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D3.3 - Use cases and scenarios manual v1

Deliverable No.	D3.3	**Due Date**	31/08/2018
Type	Report	**Dissemination Level**	Public
Version	1.0	**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		
Work Package	WP3		

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03-Aug-2018	0.2	Addition of PPA and ThPA use cases Addition of precisions in GPMB use case (environmental management, equipment purchasing)
13-Aug-2018	0.3	Review and completion of parts by Del. Leader and Coordination
28-Aug-2018	0.4	Review and comments by PIC
31-Aug-2018	1.0	Final release

Key Data

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Abstract

According to the priority objectives defined by the ports themselves and in the overall project scope, PIXEL will be able to provide answers on the following gidelines to the port community :

- At the environmental level: by reducing greenhouse gas emissions, improving the use of renewable energy (for example by linking port data with ships to different weather sensors), or streamlining at its maximum potential the use of energy during a transfer of goods.
- At the technological level: by providing specific skills and tools, Pixel aims to centralize and monitor data, homogenizing a complex process of use. It therefore also provides an obvious answer in process optimization and associated IT services.
- At the logistical level: making possible a better use of infrastructures, Pixel should streamline the port passages deemed multimodal and thus improve productivity, competitiveness, reduce congestion.

In order to develop PIXEL solution fitting all real scenarios planned in the project, this document, aiming at specifying use cases, describes the following items:

(i) Actors that interact and participate in the use case. The actors can be either natural persons or system actors;

(ii) Top environmental indicators to consider in each particular scenario depending on the kind of technical use-case

(iii) Assumptions or pre-conditions that need to be satisfied for the use case to perform. Many times, these assumptions are also requirements to the system;

(iv) Brief flow of events and conceptual descriptions of scenarios that will take part into the use-case execution. The sequence of interactions (that will be further developed in the next version of the use-cases manual) will be focused on where and how the operational data is stored, analysed and requested by port agents involved in those transport-related operations;

(v) Expected results: shows the expected outcomes after the use case execution, especially focusing environmental KPIs to be measured and assuring that are within the accepted threshold;

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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
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
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
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, at a very early stage of the project, equally compile the first description of the use-cases that form part of the project. PIXEL is very use-case centric, relying in their needs and expected results a substantial part of its nature. In this document, some initial considerations of the ports (global situation, problems that are facing, available data and infrastructure) are depicted, establishing the first development level for further technical work packages of the project.

This document (and its further iteration, D3.4) 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 on WP4 "Modelling, process analysis and predictive algorithms", WP5 "Port Environmental Index Development" and WP6 "Enabling ICT Infrastructure Framework".

1.1. Rationale of the deliverable

D3.3 is the first version of the specifications of the use cases. At this stage of the project, D3.3 is rather a general functional specification of the use cases with a *common structure*. The level of detail of the description of the use cases is designed to be high enough in order to start the related work packages in an efficient way.

This document is released after the fourth month of execution of the project. PIXEL stakeholders, who are owning use-cases within the work plan, have been working 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 an overview of the most constraining regulation to comply with.
- **Technical context**: a first overview of the systems already available at the ports, the data which are currently collected and processed, software and hardware capacity and sensoring.
- **Description of the use-case**: what the ports are expecting of the project, what are they contributing for, how it is aligned with the whole consortium and objectives and the global flavour of the use-case
- **Scenarios**: a very simple approach to the definition of scenarios that compose the use-case

This information, that has been already identified and put on paper, will allow the first technical work packages (WP4, WP5 and WP6) to start working on their tasks. Drawing from technical and functional specifications, besides the expectations and vision from the parts, is enabling the whole Consortium to establish the basis for the future consecution of PIXEL objective.

The next and final version of the "use cases and scenarios definition for port environmental issues" (D3.4) will include the necessary level of detail in order to implement WP7. For example, the port processes will be described thanks to UML diagrams and the interfaces between local IT systems and PIXEL will be specified.

1.2. Deliverable context

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 Port of Bordeaux (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 for port entrance and transport planning.

