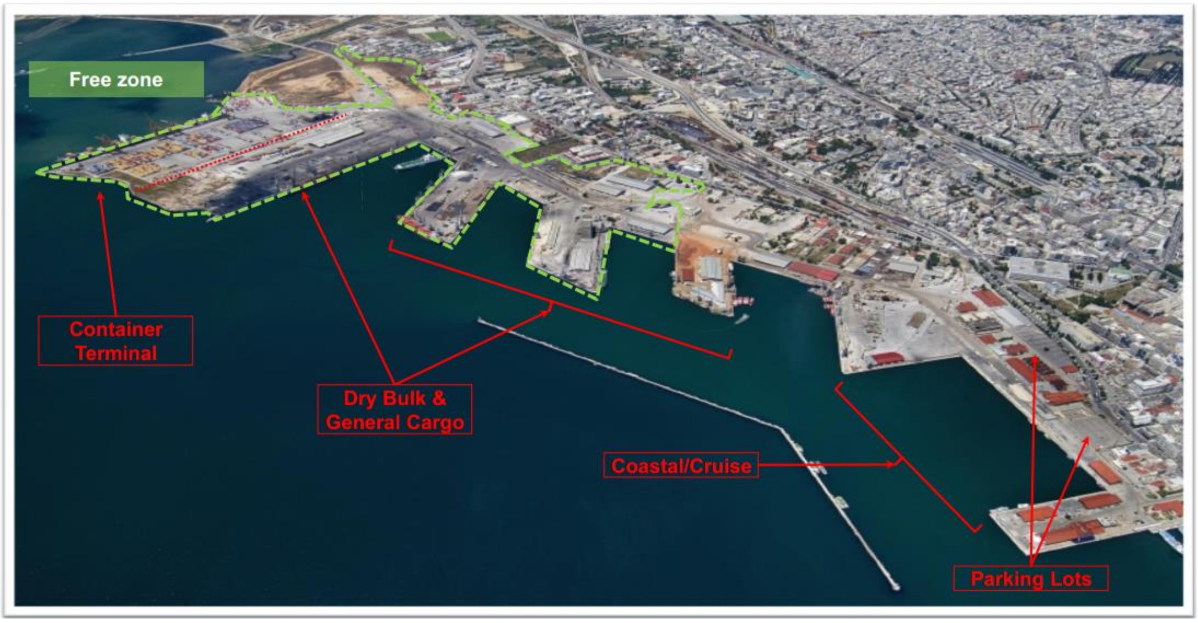

Figure 63. Port of Thessaloniki infrastructure

The role of the port of Thessaloniki, is reinforced by the existence of railways at all its quays with double / triple rail links linked to the national and international rail network, thus, enhancing the opportunities of intermodal transport of goods, with destinations inside and outside Greece.

The railway infrastructure within the Free Zone of the port, includes two independent line systems, which entering the port from two different points (Gates 7 and 11). The first line entering near Gate 7, is old and currently inactive. The new line entering the Port near Gate 11, is operational and is an important infrastructure for the transport of various types of products from / to the port. The total line length, which is mostly developed within the Free Zone, amounts to approximately 17,400 meters. Nowadays, the above railway link through Gate 11, crosses 26th October Street, a major entrance to the city of Thessaloniki, causing congestion in traffic towards the city center. Also, the poor geometric characteristics of the rail link, interfere with the unobstructed train movement to and from the port, increasing journey times between the port and sorting stations.

Regulatory context

Under a concession agreement with the Greek State, signed in 2001 for 50 years, Th.P.A. S.A. had until recently, the exclusive right to use and exploit the infrastructure and superstructure of the Port of Thessaloniki. The most recent developments (2016) on port policy, concern the establishment of the Public Port Authority (DPA), the redefinition of the Port Authority's role (transformation into an independent authority) and the exploration of the prospects for reorganization of the Port Facility, with possible mergers and transformation into societes anonymes (L.4389 / 2016).

In this framework, the consortium comprising of “Deutsche Invest Equity Partners GmbH”, “Belterra Investments Ltd.” and “Terminal Link SAS” acquired the 67% of the shares of Thessaloniki Port Authority SA, through a concession agreement, that was ratified with the law number 4522/2018 (Official Gazette A 39) “Ratification of the amendment and codification of the Concession Agreement dated 2 February 2018 between the Greek State and Thessaloniki Port Authority S.A. and other provisions”.

Apart from the change of THPA SA legal status, new EU Custom Code, and the recently (15/10/2018) published decision of the Greek government about the establishment and operation of Free Zones and implementation of EU 2017/352 Regulation, constitute main factors influencing port-hinterland chain structures.

ThPA SA has an approved plan in place, for the management of ship waste and cargo residues for vessels mooring at the port of Thessaloniki, as well as, a Contingency plan for oil pollution incidents in ThPA's jurisdiction area. It operates according to an approved environmental protection plan for operations, under which, noise pollution tests are conducted on a regular basis. In addition, water quality is regularly tested to ensure the standard of the aquatic environment, while, installed equipment for measuring atmospheric pollution is in place. Finally, all waste generated by its facilities, such as end-of-life tires, lubricating oil wastes, wood packing, metal packaging, excavated and demolished aggregates, scrap, filters oil and oil, shavings and fabrics, are recycled.

The company is certified with an ISO 14001 for commercial vessels mooring, unloading of bulk cargo and containers, storage and transport of cargo. Mooring of passenger vessels and cruise ships, concession of sites for commercial and cultural activities and an ISO 9001 for loading/unloading of general cargo, solid bulk cargoes, excluding cereals. Occupational Health and Safety Regulations of Thessaloniki Port Authority

ThPA SA has adopted all national and EU regulations concerning environmental issues. The Decision approving the environmental terms for the operation of the Port of Thessaloniki, includes all regulations which should be followed and the relevant rules and limits. For the PIXEL project, the regulations that are of interest, are the Governmental decisions 14122/549/E103/24.3.2011 (based on EU Directive 2008/50) and 2206/1075/E103/29.5.2007 (based on EU Directive 2004/107) which describe critical values for air quality, as well as, the Governmental Decisions 37393/2028/29.2.2003 and 9272/471/12.3.2007, which include critical values of noise.

More information regarding the European, national and local regulatory context can be found in Appendix F.

E.2. Current environmental position

ThPA SA Environmental department is responsible for monitoring the pollution on port land and marine environment, as well as, the compliance of all involved actors with ThPA SA’s Environmental policy. For that reason, the Environmental Monitoring mechanism was set up, in order to recognize and record any environmental obligations, involved authorities, responsibilities and data management. Besides the position of the port towards environmental actions, it has been particularly relevant for PIXEL, the viewpoint and current standing of ThPA SA with regards to impact measuring, standardization, quantification and, namely, the comparison of their approach with other present initiatives.

In this sense, during the execution of task T3.3, both ThPA SA and other entities involved in its execution, went through a deep research about interesting platforms/initiatives/entities, aiming at measuring and controlling the environmental impact associated to port operations.

In the course of the action, three points were finally tracked down. The results of this analysis are depicted in the three tables below. With this task, the Consortium has been able to, somehow, spot the port in the common space of research. Though it, is remarkable that nowadays a common methodology for this benchmarking does not exist; both ThPA SA and other partners in the Consortium (PRO, CERTH), consider this approach valid and accurate.

To begin with, in Table 31 there is a comparison of THPA’s current and future perspective about the most relevant environmental components that compose the impact of the port. We have utilised the reference of Green Marine Program initiative to establish this match. The colour-code and numbering for this table is the same than the utilised in the previous Appendices B, C and D for other port’s benchmarking.

Table 31. THPA's environmental position benchmarking – Green Marine

Potential KPIs for Ports	Current Level		Expected Level (2020)			
1. Aquatic invasive secies	1		1	3		
2. Greenhouse gases and air pollutants	1		1	3	4	
3. Spill Prevention	1		1	2	3	
4. Dry bulk handling and storage	1	3	1	2	3	4
5. Community impacts	1		1	2	3	
6. Environmental leadership	1		1	2		
7. Waste management	1	3	1	3	4	
8. Underwater noise	N/A		N/A			

Moreover, the Consortium proceeded with a slightly different approach: to use the reference of the ESPO's Port Performance Indicators, in the umbrella of the project PPRISM.

PIXEL's approach has been to, drawing from the list of the performance indicators with regards to environment, to position the port of Thessaloniki and to analyse how far the project is from achieving measurement of each one of the indicators. This has been done through the following table, indicating next to each KPI the data source needed for the measurement and whether it is available or not in THPA in this moment of the project.

This will help both WP5 and WP7 in the future to establish sensors needed, data to consider and guidelines on the implementation of the PEI in THPA.

Table 32. THPA's environmental position benchmarking - PPRISM

PPRISM KPIs for Ports		Relevance 1:low 2:medium 3:high	DataSource N/A or reference	Automatization Yes/No
Energy & Water	Total energy consumption by annual cargo handled.	3	Databases	Yes
	Total water consumption by annual cargo handled.	2	Paper	No
	Ratio of renewable energy per total energy consumed	3	N/A	No
Emissions to air	Total Greenhouse Gas Emissions	3	N/A	No
	NOx, SOx, PM10, VOCs CO, O	3	Databases - in static files	Yes
	Lden (overall day-evening-night noise level)	3	annual measurements - in static files	No
	Lnight (23:00 - 7:00hrs noise level)	3	annual measurements - in static files	No
	Compliance with limits at day, evening and night time	3	evaluation from Environmental personnel in contrast with legislative thresholds	No
Discharges to water	Thermal conditions	3	Static files	No
	Oxygenation conditions	3	Static files	Yes
	Salinity	3	N/A	No
	Nutrient condition	3	N/A	No

	Turbidity/Transparency	3	N/A	No
Ecosystems and habitats	Existence of an inventory of environmental Aspects	2	Yes. From ISO14001 excel file	No
	Existence of an environmental Monitoring programme	3	Database of annual contracts (contractor/ methodology) for handling waste	No
	Number and results of EMS audit/review/certification	2	N/A	No
	Self Diagnostics results (SDM)	2	N/A	No
	Compliance	3	N/A	No
	Number of prosecutions for non-compliance	2	N/A	No
Transport	CO2 emissions by annual cargo handled (Carbon Footprint)	3	Yes	No

Finally, after the knowledge gained with this activity, the ports created another document. This time it was not a comparison but an indication of environmental KPIs relevant for each port, freely identified and catalogued following similar approach:

Table 33. Potential KPIs for THPA

Potential KPI for Port	Relevance 1:low 2:medium 3:high	DataSource N/A or reference	Automatization Yes/No
Aquatic invasive secies	2	N/A	No
Greenhouse gases and air pollutants	3	Meteorological stations inside THPA	No
Spill Prevention	3	N/A	No
Dry bulk handling and storage	3	Database / ERP	Yes
Community impacts	2	N/A	No
Environmental leadership	2	N/A	No
Waste management	2	Database / ERP	Yes
Underwater noise	1	N/A	No
Parking area occupancy	1	N/A	No
Local IoT platform implementation	3	Data uploaded to the web/cloud	Yes
Number of sensors to the local IoT platform	3	Database	Yes
Number of types of data (sensors) connected to the IoT platform	3	Database	No

E.3. Technical context

Sensors and existing networks

The protection of the environment, is considered of great importance by ThPA SA. For this reason, it has an approved waste management plan for vessels, berthing at the port of Thessaloniki, as well as, a contingency plan, in case of oil pollution incidents and hazardous substances. At the same time, measurements of the marine environment quality are conducted, while it has an air pollution measuring unit in place and a noise measurement program for all installations and machinery

With regard to the sensors that are installed and functioning nowadays in the Port of Thessaloniki (and that will be of relevance for PIXEL) three main categories can be identified: air-quality monitoring station, sea water quality monitoring and noise-measurement related sensors.

Air Quality Monitoring Station

The air quality monitoring station (2m*1.6m*2.5m), is located just a short distance from the city and within a reasonable distance from areas of continuous normal operation (see Figure 64) . It is a prefabricated hut placed on a concrete base made of steel frame with aluminum panel walls and 9000 btu / h inverter air conditioner. It is fenced and according to the relevant classification used by RIS, it could be classified as "industrial".