	PPA will integrate air quality, meteorological public transport data produced by devices, sensors and systems to PIXEL. Concerning ThPA, data from Port IT systems, stations, sensors and devices will be integrated to PIXEL system. In the PIXEL system will also be integrated 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* Data from the heterogeneous systems and various sources will be collected and processed at ThPA using tools that will be provided *Objective 3 : Develop an operational management dashboard to enable a quicker, more accurate and in-depth knowledge of port operations* The PCS of Port of Bordeaux (VIGIEsip) will integrate the developed dashboard providing a GUI (Graphic User Interface) to the main port's stakeholders. The PPA PMIS will integrate the developed dashboard providing a GUI (Graphic User Interface) to the main port's stakeholders. The port and port's main stakeholders at ThPA can see the operational data in a user friendly, easy to understand dashboard. Selected results could be presented to the citizens. *Objective 4 : Model and simulate port-operations processes for automated optimisation* The processes of loading and unloading goods in port of Bordeaux will be modelled. The processes of automated re-routing of trucks entering Port of Monfalcone (FVG) in the case of congestion will be modelled. PPA port mobility management operations will be simulated for their environmental impact in pursuit of finding optimal resource consumption. The incoming and outgoing flows of the trucks as well as the movements of trucks and ports mechanical equipment during operations at ThPA will be modelled. *Objective 5 : Develop predictive algorithms* This deliverable will contribute to identify the different inputs and outputs of predictive algorithms for ports operations (GPMB) and transportation operations (ThPA). Predictive algorithms will be developed to plan entries to the Port of Monfalcone and FVG 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)* Contribute to the development of (PEI) through the provision of the relevant PPA port environmental data.
Exploitable results	N/A

Work plan	This deliverable integrates the first works done in T3.2 and T3.3. It is a crucial document because it will feed WP4, WP5, WP6 and WP7.
Milestones	MS2 and MS3
Deliverables	Input : D3.2 : PIXEL Requirements Analysis Output : D3.4: Use cases and scenarios manual v2 D3.2 → **D3.3** → D3.4
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”

2. Introduction

With more than 10 billion tonnes of global goods transport by sea, ports are logistics hubs that are essential for the development of each country. Nevertheless, in order to improve the interoperability of the different terrestrial logistics modes, they have 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 optimize their logistical, industrial, environmental and societal performance ratios. The latter therefore has plenty of information to date 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 fluidity 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 excellency.

PIXEL project is very user-centric: it means that its results should bring solutions to ports in order to shape the “ports of the future”.

This document explains the current situation of the four ports involved in PIXEL: Bordeaux, Monfalcone, Piraeus and Thessaloniki, and their commitment to develop and to contribute to some “ports of the future” concepts through use-cases:

Table 2. Challenges and contributions addressed by PIXEL ports

Port of the future challenges	Challenges/contributions addressed by ports			
	Bordeaux	**Monfalcone**	**Piraeus**	**Thessaloniki**
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	X	X	X	X
2. They are a main catalyst for regional development and 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	X	X	X	X
3. Specific issues (like dredging, emission reductions, and energy transition, incl. electrification, smart grids, port-city interface and the use of renewables management and emissions) are combined with other challenges common to all multi-modal terminals	Energy transition Port-city interface LNG dredge	Pollutant emissions monitoring Port-city interface	Port-city interface	Energy transition Pollutant emissions monitoring Port-city interface
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	X		X	X
5. Sustainable maintenance, repair and reconfiguration	X	X	X	X
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, and moves towards the circular economy	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) efficient connections with the hinterland transport network	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 deserve particular attention	X			
12. Proposals should consider the possible transferability of solutions to other ports	X	X		

All the ports will integrate existing systems (such as TOS, PCS) and devices (sensors) to the PIXEL platform which will bring a broader repository than vertical IT systems can and calculation power able to boost data analysis in real-time as well as in more long-term trends. Thanks to this comprehensive collection of data, PIXEL should give added value to ports in different fields of activity such as transportation optimization and energy transition:

- Port of Bordeaux will explore the opportunity to produce renewable energies to fulfil the port's operations needs.
- Port of Monfalcone will search to increase the efficiency of port-inland connections in order to improve port accessibility and transport planning.
- 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.
- Port of Thessaloniki will work on the interoperability of city and port in freight traffic to optimize the traffic between the city and the port area, reducing pollution, queues, energy consumption etc

3. Common repository

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 annex of this document, draft versions of the filled questionnaires are attached. The full completion of the questionnaires will be provided with the deliverable D3.4.

3.2. KPIs

A set of common KPIs to describe and appoint the different use-cases has been identified. It should be enhanced thanks to the WP5 works and especially the task T5.2 "KPI Definition".