Figure 64. Air quality monitoring equipment in Thessaloniki

Table 34. Air Quality Monitoring Station sensors (Port of Thessaloniki)

Pollutant	Measurement Standard	Method / Equipment
Sulfur dioxide(SO2)	EN 14212:2005	Ecotech Serinus 51 / UV fluorescent radiation technology
Nitrogen dioxide(NO2) / nitrogen oxides (NOx)	EN 14211:2005	Ecotech Serinus 40 / Gas phase chemiluminescence detection
Carbon monoxide(CO)	EN 14626:2005	Ecotech Serinus 30 / Non-Dispersive Infrared Spectrophotometry (NDIR) technology
Particulate Mater (PM10), (PM2.5)	Light scattering method with approval to EN12341	GRIMM EDM 180+

Ni, Cd, Mn, PAHs	EN 12341 PM_{10}	TECORA Echo PM
Benzene /BTX	EN 14662.01:2005 EN 14662.02:2005 EN 14662.03:2005	Radiello Passive/Diffusive Air Samplers
Data Logger / Data management		Air Monitors Web Logger / Airmonitors.net

Sea water Quality Monitoring

Every 2 times a year (every 6 months) sea water is sampled in 4 prefixed points (see Figure 65). The measured variables are: Temperature, pH, Dissolved Oxygen, Suspended Solids, Heavy Metals (As, Pb, Zn, Cd, Cr, Co, Cu, Ni, Mn). Dedicated accredited laboratory performs the analysis. No problems with sea water quality.

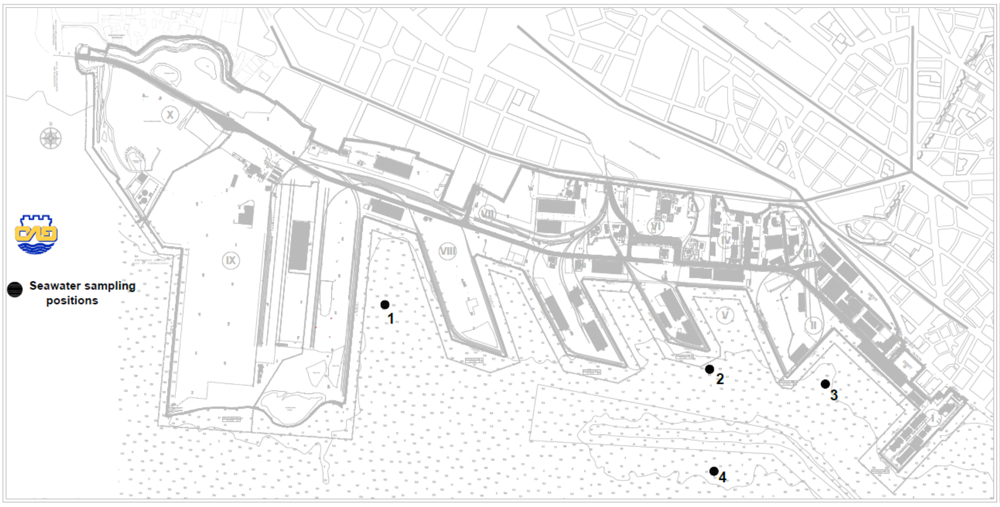

Figure 65. Seawater sampling positions

Noise Measurements

Noise Measurements are conducted once a year (in May), in 10 prefixed points in the perimeter of the Port. Measuring equipment (integral sound meters and calibrators) are of precision, Class 1, which meet the requirements of IEC 61672-1: 2002, Category 1, as well as, older standards (IEC 60651: 1979 and IEC 60804: 1).

Figure 66. Environmental noise monitoring positions

Table 35. Noise measurements technical data

Measurement Range	20-140 dB, filters A,C και Z
Frequency Range	20 Hz – 20kHz
Time weighting	F, S, I
Frequency Weighting	A, C, Z
Parameters Measured	SPL, L_{eq}, L_{ae}, L_{max}, L_{min}, L_n, Peak
Threshold warning	Yes
Operating temperature	-10 °C to 50 °C
Operating Humidity	30% to 90%

Furthermore, during the execution of task T3.3, THPA (supported by other technical partners of PIXEL) analysed the most affecting parameters in relation to the environment in Thessaloniki area. Afterwards, the Consortium made an exercise to identify the type of sensors that could help measuring those. Finally, that information was matched with the existing sensors in THPA and a "positioning" table was elaborated. The following table will be very useful in forthcoming work packages to know which information is available, which can be reached during PIXEL and how to address different actions (PEI deployment, pilot execution):

Table 36. Relevant environmental measures and sensors available - THPA

Port activities-related sensors		**Availability in THPA**
Trucks entry/exit	RFID tags	Yes
Sensor of wind direction/speed	GC#3	Yes
Sensor of wind-related data	Rooftop of TY building	Yes
Geospatial reference	Sensor in meteo stations	Yes
Other sensors/data		**Availability in THPA**
Electricity consumption	KwH from manual entries	Yes
Meteo station	Pollutants (PM10, PM25, SO2..)	Yes
	Heavy metals in air	
	Humidity, temperature	
Environment and navigation sensors		**Availability in THPA**
Fuel consumption	RFID tags on vehicles' pumps	Yes
PM analyzer TSI8530	-	Yes
Four points of manual entries of water quality		Yes

ICT systems

Infrastructure Overview

The available equipment in ThPA is considered state-of-the art and is characterised by high performance and reliability. Virtualization infrastructure runs on physical servers. Computer equipment at ThPA SA is regularly updated. There are two main computer rooms with the necessary supporting infrastructure.

Considering network infrastructure, more than 15 buildings are connected with fiber optics cable using the latest equipment technology. An extended wireless network covers the container terminal. IP surveillance cameras of latest technology are in place, which are used for operational monitoring.

Software Overview

ThPA SA runs an ERP system (SAP R/3) for all relevant processes. For Conventional cargo, a customised version of an ERP has been implemented, whereas for Container operations a Terminal Operating System (FRETIS) is used.

Other systems in place include EDMS (Electronic Document Management System), Human Resources Management, and Statistics and Milestone VMS (Video Management Software) for surveillance cameras.

A fuel management system is also available.

A range of web applications have been developed in house, e.g.:

- Docs.thpa.gr, for document management
- Accesscards.thpa.gr for the management of ISPS related access cards for persons and vehicles
- Weather.thpa.gr, for the visualization of the wind speed and direction on quay No 26

Since 2015, another application has also been internally developed that monitors the entrance and exit of vehicles through gates FZG 10A and MG 24. These are the two gates of the free zone of the Port of Thessaloniki. Vehicles are recognized through an RFID sticker located on their windscreen and read by a reader on each lane of the gate. A system is going to be installed and used on other vehicle gates of the Port as well, in order to collect valuable statistics and analyse the behaviour and movement of vehicles of any type (trucks, cars, etc.) inside the port area.

Systems related to PIXEL

Inbound and outbound traffic in the Port of Thessaloniki is monitored by a system comprising of the following:

- RFID readers (CS203ETHER), one per lane. In Gate 16 (main gate) there are three (3) lanes for entry, and one (1) for exit. In Gate 10A there is one (1) lane for entry and one (1) for exit. All vehicles have an RFID tag located on their windshield.
- A web application, developed by a private company, visualizing (and storing) the readings of the sensors, is shown below.
- Data is stored on a MySQL relational database. The data can be shared via a web call (JSON, direct CSV download, etc.).

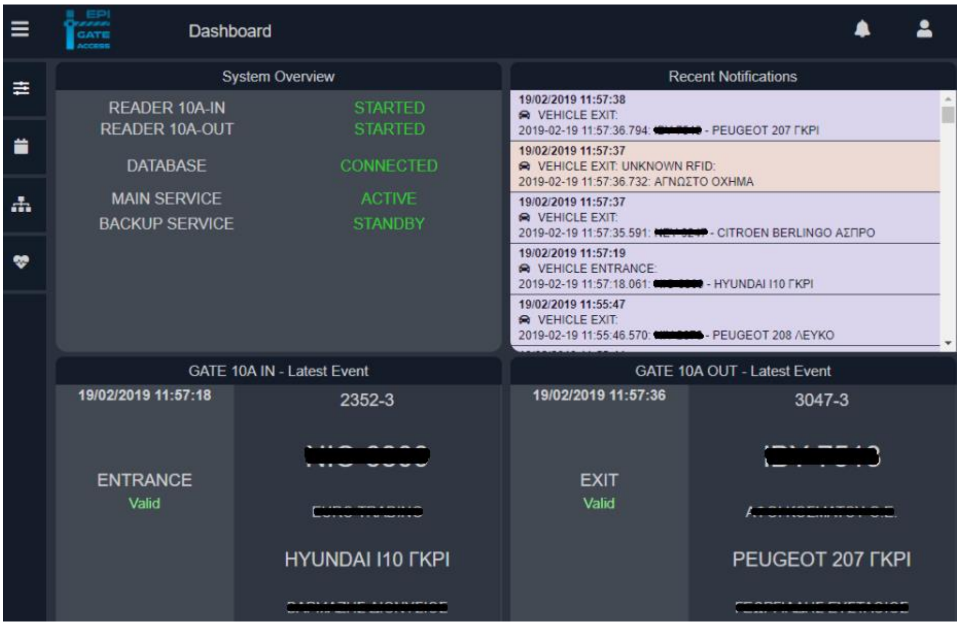

Figure 67. Screenshot of application showing RFID readings (entry/exit of vehicles)

Container Terminal

As far the Container Terminal (CT) is concerned, all data about vessel calls, arrivals, unloading/loading etc, is handled by the FRETIS Terminal Operating System (TOS), developed by a private company. The TOS is comprised by a number of modules, depending on the business area, for example: GIS (positioning containers on yard), receipt of XML messages for vessel operations such as calling (CALINF, COARRI), invoicing, gate control (related paperwork), etc. The invoicing module includes a “bridge” (link) to SAP (analysed below), to sync financial data. All data is stored in a Microsoft SQL Server relational database.

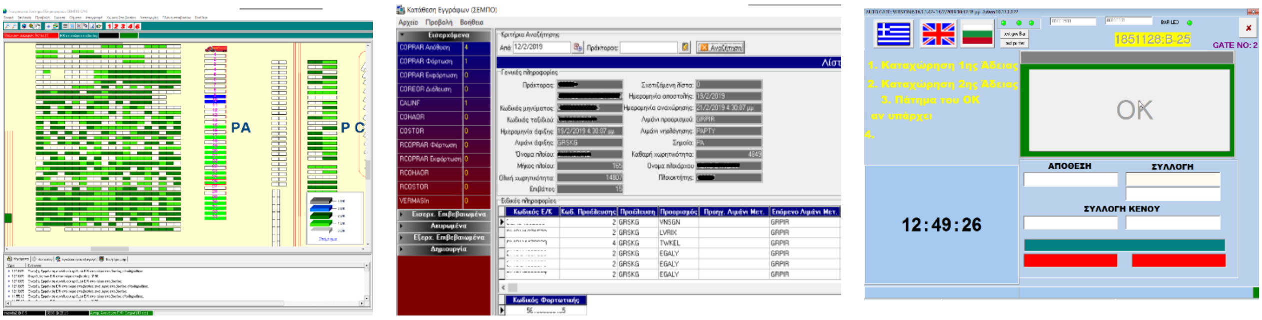

Figure 68. Screenshots of FRETIS modules (indicative): GIS / yard planning, XML messages, gate control

Conventional Cargo

For conventional cargo, most relevant data is stored in a custom application called Statistics, developed by a private company. In it, vessel calls, duration of works, type and quantity of cargo handled, etc, is (manually) entered. All data is stored in a Microsoft SQL Server relational database.

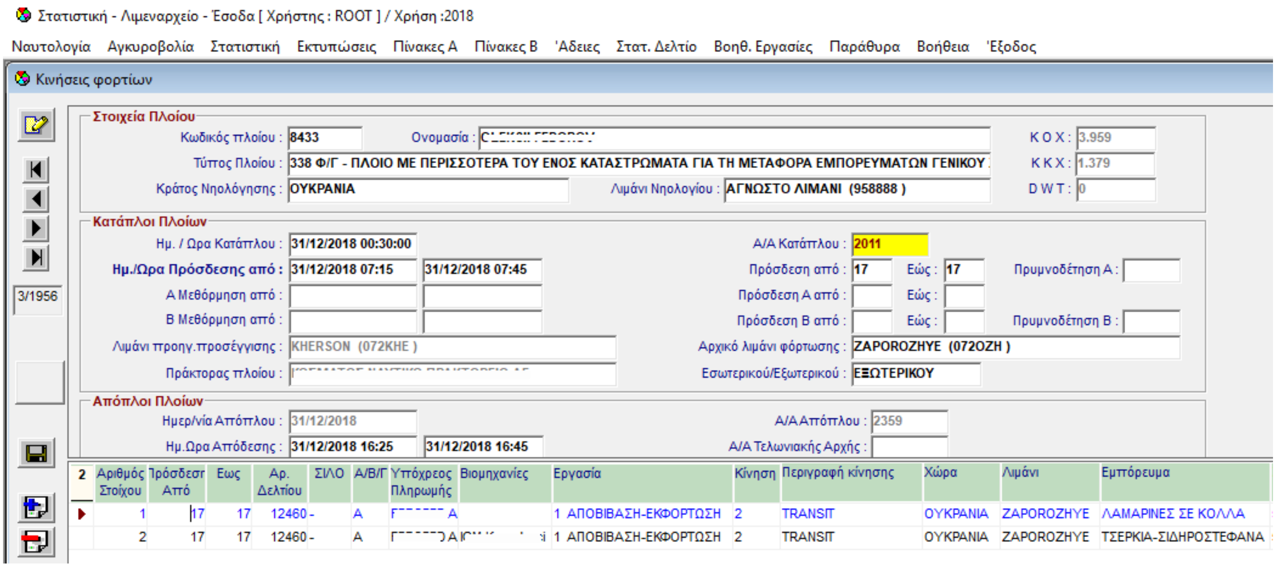

Figure 69. Screenshot from Statistics software

FAL forms

ThPA does not use the standardized FAL forms, as they are officially defined. However, most of the information requested in a FAL form, is in the end available to ThPA, via the aforementioned systems.