Table 3. KPIs for description of use-cases

Impact	KPI	Description
Reduction of impact on climate change and the environment of port activities	Greenhouse gases (GHG) emission / carbon footprint	Total CO2 emissions of the port in a year
	Fine particles emission (NOx, SOx…)	Emissions of dredging activities in a year

	Rate of renewable energy in the energy mix of the port	Renewable energy sources with respect to total energy consumption
	Environmental leadership (Green Marine 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 from 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	Does the port has 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 the 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 the Port of Bordeaux

4.1. Context conditions

4.1.1. Economic, geographical and urban 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.

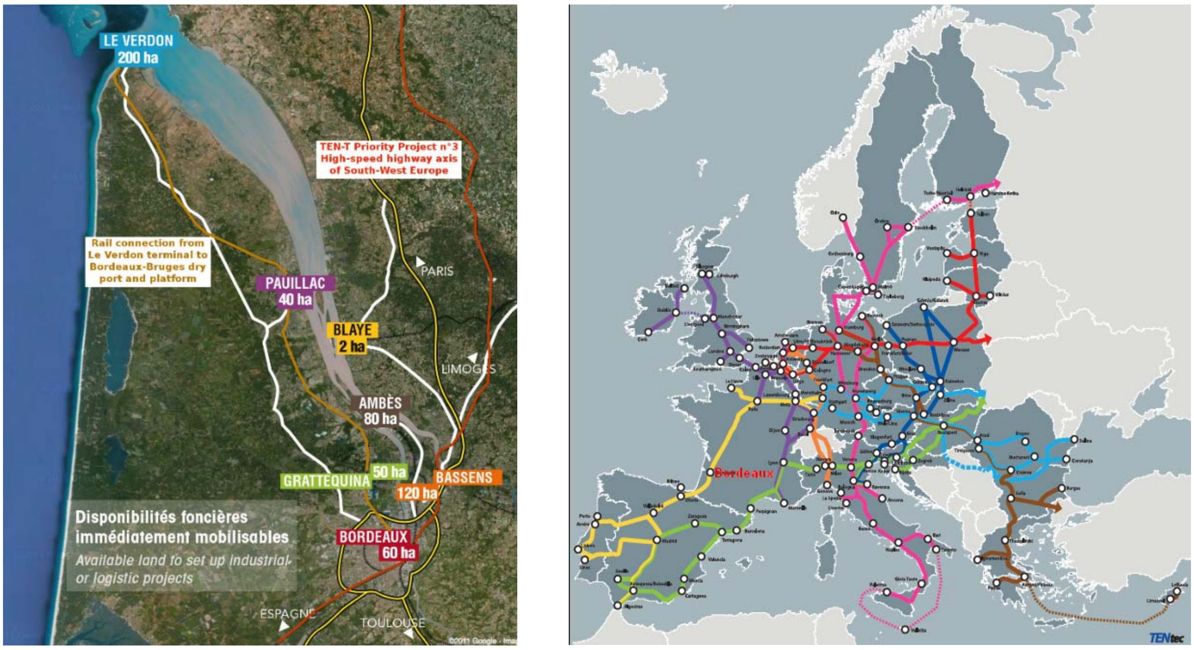

Figure 1. GPMB geographical situation and TEN-T location

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 phenomenon: 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.

4.1.2. Regulatory context

4.1.2.1. Legal status of the port

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 functions of developer 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.

4.1.2.2. Local regulations

The Port of Bordeaux doesn't belong to any Sulphur Emission Control Area (SECA[1]). Some local alert procedures about air quality may be put in place especially to monitor SOx emissions in industrial areas such as ports.[2]

4.1.3. Technical context

4.1.3.1. 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[3] 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 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.

4.1.3.2. 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 device to control and to secure the "*Pont de Pierre*" crossing by river barges.

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

[1] Sulphur Emission Control Area
[2] https://www.atmo-nouvelleaquitaine.org/article/dispositifs-prefectoraux-dalerte
[3] http://www.peepos.eu

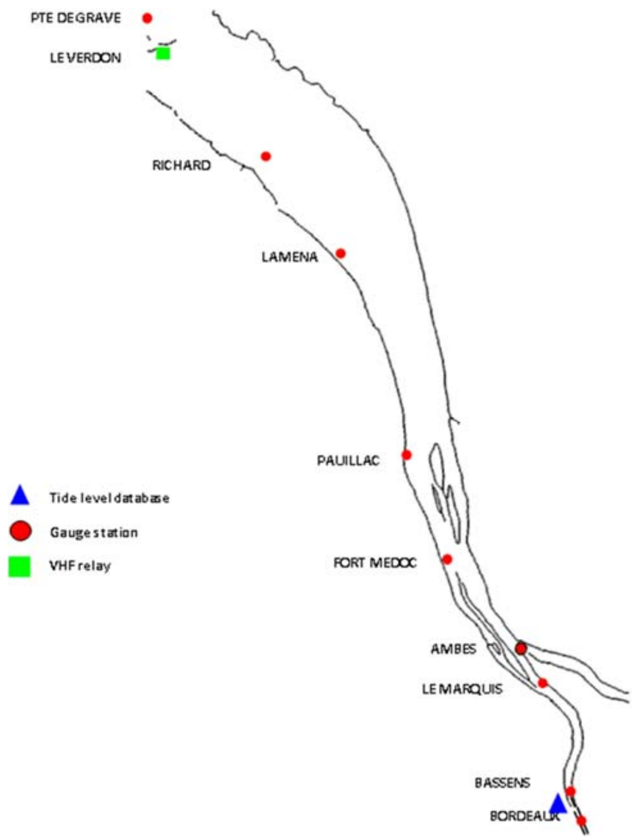

Figure 2. Location of the gauge stations in the Gironde Estuary

4.1.3.2.1. 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.

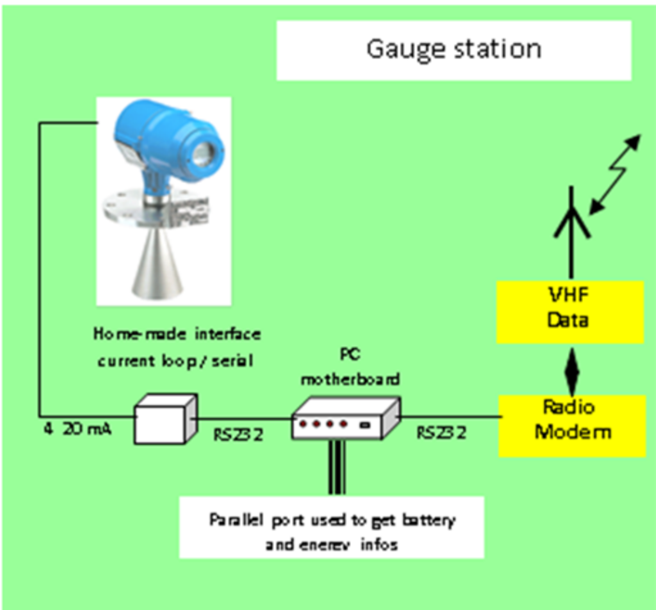

Figure 3. Architecture of the gauge stations network

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.