Fuel consumption

ThPA monitors the consumption of fuel in real-time, using a system comprising of:

- RFID rings & sensors installed on fuel nozzles and vehicles' reservoirs
- The application GAS Station, developed by the company Logicom. The application includes a number of modules, related to syncing the nozzle data, the fuel availability, linking to SAP (see below), etc.

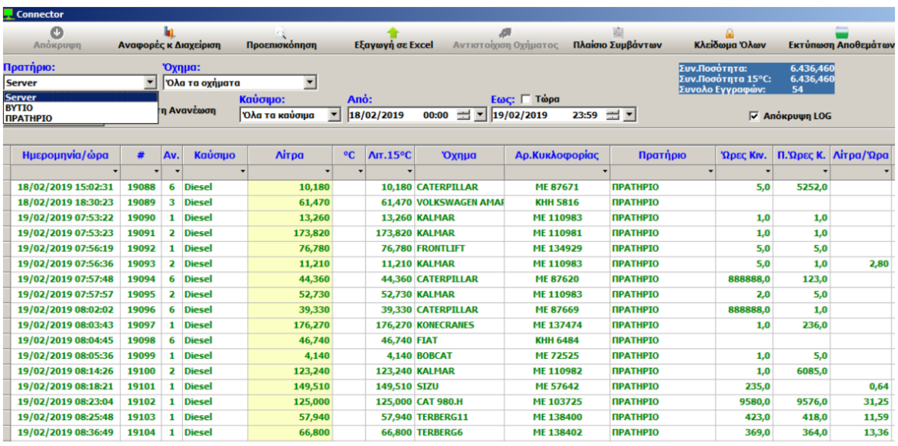

Figure 70. Screenshot of one of the GAS Station modules - Connector

SAP

ThPA uses SAP (R/3) for a large number of operations. Related to the scope of PIXEL is data about ships, both in the CT and the Conventional Cargo, and also fuel consumption.

Because each of these systems was either developed or purchased at a different point in time, and independently, some data is duplicated. For example, data about a ship in the Conventional Cargo, name, arrival date, hours worked, total amount of cargo, etc is entered both in the Statistics software and SAP. Also, for the same reason, ad-hoc software "bridges" have been developed, to sync data from a system to SAP, in real-time.

SAP data is stored in a Microsoft SQL Server relational database.

Data availability

ThPA SA stores a lot of data concerning operations, vessels and trucks visits and also measurements dust, noise and sea water measures. Operational data is stored in internal relational databases. Environmental data can be extracted in csv files from the weather station.

All results of current environmental measures are published in ThPA website[13].

Regarding wind data, it is available in real-time via the following mechanism:

- A wind speed and direction sensor, accessible from the network via a Serial-to-Ethernet converter
- A custom in-house application that reads raw data from the sensor, and stores them in a Microsoft SQL Server relational database
- A custom in-house web application that visualizes the stored data. The result that can be currently observed is depicted in Figure 71.

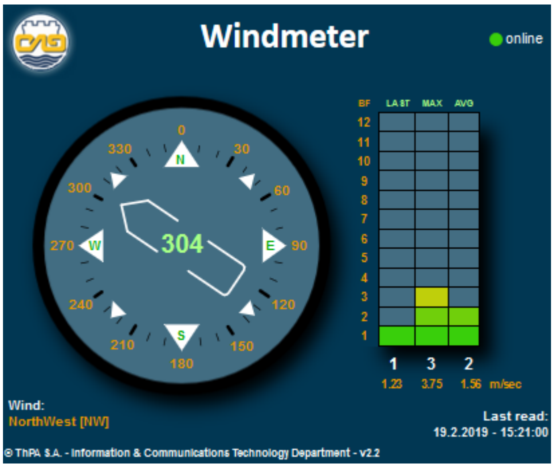

Figure 71. Screenshot of wind visualization app

Public data

Some of the data mentioned above is available to the public:

- Information about the CT - found under the 'C.T. M.I.S.' menu item in the web site[14]:
  - Ship arrivals: https://www.thpa.gr/index.php/en/services-3/ship-arrivals
  - Containers marked for inspection: https://www.thpa.gr/index.php/en/services-3/inspection-of-containers

[13] http://www.thpa.gr/index.php/el/olth/social-responsibility/environment..

[14] https://www.thpa.gr/https://www.thpa.gr/

- Schedule of works: https://www.thpa.gr/index.php/en/services-3/work-schedule
- Pending arrivals: https://www.thpa.gr/index.php/en/services-3/pending-arrivals-en
- Voyage status: https://www.thpa.gr/index.php/en/services-3/open-en

- Wind data: https://weather.thpa.gr

It needs to be pointed out that, apart from the publicly shared data mentioned above, all other ThPA SA data are stored inside the ThPA LAN and are not publicly available.

For any datasets required in the PIXEL project from ThPA, custom ad-hoc web calls will have to be implemented. Therefore, interested stakeholders from the PIXEL Consortium will need to collaborate with the ThPA SA ICT department, in order to better define the appropriate queries to be built.

Moreover, for any data coming from SAP, the process may be more complicated compared to data from MySQL / MSSQL databases, as it is not advisable to run SQL queries directly to the SAP DB. In these cases, ThPA ICT Department will contact ThPA SA SAP consultant, to work out a way to export and share.

Finally, all data that ThPA shares with PIXEL should comply with any privacy concerns.

Following the scenarios described in 7.4 and the currently existing sensor networks the Consortium has established the following table summarising data availability for THPA use-case:

Table 37. Data availability THPA use case

Data owned

Information relevant to the use-case operations	**Availability in THPA**	**Comments**
FAL Forms	Y	SAP & DB - ship info, cargo
Entry / exit of trucks (RFID tags)	Y	Real-time. Stored in relational database (mysql)
Wind direction/speed	Y	sensor inside ThPA, on GC#3: Real-time, stored in relational database (SQL Server)
Wind direction/speed, temperature, relative humidity (%)	Y	Sensor inside ThPA (rooftop of TY building). Export, static files in TXT (needs transformation)
Electricity consumption #1	Y	Manual data entry (from monthly electricity bills), for 9 electric substations (mid-voltage). Not all relevant data, only a subset: consumption in KWh, cosine, financial data. Stored in relational database (mysql).
Real-time fuel consumption, RFID tags/sensors on vehicles & pumps	Y	Stored in relational DB, option to export to static files (CSV,..)
Spatial data	Y	.dxf files, .shp files , a (hand-crafted) KMZ (GoogleEarth) with “points-of-interest” inside THPA premises (ie location of met stations)
Environmental	**Availability in THPA**	**Comments**
Pollution data #1: PM10 & PM2,5	Y	From TSI8530 (portable handheld PM analyzer) used inside ThPA. Data downloaded locally in XLSX format

Pollution data #2: Various pollutants (SO2, NO2, CO, PM10, PM2,5) from met station inside ThPA	Y	Gathered 24x7, sent (via SIM card) real-time to web logger airmonitors.net (web interface & export, API option mentioned on website). Also installed, a “TECORA echo PM” sampler, 10mins every hour, data gathered once a month, heavy metals in air (mean monthly value)
Sea water quality	Y	Every six months sampling of four points, mobile sampler, manual data entry of results

Data from outside sources

City data (open data)	Current availability	Comments
Primary weather data from NMS stations (Athens…)	Yes. Open data.	https://opendata.ellak.gr/2018/02/06/anichta-meteorologika-dedomena-stin-ellada/
Thessaloniki's municipality open data	Yes. Open data.	https://opendata.thessaloniki.gr/el/search/type/dataset
Weather data of stations. Summaryper months.	Yes. Open data.	http://meteosearch.meteo.gr/data/kerkyra/2018-10.txt
Thessaloniki's municipality open data on meteo	Yes. Open data.	
Environmental	**Current availability**	**Comments**
Pollution data #3 (from City’s sensors, outside ThPA)	Yes. Open data.	http://www.ypeka.gr/Default.aspx?tabid=495&language=el-GR
		Static files for download in CSV, as far back as 1984 (Which measurements are of interest? PM10 only, or all?). No geo-information
Electricity consumption #2:	Yes. Open data.	https://meteringnet.deddie.gr
		To enter with THPA account. DEDDIE (ΔΕΔΔΗΕ) is the Greek State grid owner. Real IoT, sensors on electricity meter, consumption every 15’ (per substation), 9 substations. Option to download locally in XLS, CSV, PDF. No API for automatic download/import mentioned on site, though.
Thessaloniki's city atmospheric pollution. SO2, PM10, PM2,5, NO, CO, NO2, O3…	Yes. Open data.	Link
		.xlsx format. Archive from 1989 to 2016. DCAT compatibility. Also available in RDF and JSON.
Greek Ministry of Environment and Energy	Yes. Open data.	http://www.ypeka.gr/Default.aspx?tabid=495&locale=en-US&language=el-GR
		.dat historic data

As it can be seen, several heterogeneous data sources are considered for ThyPA SA use case. The project will leverage already existing technological enablers for data integration, to feed the PIXEL Information Hub. Additionally, other IoT agents will need to be developed in order to integrate different data formats into the PIXEL ICT infrastructure.

E.4. Port operations for the use case

Enabling the IoT platform

The use case of the Port of Thessaloniki focuses on the interoperability of city and port in freight traffic to optimize the traffic between the city and the port area, aiming at reducing air and noise pollution impact. The pilot will focus on achieving integration among the port, the city and transportation actors, through integration of existing systems (such as TOS) and devices (sensors), with the broader platform of PIXEL. In addition, the Port of Thessaloniki will analyse with technical partners of the Consortium the appropriate IoT platform to be deployed by taking into account the existing equipment and devices and evaluate possible additional sensors needed to fulfil the use case. The IoT solution that will be implemented will be created in the PIXEL project and it will be composed by several components based on open-source technologies and custom developments.

In particular, PIXEL will enable the end-to-end visibility of the port's operations that relate to cargo handling, mainly focusing on the incoming and outgoing flows of the trucks, as well as the movements of trucks and ports mechanical equipment during operations. Furthermore, it will enable the development of simulation modelling tools for detailed analysis and predictions on truck flows, including their emissions, port turnaround times, emissions in port operations, etc.

Port operations

ThPA SA use case, regards the inbound and outbound flows of heavy vehicles in the Port of Thessaloniki through Gate 16. It will be necessary to study the characteristics of each type of machinery required, for the proper functioning of the supply chain and to associate new entrants (sensors, traffic analysis, etc.), in order to meet the overall objectives of the project. Maritime traffic in port, must also be evaluated and in order to know the future use of the various supply chains.

For the PIXEL project, the types of cargo transiting in the Port of Thessaloniki can be defined in five categories of ship handling, having different logistic schemes and thus, different environmental impacts:

- Imports / Exports of containers
- Imports / Exports of dry bulk cargo
- Imports / Exports of general cargo (mostly in pieces/packages)
- Imports / Exports of cereal
- Imports / Exports of liquid bulks

The operations for both inbound and outbound cargo flow can be grouped around three major blocks: (i) handling of cargo arrival, (ii) cargo storage in the terminal yard and (iii) the operations regarding the cargo departure. Figure 72 presents the overall operational processes for container handling within the container terminal of the port.