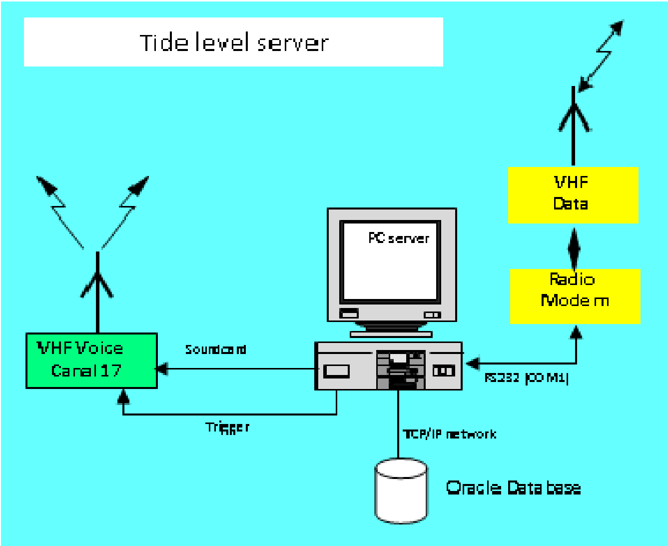

Figure 4. Architecture of the tide level server

4.1.3.2.2. Pont de Pierre crossing

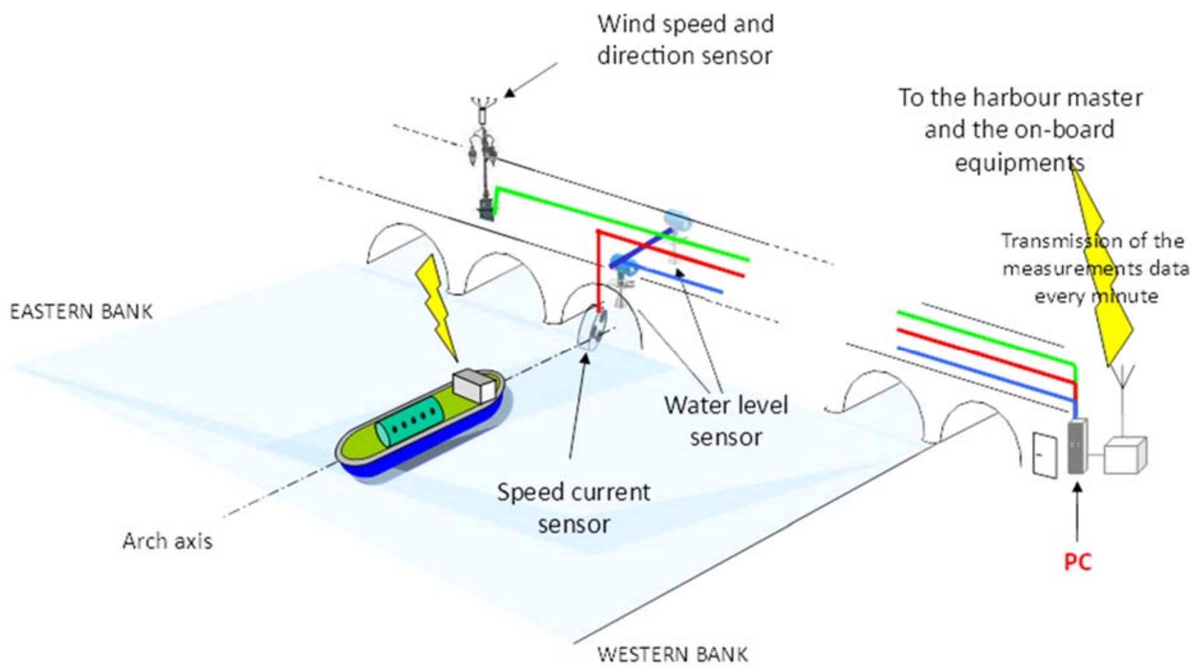

Figure 5. Pont de Pierre crossing structure and network

Again, there is a multi-purpose PC which

- gathers data from sensors (the water level sensor is the same as in the gauge station),
- stores them,
- transmits voice messages to boats (on-board equipment)
- and sends data via TCP/IP network to GPMB’s database

4.1.3.3. ICT systems

GPMB has also developed its own Port Community System (VIGIEsip) in 2014 to organize port calls, to bring port digital services and to comply the single window directive[4]. GPMB has chosen to use Open Source technologies to create VIGIEsip.