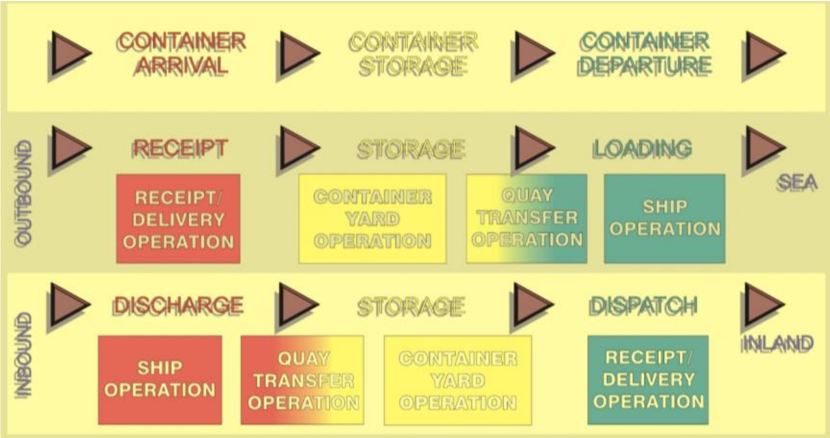

Figure 72. Thessaloniki port operations overview

These three major operational blocks can then be divided in sub-groups of operations which are repeated in the two different flows (outbound, inbound):

- Cargo receipt/delivery operations refer to handling cargo that come to or leave the terminal through the land interface (terminal gates) and usually involve the short-term parking of the external truck on special allocated areas in terminals (adjacent to the yard). These operations can be executed with mechanical equipment of the port.
- Yard operations refer to storage of cargo in the yard and possible transfers within the yard in order to accommodate more efficient terminal operations. These operations can be handled by mechanical equipment and trucks.
- Quay transfer operations refer to handling of cargo on the sea interface in order to service the vessel. Cargo is being moved between the yard and the quay (respective quay crane) and is currently handled by mechanical equipment.
- Finally, the ship operations involve the use of quay cranes to load or unload the vessel.

Currently there is one main gate to the Port - GATE 16, located at the west side of the port close to the adjacent industrial and the main bus station of the city. Trucks are monitored through RFID stickers at Gate 16, the main gate of the port. Trucks directed to the container Terminal also pass from damage documentation portal gates in which a weight in motion system is also installed. Data is stored in a relational database.

Figure 73. Main gate to the port of Thessaloniki

Container Receipt-Delivery Operations (Parking to yard and vice versa) for the Container Terminal

The overall process related to container receipt (or delivery) involves the unloading (or loading) of the container from (to) a truck that has entered the terminal through the terminal gates and the movement of the container to (or from) the container yard. Similar procedures are followed in the Conventional Cargo Terminal. The ordering of the individual operations steps is shown in Figure 74.

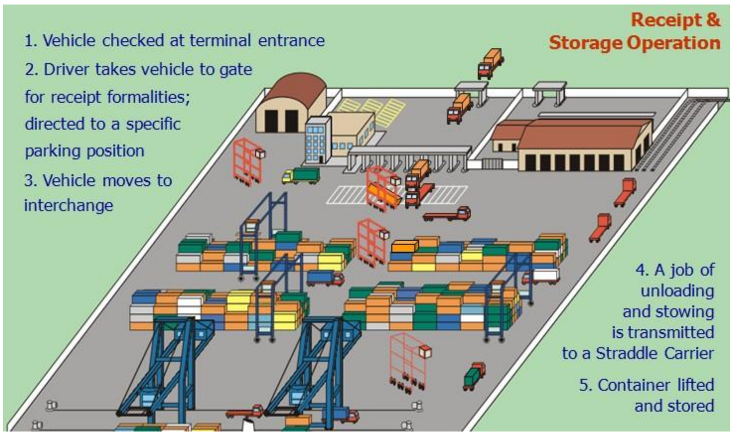

Figure 74. Port of Thessaloniki scenario 1

Quay Transfer Operations (Yard to Ship and vice versa)

Similar to the process for container receipt and delivery that was presented above, the container movement operations from yard to quay for loading on the vessel (or vice versa in the case of vessel unloading) are shown in Figure 75.

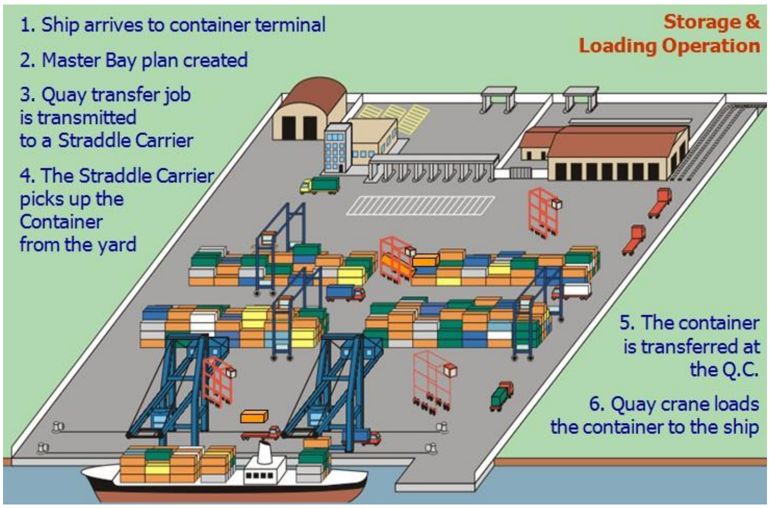

Figure 75. Port of Thessaloniki scenario 2

Containerized cargo has a simple loading / unloading logistics model, involving Ship-To-Shore cranes (STS) and stackers or straddle carriers (horizontal handling). After the vehicle is checked and enters the premises of the port, is directed in the Container Terminal, where it parks in a predefined position, and with the use of a straddle carrier, the cargo is unloaded in the Yard. When the cargo is to remain for storage in the Yard, it is then properly arranged by a reach stacker. Finally, on the predefined date and time of the vessel's arrival, cargo is transferred to the dock, with the use of a straddle carrier and loaded on the vessel with the STS crane.

The loading procedure involves pretty much the same steps. After the vehicle enters the premises of the Container Terminal parks in a predefined position. If the cargo is already in storage, then, with the use of a reach stacker and/or a straddle carrier, is loaded on the vehicle. The STS cranes required for the process are electrical, while stackers or straddle carriers are fuel-based.

Dry bulk cargo (except cereal) is loaded and unloaded with a use of a crane and a loader (fuel-based). The same procedure is followed in each case (loading/unloading). The truck enters the Dock, where it unloads its cargo by overturn. From there, with the use of a crane and/or the use of a loader (in order to rearrange cargo), is loaded on the vessel. The vessel is unloaded by a crane and directly loaded on a truck, while there are cases when a loader (in order to rearrange cargo) is in need. In the cases of the cargo remaining in ThPA SA premises, it is later loaded on the vehicles with the use of a loader.

Vehicles carrying General Cargo, are unloaded on the dock with a forklift and from there, with the use of a crane, on the vessel. There are cases, when the cargo is directly loaded from the vehicle to the vessel, with the use of a crane. Unloading of a vessel, occurs the other way around; the crane unloads the cargo directly on the truck or in the yard (storage); from there, with the use of a forklift, is loaded on the truck.

Cereal in the Port of Thessaloniki is currently handled by a sub-contractor. From storage, cargo is loaded on a truck with the use of screws or pneumatic conveyors and from there, gets transferred on the dock (load to vessel) Unloading of a vessel occurs with the use of a crane and/or a hopper.

Liquid bulk cargo is handled by a sub-contractor. With the use of a set of pipes and pumps the vessel's cargo is unloaded in a truck and then, transported to the nearby tanks. The loading of a vessel occurs the other way around. Using a set of pipes and pumps, the cargo is loaded on a truck and then, transported on the Dock, where it gets unloaded directly on the vessel (pipes and pumps).

System Integration

The measurements coming from the new sensors must be sent to the PIXEL platform. Data exchange protocols need to be defined and then implemented. A specific focus will be done concerning new equipment and how to connect them to the IoT platform, that will be selected by ThPA SA and the technical partners of the Consortium later in the project. This selection will be constrained to a custom personalisation of the global architecture defined for PIXEL IoT solution. For this use-case, technical partners altogether with ThPA SA's ICT department will choose the most suitable features and components to build the most proper deployment.

To incorporate technological components and harmonize the Port of Thessaloniki use-case with the global PIXEL system an effort will be made to homogenize and integrate data from several software sources. This integration will facilitate fast gate in/out operations and alleviate traffic congestion by establishing a smoothed arrival/departure pattern for trucks to/from. Furthermore, operational tools, modelling and data processing is also planned in order to measure environmental impact by ThPA SA due to pollution (air and noise). The use case will focus on the combined/integrated use of:

- The port's Terminal Operating System (TOS), managing all container operations in the terminal (arrival notifications, departures, container handling, etc.),
- The port's Gate Control System (GCS), managing truck access by automated truck plate recognition, OCR in container codes, damage detection and weight in motion,
- The city's Traffic Management Centre (TMC),
- The port's automated material handling equipment (automated straddle carriers), based on the integration of GNSS and on-board sensors at data level,
- IoT sensors for traffic monitoring in the city,
- IoT sensors for measuring air quality and noise pollution in the port area
- Automated data capture and analytics.
- City's open information about environment and traffic
- In-house web-apps owned by THPA

E.5. Flanking stakeholders

The stakeholders identified to be considered in ThPA SA's use case are:

- **Thessaloniki Port Authority**: IT Department, Port Security, Environment, Employee health & Safety Department, Strategic Planning, Marketing and sales Department, Container Terminal Division Conventional Cargo Division.
- **Carriers and drivers**: they need to request for entering the Port of Thessaloniki, interacting with
    1. Shipping companies located within the Port to know when their services are required (loading or unloading from the truck);
    2. Public authorities working at the port to receive authorization to enter;
    3. ThPA in the case they are re-routed in its premises.
- **Public authorities:** Ministry of Environment and Energy, General Marine Secretariat – Ministry of Shipping and Island Policy, Hellenic Ministry of Infrastructure, Health and Veterinary Inspection office (Ministry of Agriculture) Transport and Networks, Coast Guard, Port Police, Customs officers, Hellenic Data Protection Authority (HDPA).
- **Shipping companies** located within the Port of Thessaloniki: they interact with ThPA SA, other shipping companies and carriers/drivers to arrange for loading/unloading operations.
- **Freight forwarders, logistics providers, Rail operators**: they interact with drivers/carriers and ThPA SA, offering logistic services.
- **Central Government** (vessel data). ThPA SA is directly notified on the data coming through Maritime Authorities.
- Stakeholders (the city's Traffic Management Centre).
- Machinery operators.

Appendix F – Regulatory context

F.1. Summary overview

As result of task T3.2 an in-depth study was performed devoted to the regulatory aspects related to the pilot ports of the project. The legal aspects have been examined both at the European level and the national level of the project participating countries.

The European regulatory context refers to the areas related to:

- The Vessel traffic monitoring in EU waters and the (SafeSeaNet) network aiming to link the European maritime authorities for the provision and exchange of information on ships, ship movements, and dangerous cargoes
- The European maritime single window environment in order to simplify and harmonize the administrative procedures applied to maritime transport
- The Air Emissions standards for the regulation of the ship generated specific emissions and discharges
- The Air Pollution legislation to achieve emission reductions of the main pollutants
- The Greenhouse Gas directives aiming to improve and extend the greenhouse gas emission allowance trading scheme.
- The Sulphur Directive for the reduction of Sulphur Dioxides (SO2)
- The Alternative Fuels directive aiming to substitute fossil oil sources in the energy supply to transport
- The Port Reception Facilities regulations to limit and control the discharges generated at sea
- The European Commission, Transport regulation for the ports development
- The EU data protection rules related for the protection of natural persons regarding the personal data processing and also the free movement of personal data.

The national regulatory context has been examined for France, Italy, Spain and Greece and refers to:

- Environment (waste, pollution) legislation
- Transportation legislation
- Safety and security legislation
- Personal data management legislation

The legislation, policies and regulations at local pilot port level has been examined by the PIXEL pilot ports of Bordeaux, Monfalcone, Piraeus and Thessaloniki in the areas related to the use cases as follows:

- Environment policies and regulations
- ISO certification for Environmental Management
- The processing of personal data and on the free movement of such data
- The regulatory/supervisory bodies in each pilot area

F.2. European regulatory context

This section aims to examine the European regulatory context in key PIXEL project domain areas related to the pilot use cases (e.g. environment issues, transportation regulation, ports in general, etc.).

F.2.1. Vessel traffic monitoring in EU waters (SafeSeaNet)

“SafeSeaNet” is a maritime data exchange network aiming to link the European maritime authorities for the provision and exchange of information on ships, ship movements, and dangerous cargoes. It is a vessel traffic monitoring and information system with a view to enhancing the safety and efficiency of maritime traffic, improving the response of authorities to incidents, accidents or potentially dangerous situations at sea, including search and rescue operations, and contributing to a better prevention and detection of pollution by ships. Under the adopted Directive the Member States shall monitor and take all necessary and appropriate measures to ensure that the masters, operators or agents of ships, as well as shippers or owners of dangerous or polluting goods carried on board such ships, comply with the requirements under the Directive 2002/59/EC and its amendments.

RELEVANT LEGISLATION

- DIRECTIVE 2002/59/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 June 2002 establishing a Community vessel traffic monitoring and information system and repealing Council Directive 93/75/EEC (pages 1-33 and 10-27of: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2002L0059:20110316:EN:PDF)
- COMMISSION DIRECTIVE 2011/15/EU of 23 February 2011 amending Directive 2002/59/EC of the European Parliament and of the Council establishing a Community vessel traffic monitoring and information system (pages 13-36 of: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:131:0101:0113:EN:PDF)
- DIRECTIVE 2009/17/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 amending Directive 2002/59/EC establishing a Community vessel traffic monitoring and information system (pages 101-103 of https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:131:0101:0113:EN:PDF

F.2.2. European maritime single window environment

The European parliament and the Council of the European Union has adopted the Directive 2010/65/EU with the aim to simplify and harmonize the administrative procedures applied to maritime transport by making the electronic transmission of information standard and by rationalizing reporting formalities. Also the Directive applies to the reporting formalities applicable to maritime transport for ships arriving in and ships departing from ports situated in Member States.

RELEVANT LEGISLATION

- DIRECTIVE 2010/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 October 2010 on reporting formalities for ships arriving in and/or departing from ports of the Member States and repealing Directive 2002/6/EC (https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:283:0001:0010:EN:PDF)

Detailed information on “The European maritime single window: environment can be found at: http://emsa.europa.eu/related-projects/emsw.html

F.2.3. Air Emissions

Ships are sources of different substances to the atmosphere due to the onboard propulsion and energy production. The direct result is the emission to the atmosphere of Sulphur Oxides (SOx), nitrogen oxides (NOx), particulate matter (PM) and carbon dioxide (CO2).
The ship generated emissions are heavy in areas confronted with marine traffic leading in terms of air quality, both at local level, in coastal areas, or in a more global level, regarding the CO2 emissions with the result being the production of Greenhouse Gas emissions and therefore the contribution to global warming. Many actions have been undertaken to significantly reduce the ships generated air emissions through the IMO Annex VI of MARPOL, establishing standards for the regulation of the ship generated specific emissions and discharges.

RELEVANT LEGISLATION

- REGULATION (EU) 2015/757 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, and amending Directive 2009/16/EC. Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R0757&qid=1489056000897&from=EN
- DIRECTIVE (EU) 2016/802 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 May 2016 relating to a reduction in the sulphur content of certain liquid fuels. Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.132.01.0058.01.ENG
- DIRECTIVE 2012/33/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 November 2012 amending Council Directive 1999/32/EC as regards the sulphur content of marine fuels. Reference: pages 1-13 of: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:327:0001:0013:EN:PDF
- DIRECTIVE 2005/33/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 July 2005 amending Directive 1999/32/EC. Reference: pages 59-69 of: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:191:0059:0069:EN:PDF
- COUNCIL DIRECTIVE 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC.

  Reference: pages 1-16 of: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1999L0032:20090625:EN:PDF

F.2.4. Air Pollution

Maritime transport activity emissions have been a leading cause for the air quality in the EU area during the last decades. Specific legislation has been developed by the EU to achieve emission reductions of the main pollutants: Sulphur Oxide (SOx), Nitrogen Oxide (NOx), Ozone Depleting Substances (ODS) and Volatile Organic Compounds (VOC).

RELEVANT LEGISLATION

- REGULATION (EU) 2015/757 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, and amending Directive 2009/16/EC. Reference pages 55-76 of https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R0757&qid=1489056000897&from=EN
- DIRECTIVE (EU) 2016/802 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 May 2016 relating to a reduction in the sulphur content of certain liquid fuels. Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.132.01.0058.01.ENG
- DIRECTIVE 2012/33/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 November 2012 amending Council Directive 1999/32/EC as regards the sulphur content of marine fuels. Reference: pages 1-13 of https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:327:0001:0013:EN:PDF
- DIRECTIVE 2005/33/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 July 2005 amending Directive 1999/32/EC. Reference: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:191:0059:0069:EN:PDF
- COUNCIL DIRECTIVE 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC (OJ L 121, 11.5.1999. Reference: pages 1-16 of https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1999L0032:20090625:EN:PDF

F.2.5. Greenhouse Gases

Maritime transport activity is a main producer of CO_2 emissions and Greenhouse gases and the EU has therefore adopted directives aiming to improve and extend the greenhouse gas emission allowance-trading scheme.

RELEVANT LEGISLATION

- DIRECTIVE 2009/29/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community. Reference: pages 63-87 of https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0063:0087:en:PDF

F.2.6. Sulphur Dioxides

Sulphur Oxides (SOx), and in particular Sulphur Dioxides (SO_2), are emitted when fuels containing sulphur are combusted. Sulphur dioxide contributes to acid deposition, which, in turn, can lead to potential changes in soil and water quality. The subsequent impacts of acid deposition include adverse effects on in rivers and lakes and damage to forests, crops and other vegetation. SO_2 also contributes to the formation of particulate aerosols in the atmosphere and is therefore also indirectly linked to effects on human health.

RELEVANT LEGISLATION

- DIRECTIVE (EU) 2016/802 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 May 2016 relating to a reduction in the sulphur content of certain liquid fuels. Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.132.01.0058.01.ENG
- DIRECTIVE 2012/33/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 November 2012 amending Council Directive 1999/32/EC as regards the sulphur content of marine fuels. Reference: pages 1-13 of https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:327:0001:0013:EN:PDF
- DIRECTIVE 2005/33/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 July 2005 amending Directive 1999/32/EC.
  Reference: pages 59-69 of https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:191:0059:0069:EN:PDF
- COUNCIL DIRECTIVE 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC. Reference: pages 1-16 of https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1999L0032:20090625:EN:PDF

F.2.7. Alternative Fuels

Alternative Fuels, are fuels that can substitute fossil oil sources in the energy supply to transport, having the potential to contribute to its decarbonisation of transport and improve the environmental performance of the transport sector. In shipping, along with other transport modes, there is a growing interest for the potential application of different cleaner fuel solutions, with some of them posing significant challenges to ship design.

RELEVANT LEGISLATION

- DIRECTIVE 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 October 2014 on the deployment of alternative fuels infrastructure. Reference: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32014L0094

- DIRECTIVE 2012/33/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 November 2012 amending Council Directive 1999/32/EC as regards the sulphur content of marine fuels. Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012L0033

A valuable source of information on the Alternative Fuels for Shipping Current technological options, their advantages and main challenges for their use in shipping has been prepared by EMSA at: http://www.emsa.europa.eu/component/flexicontent/download/4500/2657/23.html

F.2.8. Port Reception Facilities

In order to limit and control the discharges generated at sea, ports have to provide adequate shore-based facilities for collecting all types of ship generated waste. The types of waste generated on board ships concern oily wastes, sludge, drainage from the bilges, sewage and garbage, including cargo residues during loading and unloading operations. The impact of these discharges are a cause for chemical pollution and can affect the acidity of the ocean waters or add chemicals into the food chain, effecting therefore the marine life and the human health.

RELEVANT LEGISLATION

- Directive 2000/59/EC of the European Parliament and of the Council of 27 November 2000 on port reception facilities for ship-generated waste and cargo residues - Commission declaration. Reference: Pages 81-90 of: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0059:EN:HTML

An interesting reference for the Technical Recommendations on the Implementation of Directive 2000/59/EC on Port Reception Facilities has been issued by EMSA and can be found at: http://www.emsa.europa.eu/news-a-press-centre/external-news/download/4479/2875/23.html

Extensive referencing and updating of the current proposals and negotiations at EU level on the issue of the port reception facilities for the delivery of waste from ships can be found at: http://www.europarl.europa.eu/legislative-train/theme-new-boost-for-jobs-growth-and-investment/file-port-reception-facilities-for-the-delivery-of-waste-from-ships

Another interesting reference for “The Management of Ship-Generated Waste On-board Ships: (EMSA/OP/02/2016 –copyrighted by CE Delft, Delft) and can be found at https://maritimecyprus.files.wordpress.com/2017/02/the-management-of-ship-generated-waste-on-board-ships-emsa-op-02-2016s.pdf

F.2.9. European Commission, Transport regulation

Modern port services are required in order to contribute to the efficient use of ports and a positive climate to investments. Port development should be in line with the future logistics requirements and the future transport needs and a more efficient use and functioning of the trans-European transport network and the internal market.

RELEVANT LEGISLATION

- REGULATION (EU) 2017/352 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 February 2017 establishing a framework for the provision of port services and common rules on the financial transparency of ports Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017R0352

- COMMUNICATION FROM THE COMMISSION Ports: an engine for growth /* COM/2013/0295 final */. Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0295
- Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a framework on market access to port services and financial transparency of ports /* COM/2013/0296 final - 2013/0157 (COD) */. Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013PC0296
- COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Proposal for a Regulation of the European Parliament and of the Council establishing a framework on the market access to port services and the financial transparency of ports /* SWD/2013/0181 final */. Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013SC0181
- COMMISSION STAFF WORKING DOCUMENT EXECUTIVE SUMMARY OF THE IMPACT ASSESSMENT Accompanying the document Proposal for a regulation of the European Parliament and of the Council establishing a framework on the market access to port services and the financial transparency of ports /* SWD/2013/0182 final */. Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013SC0182

F.2.10. EU data protection rules

Due to the fact that the protection of natural persons in relation to the processing of personal data is a fundamental right and everyone has the right to the protection of his or her personal data the EU has adopted REGULATION (EU) 2016/679 which sets up the rules relating for the protection of natural persons regarding the personal data processing and also the free movement of personal data.

RELEVANT LEGISLATION

- REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1528874672298&uri=CELEX%3A32016R0679
- Corrigendum to Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1528874672298&uri=CELEX:32016R0679R(02)
- COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL Stronger protection, new opportunities - Commission guidance on the direct application of the General Data Protection Regulation as of 25 May 2018. Reference: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1517578296944&uri=CELEX%3A52018DC0043

F.3. National regulatory context

This section provides the national regulatory context of the PIXEL participating countries in the areas of (i) Environment (waste, pollution) legislation, (ii) Transportation legislation, (iii) Safety and security legislation, and (iv) Personal data management legislation. The information will be provided in a list format with the appropriate references.

F.3.1. French regulatory context

Environmental management

- Environnement (bruit/paysage/loi sur l'eau/participation du public/ICPE/etc…): Code de l'Environnnement. https://www.legifrance.gouv.fr/affichCode.do?cidTexte=LEGITEXT000006074220

- Domanialité : Code Général de la Propriété des Personnes Publiques (CG3P). http://codes.droit.org/CodV3/propriete_personnes_publiques.pdf

Transportation legislation

- Code des transports livre III : Grands Ports Maritimes. https://www.legifrance.gouv.fr/affichCode.do?idArticle=LEGIARTI000023080789&idSectionTA=LEGISCTA000023080791&cidTexte=LEGITEXT000023086525&dateTexte=20181106

Safety and security legislation

- Code de l'Environnnement (as for environmental management): https://www.legifrance.gouv.fr/affichCode.do?cidTexte=LEGITEXT000006074220
- Code du travail https://www.legifrance.gouv.fr/affichCode.do?cidTexte=LEGITEXT000006072050
- Code ISPS https://www.arbitrage-maritime.org/fr/PDF/Code_ISPS.pdf
- Directive européenne 725/2004 https://eur-lex.europa.eu/legal-content/FR/ALL/?uri=celex:32004R0725
- Code des transports (link above)

Personal data management legislation

- Réglement Géneral sur la Protection des Données (RGPD). https://www.cnil.fr/fr/reglement-europeen-protection-donnees. https://www.economie.gouv.fr/entreprises/reglement-general-sur-protection-des-donnees-rgpd

F.3.2. Italian regulatory context

Environmental management

- Directive 2000/59/EC transposed by Decreto Legislativo 24 giugno 2003, n. 182 "Implementation of Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues ." (GU General Series n. 168 del 22-07-2003)