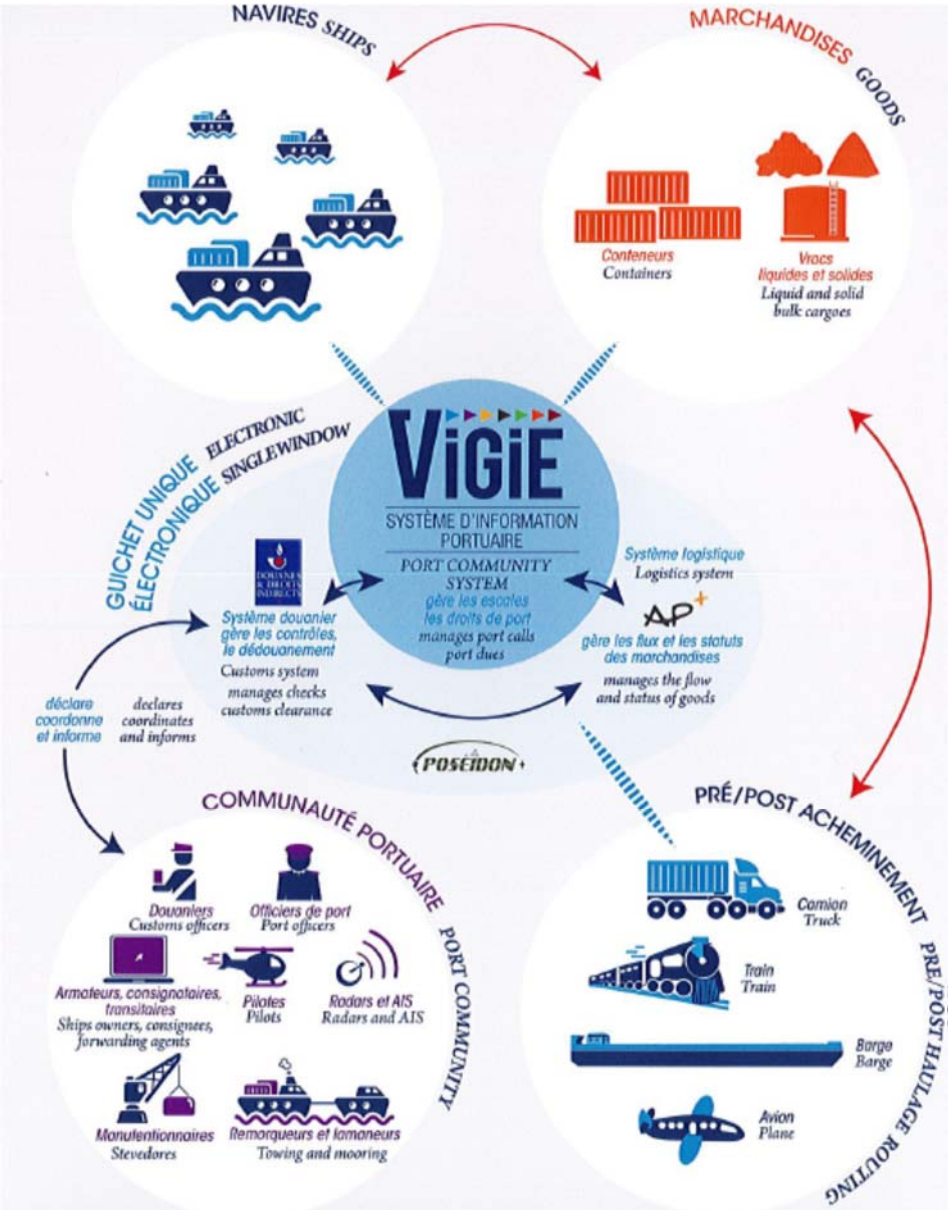

Figure 6. GPMB ICT systems

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.

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

4.1.3.4. Data availability

GPMB stores a lot of data concerning maritime traffic during the last 20 years and measurements provided by the different sensors set up in the port. The databases are powered by Oracle or by PostgreSQL and are operated by GPMB.

In the next figure, a sample of how this data is structured and a summary of its volume in a given moment 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
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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 7. 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 analyze, 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 reach 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

4.1.3.5. Environmental management

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
    - Promote the in-situ treatment of polluted soil
    - Avoid landfilling whenever possible
    - Manage flood risks
    - Develop alternative solutions for managing stormwater
    - 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

For an overall vision of the environmental policy of GPMB, see https://www.bordeaux-port.fr/sites/default/files/images/contenus-site/Port-politiq%20environn-HD-PaP.pdf

4.1.4. Expectations about PIXEL

Framed in achieving this new port concept in a very efficient way, GPMB aims these PIXEL advantages to be developed:

(i) 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
(ii) local energy needs during the call of a ship in order to cope with renewable energy production ; the port must itself reduce its own carbon footprint

(iii) a Port Environmental Index (PEI) to measure the efficiency of a port's green policy, and of the supply chain connected to the port
(iv) major traffic long term trends thanks to deeper port statistics analysis

GPMB will benefit PIXEL to integrate its port management systems (traffic monitoring, arrivals/departs, logistic management, etc.) with photovoltaic production and storing systems and traffic management systems. Using PIXEL's IoT and big data platform, GPMB will be able to know its energy needs/uses and the impact of the provided services on consumption.

4.2. Summary of the use case

4.2.1. Improvements / problems to be solved for the port

GPMB needs to go along with the development of its territory and especially of Bordeaux Metropolis. It needs to be more secure, more attractive, and more citizen-friendly. It also must choose its investments with care: the decisions must be taken with exhaustive analysis.