- Directive 2007/71/EC transposed by Decreto del Ministero dell'Ambiente del Territorio e del Mare del 01/07/2009 "Implementation of Directive 2007/71/EC amending Annex II to Directive 2000/59/EC of the European Parliament and of the Council on collection facilities for ship-generated waste and cargo residues" (GU General Series n. 162 del 15-07-2009)
- Directive 2005/33/EC transposed by Decreto Legislativo 9 novembre 2007, n. 205 "Implementation of Directive 2005/33/EC amending Directive 1999/32/EC in relation to the sulphur content of marine fuels." (GU General Series n. 261 del 09-11-2007 - Suppl. Ordinario n. 228)
- Directive 2009/30/EC transposed by Decreto Legislativo 31 marzo 2011, n. 55 "Implementation of Directive 2009/30/EC, which amends Directive 98/70/EC, with regard to specifications for petrol, diesel fuel and diesel, as well as the introduction of a mechanism to control and reduce gas emissions to greenhouse effect, amending Directive 1999/32/EC with regard to specifications related to fuel used by inland waterway vessels and repealing Directive 93/12/EEC." (GU General Series n. 97 del 28-04-2011)
- Decreto Legislativo 3 aprile 2006, n. 152 "Rules on the environment." (GU General Series n. 88 del 14-04-2006 - Suppl. Ordinario n. 96)
- Legge 22 maggio 2015, n. 68 " Provisions on crimes against the environment" (GU General Series n.122 del 28-05-2015)
- Decreto del Ministero dell'Ambiente del Territorio e del Mare del 13/12/2013 "Directive for the conduct of environmental protection activities by the Corps of Maritime Authorities"
- Legge 26 Ottobre 1995, n. 447 "Legge quadro sull'inquinamento acustico". – Law 447/1995 "Framework law on acoustic pollution
- CIRCULARS AND DISPAYS regarding the environment legislation: http://www.guardiacostiera.gov.it/normativa-e-documentazione/Pages/tutela-dell'ambiente-costiero.aspx

Transportation legislation

- REGIO DECRETO 30 marzo 1942, n. 327 " Approval of the definitive text of the Navigation Code ." (042U0327) (GU n.93 del 18-4-1942)
- Regolamento (CEE) n. 4055/86 del Consiglio, del 22 dicembre 1986, applying the principle of freedom to provide services to maritime transport between Member States and between Member States and third countries (GU L 378 del 31.12.1986)
- Regolamento (CE) n. 4057/86 del Consiglio, del 22 dicembre 1986, concerning unfair pricing practices in maritime transport (GU L 378 del 31.12.1986)
- Regolamento (CEE) n. 4058/86 del Consiglio, del 22 dicembre 1986, on coordinated action to safeguard free access to maritime transport in transoceanic traffic (GU L 378 del 31.12.1986)
- Regolamento (CE) n. 1/2003 del Consiglio, del 16 dicembre 2002 concerning the application of the competition rules defined in Articles 81 and 82 of the Treaty (GU L 1 del 4.1.2003)
- Regolamento (CE) n. 246/2009 del Consiglio, del 26 febbraio 2009 concerning the application of Article 81 (3) of the Treaty to certain categories of agreements, decisions and concerted practices between liner shipping companies (GU L 79 del 25.3.2009)
- Regolamento (CE) n. 906/2009 della Commissione, del 28 settembre 2009, the application of Article 81 (3) of the Treaty to certain categories of agreements, decisions and concerted practices between liner shipping companies (GU L 256 del 29.9.2009)
- Legge 6 giugno 1974, n. 298 - Istituzione dell'albo nazionale degli autotrasportatori di cose per conto di terzi, disciplina degli autotrasporti di cose e istituzione di un sistema di tariffe a forcella per i trasporti di merci su strada (Law 298/1974 – Istitution of the national carriers' register, regulation on road transport and definition of rates)

- D.P.R. n. 142 - 30 marzo 2004 - "Disposizioni per il contenimento e la prevenzione dell'inquinamento acustico derivante dal traffico veicolare, a norma dell'articolo 11 della legge 26 ottobre 1995, n. 447.
- (GU n.127 del 1-6-2004) testo in vigore dal 16-6-2004" (Regulation on reduction and prevention of acoustic pollution deriving from vehicles)

Safety and security legislation

- D.gs 81/08 -testo unico sulla sicurezza aggiornamento Luglio 2018
- DLgs 81/15 - Disciplina organica dei contratti di lavoro e revisione della normativa in tema di mansioni
- DLgs 149/2015 - Semplificazione dell'attività ispettiva in materia di lavoro e istituzione dell'ispettorato nazionale del lavoro
- D.M. 13/2/14 - Procedure semplificate adozione "modello organizzativo 231" per PMI
- D.M. 30/11/12 Procedure standardizzate per la valutazione dei rischi
- DPR 177/11 Qualificazione imprese operanti in ambienti sospetti inquinamento e spazi confinati
- DLgs 475/92 Dispositivi di protezione individuale
- Circolare ministeriale 17/12/04 Tutela salute dei non fumatori
- DLgs 276/03 Libretto del cittadino
- D. Lgs. 532/99, 26/11/1999 - Disposizioni in materia di lavoro notturno
- D.M. 04/03/2013 - Segnaletica stradale destinata alle attività lavorative che si svolgono in presenza di traffico veicolare
- D.M.10/03/1998 - Criteri generali di sicurezza antincendio e per la gestione dell'emergenze nei luoghi di lavoro
- DM 388/03 Regolamento recante disposizioni sul primo soccorso aziendale, in attuazione dell'art. 15 comma 3 del D.Lgs 19/09/94 n. 626 e successive modifiche
- D. Lgs. n.40, 04/02/2000 - Attuazione della direttiva 96/35/CE relativa alla designazione e alla qualificazione professionale dei consulenti per la sicurezza dei trasporti su strada, per ferrovia o per via navigabile di merci pericolose
- D. M. 16/1/1997, 16/01/1997 - Individuazione dei contenuti minimi della formazione dei lavoratori, dei rappresentanti per la sicurezza e dei datori di lavoro che possono svolgere direttamente i compiti prorpi del responsabile del servizio di prevenzione e protezione
- Accordo interconfederale sui Rappresentanti dei Lavoratori del 18 Giugno 2009
- D.P.R. 336/94, 13/04/1994 - Regolamento recante le nuove tabelle delle malattie professionali nell'industria e nell'agricoltura
- D.P.R. 175/88, 17/05/1988 - Attuazione della direttiva CEE n. 82/ 501, relativa ai rischi di incidenti rilevanti connessi con determinate attività industriali, ai sensi della legge 16 aprile 1987, n. 183
- D.Lgs. 35 / 2010 - Attuazione della direttiva 2008/68/CE relativa al trasporto interno di merci pericolose
- EU Directive 725/2004 "on enhancing ship and port facility security" which refers to the Chapter International Convention for Safety of Life at Sea and to ISP CODE (International Ship and Port Facility Security Code)
- IMO – ISPS Code " International Ship and Port Facility Security"
- Decreto Legislativo 6 novembre 2007, n. 203 "Implementation of Directive 2005/65/EC on enhancing port security." (GU General Series n. 261 of 09-11-2007)

Personal data management legislation

Regulation (EU) 2016/679 implemented by Decreto Legislativo 10 agosto 2018, n. 101 "Provisions for the adaptation of national legislation to the provisions of Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of individuals with regard to the processing of personal data, as well as to the free circulation of such data and repealing Directive 95/46 / EC (General Data Protection Regulation). "(GU General Series n. 205 of 04-09-2018)

F.3.3. Greek regulatory context

Environmental management

- Law 4522/2018 (Government Gazette A 39) "Ratification of the February 2, 2018 amendment and codification in a unified text of the Concession Contract dated 27 June 2001 between the Greek State and the Port Authority of Thessaloniki SA and other provisions". https://nomoi.info/ΦΕΚ-Α-39-2018
- Presidential decree 405/1996 - Regulation on the loading, unloading, handling and residence of dangerous goods in ports and their transport by sea http://www.elinyae.gr/el/item_details.jsp?item_id=2744&cat_id=859
- Law 4014/2011 - Government Gazette A209/21-09-2011 – Environmental licensing of projects and activities, regulation of arbitrations in connection with the creation of an environmental balance and other provisions of competence of the Ministry of the Environment (with a number of Ministerial Decisions on the classification of projects, requirements on environmental licensing etc.) http://www.elinyae.gr/el/item_details.jsp?cat_id=691&item_id=9063
- Law 1650/86 - Government Gazette A160/18-10-1986 – Environmental protection (with its amendments) http://www.elinyae.gr/el/lib_file_upload/160-86.1111230803158.pdf
- Law 4042/2012 - Government Gazette A24/13-02-2012 - Criminal protection of the environment - Compliance with Directive 2008/99/ EC - Framework for waste production and management - Compliance with Directive 2008/98/ EC - Regulation of Ministry of Environment, Energy and climate change http://www.ypeka.gr/LinkClick.aspx?fileticket=7Z1up05Xrto%3D
- Law 2939/2001 (Government Gazette 179 A') "Packaging and Alternative Management of Packaging of Other Products - Establishment of National Agency for Alternative Management of Packages and Other Products (EGEDSAP) and other provisions", as amended and in force. http://www.elinyae.gr/el/item_details.jsp?cat_id=2826&item_id=2109
- Law 3199/2003 (Government Gazette 280 A) on "Water protection and management - Compliance with Directive 2000/60 / EC of the European Parliament and of the Council of 23 October 2000", as amended and in force. http://www.elinyae.gr/el/item_details.jsp?cat_id=925&item_id=3773
- Law 3325/2005 (Government Gazette 68 A') "Establishment and operation of industrial and craft facilities in the context of sustainable development and other provisions". http://www.elinyae.gr/el/item_details.jsp?cat_id=164&item_id=5431
- The PD. 82/2004 (Government Gazette 64 A') "Replacement of the Joint Ministerial Decision 98012/2001/1996" Determination of measures and conditions for the management of waste oils "(B 40)" Measures, conditions and program for the alternative management of Lubricant Waste Olive Oil". http://www.elinyae.gr/el/item_details.jsp?cat_id=2825&item_id=3730
- Joint Ministerial Decision 13588/725/2006 (Government Gazette 383 B) "Measures, conditions and limitations for the management of hazardous waste in compliance with the provisions of Directive 91/689 / EEC on hazardous waste" of the Council of 12 December 1991. Replacement of item no. 19396/1546/1997 Joint Ministerial Decision "Measures and Conditions for the Management of Hazardous Waste" (B 604). http://www.elinyae.gr/el/item_details.jsp?item_id=6537&cat_id=927

- Joint Ministerial Decision No. 24944/1159/2006 (Government Gazette 791 B) "Approval of General Technical Specifications for the management of hazardous waste pursuant to article 5 (paragraph B) of Joint Ministerial Decision No 13588/725/06" Measures, terms and conditions restrictions on the management of hazardous waste, etc. "(B '383) and in compliance with the provisions of Article 7 (1) 91/156 / EC of the Council of 18 March 1991". http://www.elinyae.gr/el/item_details.jsp?cat_id=2864&item_id=6538
- Joint Ministerial Decision 8668/2007 (Government Gazette 287 B) "Approval of National Plan for the Management of Hazardous Waste (NNAPE) in accordance with Article 5 (paragraph A) of Joint Ministerial Decision No 13588/725/06" Measures, terms and conditions restrictions on the management of hazardous waste, etc. "(B '383) and in compliance with the provisions of Article 7 (1) Council Directive 91/156 / EEC of 18 March 1991. Amendment of the Ministerial Decree "Measures, conditions and restrictions for the management of hazardous waste ..." (B '383) and No 24944 / 1159/06 Joint Ministerial Decision "Approval of General Technical Specifications for the Management of Hazardous Waste ..." (B '791) "". http://www.elinyae.gr/el/item_details.jsp?item_id=6962&cat_id=927
- Ministerial Decision 3231.8 / 1/1989 (Government Gazette 573 B) "Terms and conditions for the granting of licenses to ships and floating yards used as floating facilities for the reception of petroleum residues", as amended and in force. http://www.elinyae.gr/el/item_details.jsp?item_id=2205&cat_id=929
- Joint Ministerial Decision 8111.1 / 41/09/2009 (Government Gazette 412 B) "Measures and conditions for port reception facilities for ship-generated waste and ship-generated waste ...". http://www.elinyae.gr/el/item_details.jsp?cat_id=2623&item_id=7945
- The Circular with AP 8136.16 / 01/09 / 28.7.2009 "Implementation of the provisions of the Joint Ministerial Decision 8111.1 / 41/2009 (Government Gazette B 412 / 06-03-2009) on the measures and conditions for the port reception facilities for ship-generated waste and cargo residues'. http://www.elinyae.gr/el/lib_file_upload/8136%20eg%20apo.1411130615906.pdf
- The no. 30 / house. 2885/2010 (Government Gazette 1079 B) Decision of the Prefect of Thessaloniki "Determination of surface water uses and special conditions for the disposal of sewage and industrial waste to every recipient of the Prefecture of Thessaloniki. http://www.elinyae.gr/el/item_details.jsp?item_id=8890&cat_id=922
- Directive 2001/96/EC of the European Parliament and of the Council of 4 December 2001 establishing compliant requirements and procedures for the safe loading and unloading of bulk carriers https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32001L0096

Transportation legislation

- Regulation 725/2004 EC << Enhancing ship and Port facility security>>
- Greek National Law 3622/2007 << Strengthening the security of Ships, Ports, and Ports facilities>>
- Regulation 562/2006 EC << Schengen Borden Code>>. The Greek Customs and Hellenic Coast Guard apply their own legal framework for their operations in our facilities and you will be informed by them concerning these frameworks.
- Law 3446/2006 - Government Gazette 49 / A / 10.3.2006 - Organization and operation of traffic control principles for vehicles - Regulations for passenger transport and other provisions http://www.elinyae.gr/el/item_details.jsp?cat_id=175&item_id=6802
- Regulation (EU) No 1177/2010 of the European Parliament and of the Council of 24 November 2010 concerning the rights of passengers when travelling by sea and inland waterway and amending Regulation https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1541154019728&uri=CELEX:32010R1177

Safety and security legislation

- Law 4150/13 as well as the implementation of ISPS / Law 725-2004.
- Law 3622/2007 - Government Gazette 281A / 2007 - Enhancing the security of ships, port facilities and ports and other provisions http://www.elinyae.gr/el/item_details.jsp?cat_id=3482&item_id=10822
- EC 725/2004 Commission Regulation of the European Parliament and of the Council of 31 March 2004 on enhancing ship and port facility security https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32004R0725
- European Directive 2005/65/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 October 2005 on enhancing port security https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:310:0028:0039:EN:PDF

Personal data management legislation

- Law 2472/1997: Protection of Individuals with regard to the Processing of Personal Data
- Law 3471/2006: Protection of personal data and privacy in the electronic telecommunications sector and amendment of law 2472/1997.
- Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data and repealing Directive 95/46/EC (hereinafter as GDPR) https://eur-lex.europa.eu/legal-content/el/TXT/?uri=CELEX%3A32016R0679
- Law 2472/97- Government Gazette 84/2000 (amended with Government Gazette 109A/2001) - Protection of the individual from the processing of personal data http://www.nurs.uoa.gr/fileadmin/nurs.uoa.gr/uploads/Nomothesia_Nosilefton/Nomoi/Nomos_2472_FEK_501997.pdf

F.3.2. Spanish regulatory context

Environmental management

Water

- Law 41/2010, of December 29, on the protection of the marine environment. It is applied to the territorial sea, both in the Atlantic, Cantabrian, and in the Mediterranean fishing area and the continental shelf. The Law on the protection of the marine environment is applied, for example, in its protection, controlling the discharges of aircraft or ships to protect marine threatened species and also for the declaration of marine protected areas. To maintain a good marine environmental status, a good planning of the activities that take place at sea is necessary. For the elaboration and application of marine strategies, for their conservation, the autonomous communities will participate in all phases.
- Royal Decree 1514/2009, of October 2, which regulates the protection of groundwater against pollution and deterioration
- Royal Legislative Decree 1/2001, of July 20, approving the revised text of the Water Law, later amended by Royal Decree Law 4/2007.
- Royal Decree 258/1989, of March 10, which establishes the general regulations on discharges of dangerous substances from land to sea.
- Law 22/1988, of July 28, of Shores. This law includes the measures for the restoration and protection of the public marine-terrestrial domain. The public use of the sea is guaranteed taking into account a control of the quality level of the sea and water banks.

Protected areas

- Regulation here (Order ARM/2444/2008, Royal Decree 1421/2006, Royal Decree 1803/1999, Royal Decree 439/1990) do not seem to be directly applicable to ports.

Biodiversity

- Law 42/2007, of December 13, on Natural Heritage and Biodiversity. This Law takes into account the importance of maintaining essential ecological processes, the preservation of the environment, its genetic and biological diversity, the beauty and uniqueness of natural ecosystems and the geological and landscape diversity.

Climate change and renewable

- Order ITC / 3366/2010, of December 29, which establishes the methodology for calculating the unit cost of the CO2 emission rights assigned to power generation plants.
- Law 13/2010, of July 5, which modifies Law 1/2005, of March 9, which regulates the greenhouse gas emission rights trade regime, to improve and extend the general regime of emission rights trading and include aviation in it.
- Law 40/2010, of December 29, on geological storage of CO2. The purpose of this law is to incorporate the provisions of Directive 2009/31 / EC of the European Parliament and of the Council of April 23, 2009, into Spanish internal regulations, adapting them to Spain's industrial, geological and energy reality.

Transport

- Royal Decree 1565/2010, of November 19, which regulates and modifies certain aspects related to the activity of production of electric power in special regime (BOE nº 283 of 11/23/2010). The premium received for the sale of energy generated in photovoltaic solar power plants is modified.
- Royal Decree 1614/2010, of December 7, which regulates and modifies certain aspects related to the activity of production of electric power from solar thermal and wind technologies (BOE nº 298, of 08/12/2010).
- Royal Decree 1031/2007, of July 20, which develops the framework for participation in the flexibility mechanisms of the Kyoto Protocol (BOE No. 174 of 07/21/2007).
- Royal Decree 1370/2006, of November 24, which approves the National Plan for the Allocation of greenhouse gas emission rights 2008-2012 (BOE nº 282 of 11/25/2006). Modified by Royal Decree 1030/2007, of July 20 (BOE nº 174 of 07/21/2007), modified, in turn, by Royal Decree 1402/2007, of October 29 (BOE nº 260 of 30 / 10/2007).
- Order PRE / 3420/2007, of November 14, approves the individual allocation of greenhouse gas emission rights.
- Order PRE / 2827/2009, of October 19, modifies the amounts of sectoral allocations established in the National Plan for the Allocation of Rights of Emission of Greenhouse Gases, 2008-2012, approved by Royal Decree 1370/2006, of November 24 (BOE nº 256 of 23/10/2009).
- Law 1/2005, of March 9, which regulates the greenhouse gas emission rights trading regime (BOE nº 59 of 03/10/2005).
- Royal Decree Law 5/2004, of 27 August, regulating the greenhouse gas emission rights trading regime.
- Royal Decree 1315/2005, of November 4, establishing the basis for monitoring and verification systems for greenhouse gas emissions.
- Royal Decree 1264/2005, of October 21, which regulates the organization and operation of the National Registry of emission rights.
- Instrument for Ratification of the Kyoto Protocol to the United Nations Framework Convention on Climate Change, December 11, 1997.

Transportation legislation

- Order FOM / 642/2018 of June 13, modifying Order FOM / 897/2005, of April 7, regarding the declaration on the network and the procedure for awarding railway infrastructure capacity and the Order FOM / 189/2015, of February 11, by which basic principles of application of incentives are developed in the system of fees for the use of railway infrastructures, established in article 73 of Law 39/2003, of November 17, of the Railway Sector. (BOE 15)
- Order FOM / 606/2018 of May 25, on the content of the annual report for the transport of dangerous goods by road. (BOE 06-06)
- Royal Decree 271/2018 of May 11, which modifies Royal Decree 2387/2004, of December 30, which approves the Regulation of the Railway Sector. (BOE 12)
- Order FOM / 64/2017 of January 30, which modifies Order FOM / 3591/2008, of November 27, which approves the regulatory bases for granting aid for training in relationship with road transport and Order FOM / 3218/2009, of November 17, approving the regulatory bases for granting aid to autonomous road transporters that leave the activity; and the electronic processing of procedures is regulated. (BOE 02-02)
- Law 38/2015 of September 29, of the railway sector. (BOE 30)
- Royal Decree 1082/2014 of December 19, which establishes specialties for the application of rules on driving times and rest in road transport developed on islands whose surface area does not exceed 2,300 square kilometres. (BOE 12-01-15)
- Order FOM / 1996/2014 of October 24, by which the Order FOM / 734/2007, of March 20, is modified by which the Regulation of the Law of Ordination of the Terrestrial Transports is developed in the matter of authorizations of transport of goods by road. (BOE 31)
- Royal Decree 627/2014 of July 18, on assistance to victims of railway accidents, published in the B.O.E. of July 19, 2014, is applicable from July 20, 2014
- Order PRE / 907/2014 of May 29, by which an analytical accounting model is implemented in the contractor companies that provide the services of regular transportation of passengers of general use (BOE 03-06)
- Royal Decree 97/2014 of February 14, which regulates the transport of dangerous goods by road in Spanish territory. (BOE 27)
- Royal Decree 22/2014 of January 17, which modifies Royal Decree 836/2012, of May 25, which establishes the technical characteristics, the health equipment and the staffing of the Sanitary transport vehicles by road. (BOE 25)
- Order FOM / 2423/2013 of December 18, which modifies Order FOM / 3591/2008, of November 27, which approves the regulatory bases for granting aid for training in relationship with road transport. (BOE 26)
- Order PRE / 1435/2013 of July 23, by which the Regulation of the Law of Land Transport is developed in the field of sanitary transport by road. (BOE 29)
- Order FOM / 1403/2013 of July 19, on services of rail passenger transport with priority tourist purpose. (BOE 25)
- Law 9/2013 of July 4, which modifies the Law 16/1987, of July 30, of Ordination of Land Transport and Law 21/2003, of July 7, of Air Safety. (BOE 05)
- Organic Law 5/2013 of July 4, which modifies the Organic Law 5/1987, of July 30, of Delegation of State Powers in the Autonomous Communities in relation to road transport and by cable. (BOE 05)
- Order FOM / 1298/2013 of June 28, which modifies Annex VI of Royal Decree 1032/2007, of July 20, which regulates the initial qualification and the continuous training of the drivers of certain vehicles intended for road transport. (BOE 10-07)
- Order FOM / 1230/2013 of May 31, which establishes control standards in relation to public passenger transport by road. (BOE 03-07). (Amended by Order PRE / 907/2014, of May 29)

- Order FOM / 370/2013 of February 28, which revises the tariffs for regular public intercity services for general use of passenger transport by road (BOE 08-03)
- Royal Decree 128/2013 of February 22, on the organization of working time for self-employed workers who carry out mobile road transport activities (BOE 23)
- Order FOM / 2861/2012 of December 13, which regulates the document of administrative control required for the realization of public transport of goods by road (BOE 05-01-13)
- Order FOM / 2835/2012 of November 17, which modifies Order FOM / 3218/2009, of November 17, which approves the regulatory bases for the granting of aid to autonomous transporters by road who leave the activity (BOE 01-01-13)
- Order FOM / 1882/2012 of August 1, which approves the general conditions of contracting goods transport by road (BOE 05-09)
- Royal Decree 836/2012 of May 25, which establishes the characteristics techniques, health equipment and staffing of road transport vehicles. (BOE 08-06). (Amended by Royal Decree 22/2014 of January 17)
- Royal Decree 662/2012, of April 13, which establishes the framework for the implementation of intelligent transport systems (SIT) in the transport sector by road and for interfaces with other modes of transport. (BOE 14)
- Order FOM / 3528/2011 of December 15, which establishes a new transitory regime for the rehabilitation of authorizations for the transport of goods by road. (BOE 28)
- Royal Decree 1635/2011 of November 14, which modifies Royal Decree 1561/1995, of September 21, on special days of work, in terms of time of presence in road transport. (BOE 17-12)
- Royal Decree 1387/2011 of October 14, which modifies the Regulation of the Law of Land Transport, approved by Royal Decree 1211/1990, of September 28. (BOE 29)
- Royal Decree 1276/2011 of September 16, of normative adaptation to the International Convention on the rights of persons with disabilities. (BOE 17)
- Order FOM / 3386/2010 of December 20, by which rules are established for the realization by the Arbitration Boards of the Transport of functions of deposit and alienation of merchandise. (BOE 31)
- Order FOM / 2607/2010 of October 1, which establishes the requirements that must be met by the trainers who provide the initial qualification courses and continuing training for drivers of certain vehicles intended for road transport. (BOE 08)
- Royal Decree 919/2010 of July 16, which modifies the Regulation of the Law of Land Transportation to adapt it to Law 25/2009, of December 22, modification of various laws for its adaptation to the Law on free access to service activities and their exercise. (BOE 05-08)
- Order FOM / 3509/2009 of December 23, which establishes a transitory regime for the rehabilitation of authorizations for the transport of merchandise by road. (BOE 30)
- Law 25/2009 of December 22, on the modification of various laws for their adaptation to the Law on free access to service activities and their exercise. (BOE 23). (Only article 21)
- Law 15/2009 of November 11, of the Contract of Terrestrial Transport of Goods. (BOE 12 and correction of errors 16-02-10)
- Royal Decree 1163/2009 of July 10, which modifies Royal Decree 640/2007, of May 18, which establishes exceptions to the compulsory nature of the rules on driving times and rest and the use of the tachograph in road transport. (BOE 23)
- Resolution of June 5, 2009, of the General Directorate of Land Transport, which modifies the one of April 19, 2007, which establishes the minimum controls on the working days of drivers in the road transport. (BOE 25)

Safety and security legislation

- Royal Decree 843/2011, of June 17, which establishes the basic criteria on the organization of resources to develop the sanitary activity of the prevention services.
- Order TIN / 2504/2010, of September 20, by which Royal Decree 39/1997, of January 17, is developed by which the Regulation of Prevention Services is approved, with regard to the accreditation of entities specialized as prevention services, memory of preventive activities and authorization to perform the activity of audit of the prevention system of companies.
- Royal Decree 39/1997, of January 17, which approves the Regulation of Prevention Services.
- Law 31/1995, of November 8, on Prevention of Occupational Risks

Personal data management legislation

- Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and the free movement of these data and repealing the Directive 95/46 / CE (General Data Protection Regulation)
- Corrigendum to Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and the free movement of such data and repealing Directive 95/46 / EC (General Data Protection Regulation)
- Royal Decree-Law 5/2018, of 27 July, on urgent measures for the adaptation of Spanish Law to European Union regulations on data protection.
- Organic Law 15/1999, of December 13, Protection of Personal Data (in force in those articles that do not contradict the RGPD)
- Royal Decree 1720 / 2007, of December 21, by which the Regulation of development of the Organic Law 15/1999 is approved (in force in those articles that do not contradict the RGPD)
- Royal Decree 428/1993, of 26 March, approving the Statute of the Data Protection Agency

F.4. Local regulatory context

This section provides the regulatory context at the local port level related to the four different ports.

F.4.1. GPMB

Environmental policies regulation

- Pollution caused by ships into the water are managed by “affaires maritimes”. If pollution appears, the maritime prefect decrees the plan POLMAR and the marine affairs act to contain this pollution.
- Air quality: port of Bordeaux doesn’t belong to any Sulphur Emission Control Area (SECA). Nevertheless, some local alert procedures about air quality may be put in place especially to monitor SOx emissions in industrial areas such as ports (https://www.atmo-nouvelleaquitaine.org/article/dispositifs-prefectoraux-dalerte)
- Dredging: the dredging operations of the estuary are authorized by a prefectural decree which declares the practices carried out in conformity with the environmental code. In addition, local communities are working with the port on a dredged sediment management plan and listing actions to protect and reduce the impact of dredging

Article 29 of Directive 95/46/EC

- Commission Nationale de l'Informatique et des Libertés (CNIL). https://www.cnil.fr/

Regulatory bodies

- Direction génerale des infrastructures, des transports et de la mer : https://www.ecologique-solidaire.gouv.fr/direction-generale-des-infrastructures-des-transports-et-mer-dgitm
- Bordeaux Métropole : http://www.bordeaux-metropole.fr/
- Région Nouvelle Aquitaine : https://www.nouvelle-aquitaine.fr/#gref
- Département de la Gironde https://www.gironde.fr
- DDTM33 : http://www.gironde.gouv.fr/Services-de-l-Etat/Prefecture-sous-prefectures-et-DDI/Direction-Departementale-des-Territoires-et-de-la-Mer
- DREAL : http://www.nouvelle-aquitaine.developpement-durable.gouv.fr/
- ADEME Nouvelle-Aquitaine : https://nouvelle-aquitaine.ademe.fr/
- ATMO Nouvelle-Aquitaine (Air quality association) https://www.atmo-nouvelleaquitaine.org/

F.4.2. Port of Monfalcone

Environmental policies regulation

Although there are no local specific policies related to pollution, some regulations to mitigate adverse impacts of port operations on the environment can be found in the following ordinances diffused by the local Maritime Authority (capitaneria di Porto di Monfalcone – Guardia Costiera):

- Ordinanza n. 31/2003 – Waste collection. http://www.monfalconeport.it/public/allegati/4-8-2010-17-11-58_398162.pdf
- Ordinanza n. 32/2018 – Bunkering operations. http://www.monfalconeport.it/public/allegati/Ordinanza%2032-2018lr.pdf
- Piano Operativo di pronto intervento locale in caso di inquinamento o di imminente pericolo di inquinamento.
- Operational plan for local emergency response in case of pollution or imminent danger of pollution Restricted

Quality control

Despite there is no ISO Certification for Quality Management at a global port level, some port operators are certified with ISO 9001 or OHSAS:

- Marterneri S.p.A. (Monfalcone) - ISO 9001
- Cetal S.r.l. - ISO 9001
- Compagnia Portuale S.r.l. - ISO 9001
- Midolini F.lli S.p.A. – ISO 9001 and OHSAS

SDAG is certified according to OHSAS 18001:2007 and ISO 9001:2015 standard

Article 29 of Directive 95/46/EC

- Garante per la protezione dei dati personali. The "Garante per la protezione dei dati personali" is a national collegial body, composed of four members elected by the Parliament, who are in charge for a non-renewable seven-year term. The current board was elected by the Parliament (pursuant to Article 153, paragraph 2 of the Code) on 6 June 2012. Actually it is composed by: Mr. Antonello Soro (President), Mrs. Augusta Iannini (vice-president), Mrs. Giovanna Bianchi Clerici (component), and Mrs. Licia Califano (component)

- European Data Protection Board. From 25TH May 2018 the Italian Working Group instituted by Article 29 of Directive 95/46/EC has been replaced by the European Data Protection Board (EDPB).

Regulatory bodies

- Ministero delle Infrastrutture e dei Trasporti. http://www.mit.gov.it/
- Autorità di Sistema Portuale mare Adriatico Orientale. Port Authority System of the Eastern Adriatic Sea. http://www.porto.trieste.it/
- Capitaneria di Porto di Monfalcone – Guardia Costiera. http://www.guardiacostiera.gov.it/organizzazione/Pages/capitaneria-di-porto-di-monfalcone.aspx
- Regione Autonoma Friuli Venezia Giulia. http://www.regione.fvg.it/rafvg/cms/RAFVG/
- ARPA FVG - Agenzia regionale per la protezione ambientale. http://www.arpa.fvg.it/cms/
- Comune di Monfalcone. http://www.comune.monfalcone.go.it
- Comune di Gorizi. http://www.comune.gorizia.it

F.4.3. Port of Piraeus

Environmental policies regulation

PPA SA, operating according to the provisions of the Protocol on Preparedness, Response and Co-operation to pollution incidents by Hazardous and Noxious Substances, as to the OPRC Convention and to the Greek legislation, has adopted and implements a Marine Pollution Contingency Plan for oil, hazardous and noxious substances, approved by the local Port State for the preparedness and response to oil, hazardous and noxious substances marine pollution incidents from shipping and offshore installations within the PPA SA port area. This Plan is in line with the National Legislation and compatible with the Local Contingency Plan of the local Port State and the National Contingency Plan, as well. More information can be found at http://www.olp.gr/en/nature-protection/tackling-marine-pollution-emergency

PPA SA has elaborated and implements a Ship-generated Waste Management Plan, in line with the European Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues, as embodied in Greek Legislation, as well as according to the International Convention Marpol 73/78 for the Prevention of Pollution from Ships. More information can be found at http://www.olp.gr/en/nature-protection/ship-waste-management-plan

PPA SA implements environmental quality monitoring programs in collaboration with universities and external experts. Monitoring results may indicate special areas and issues of concern, needing improvement. Thus, PPA SA can evaluate its environmental performance and take proper corrective measures when necessary. In particular, PPA SA focuses on the following issues: Seawater quality, Noise quality, Air quality, Landscape, Energy management and On-shore generated Waste management. More information can be found at http://www.olp.gr/en/nature-protection/nature-quality

ISO certification and Quality control

PPA SA applies an Integrated Quality & Environmental Management System in compliance with the requirements of the ISO 9001:2015 and ISO 14001:2015 standards.
Piraeus Port Authority SA (PPA SA) has been awarded double certification against ISO 9001:2015 for Quality Management and ISO 14001:2015 for Environmental Management by Lloyd's Register (LR).

Article 29 of Directive 95/46/EC

At the present the Manager of each PPA Department is in the process to appoint one person who will be responsible for the implementation of the Project “PPA GDPR Policies and Procedures”.

Regulatory bodies

- PIRAEUS PORT AUTHORITY S.A. website: www.olp.gr
- MINISTRY OF ENVIRONMENT AND ENERGY. http://www.ypeka.gr
- Hellenic Data Protection Authority (HDPA). http://www.dpa.gr
- Ministry of Shipping & Island Policy. https://www.yen.gr/
- Hellenic Ministry of Infrastructure, Transport and Networks. http://www.yme.gr

F.4.4. Port of Thessaloniki

Environmental policies regulation

- Ministerial Decision for the Approval of Environmental Terms for the Operation of the Port of Thessaloniki (several amendments, last one on 6th August 2018) https://www.thpa.gr/files/procurement/prf253_203978.pdf
- Environmental monitoring mechanism (recognition of environmental obligations, authorities, responsibilities, data management)
- Plan for receiving and managing waste and cargo residues of ships, mooring at the port of Thessaloniki (https://www.thpa.gr/files/env/waste_cargo_man.pdf)
- Contigency plan for oil pollution incidents in ThPA's jurisdiction area.
- (Occupational Health and Safety Regulations of Thessaloniki Port Authority https://www.thpa.gr/index.php/el/kanonismoi/826-a-81)

ISO certification and Quality control

- ISO 14001 for commercial vessels mooring, unloading of bulk cargo and containers, storage and transport of cargo. Mooring of passenger vessels and cruise ships, concession of sites for commercial and cultural activities.
- ISO 9001 for loading/unloading of general cargo, solid bulk cargoes, excluding cereals

Article 29 of Directive 95/46/EC

- Authorities: Hellenic data protection Authority

Regulatory bodies

- Ministry of Environment and Energy http://www.ypeka.gr
- Region of central Macedonia. http://www.pkm.gov.gr/
- Public Authority of Ports - Ministry of Shipping and Island Policy. https://www.yen.gr/
- Hellenic data protection Authority. http://www.dpa.gr/

F.5. Regulatory context objectives and tactics

This section lists the objectives set in regards to establishing connections with the regulatory bodies, the associated communication objectives and the approach needed to successfully achieve their involvement in port use case development. PIXEL partners can anticipate from previous experiences that the risk for real engagement of regulatory bodies is high; however, legal departments in each pilot port will make an effort on that and the communication strategy will also try to target/attract the regulatory sector.

Table 38. Regulatory context objectives and tactics

Title of the objective	Communication objectives	Approach/tactics
To create strong connection with regulatory bodies as well as data protection authorities at a national and the EU level to ensure the involvement of authorities for legal guidance for the project.	The following communication objectives will be set: -Active engagement of the key regulatory bodies as listed in each port use case. -Communication exchange among the port use case relevant departments and the contacts of the regulatory bodies -Dissemination of the PIXEL objectives and the use case particulars	The development of connections with the regulatory bodies will be implemented via interpersonal communication tactics: information exchange, bilateral meetings. Regulations per port case will be presented to the relevant authorities via the project communication tools (events, training sessions etc.) and through publications (newsletters, news on thematic media)
To approach national data protection authorities and the Art. 29 Working Party of European data protection authorities. Additional regulatory bodies will be determined during the project, will include further national data protection authorities, national ministries, and cloud-focused task-forces and other EC bodies.	The following communication objectives will be set: -Preparation of a concrete strategy to approach the relevant authorities -Creation of communication capacities to guarantee effective long-run communication -Understanding/mapping challenges, opportunities of communication exchange with the regulatory bodies -Engagement of the selected regulatory bodies during the project awareness raising workshops	The Strategy will develop a detailed relevant authorities mapping procedure. This will lead the project to adopt clear messages per regulatory body. The project communication tools should be exploited. One-way communication tools: The website and social media channels will promote material produced by the project (newsletters, videos, etc.). Two ways communication tools: awareness raising events, training sessions and multidisciplinary working groups aiming at standardizing legal requirements per port use case. Publications & press releases produced will make the use case more visible to the targeted regulatory bodies.