4.2.1.1. A more secure port

To get a more secure port, GPMB is developing a 3D model of the Estuary of Gironde to anticipate its evolution and to provide real-time guiding tools. To feed the model and the related software tools, GPMB needs to bring 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 doesn't rely on new technical standards (for instance, a dedicated VHF communication protocol has been implemented to replace the lack of 3G/4G network around the Estuary) and their maintenance needs scarce skills. Furthermore, the energy consumption and the price of those PC are high which makes the densification of measuring devices along the Estuary difficult and expensive.

During the past years, GPMB has gathered hundreds of MB of measurements but has not the computing power to exploit the full potential of this data wealth.

4.2.1.2. A more 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 bets on the potential of photovoltaic electricity and on self-consumption. But the investments are high, the return on invest is difficult to achieve and the capability of the GPMB electric network must be assessed.

4.2.1.3. A more citizen-friendly port

Although GPMB has spent several millions euros to reduce its environmental impact (mitigations, innovative LNG dredge purchase), citizens are not aware and GPMB has no idea of how righteous it is compared to other ports. There is no relevant indicators to show to the citizens the 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 performance. 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.

4.2.1.4. 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.

4.2.2. 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
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, IoT…) to PCS (Port Community Systems) and to "big data calculations"
3. To develop a methodology to assess the opportunity to supply local renewable energies to the port's customers at a competitive price
4. To measure the outcomes of the green policy of a port (for instance, LNG dredge, energy efficiency actions, comprehensive environmental and energy transition strategy) thanks to PEI

4.2.3. Overview

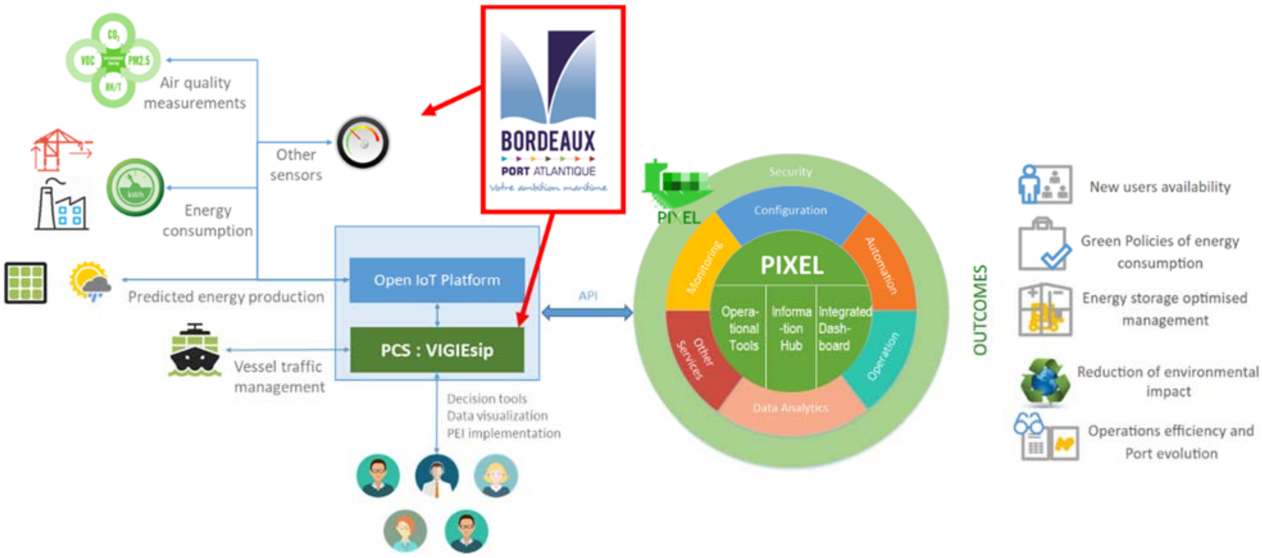


Figure 8. Port of Bordeaux use-case overview

The technical implementation of PIXEL in the Port of Bordeaux will be carried on by:

- setting up an Open IoT Platform
- connecting existing sensors (water level, wind speed…) and new sensors (energy consumption, weather…) to this platform
- developing an API (Application Programming Interface) between VIGIEsip and PIXEL in order to exchange data in standardized formats
- integrating some PIXEL components into VIGIEsip to give an appropriate end-user experience
- designing predictive algorithms to estimate the real-time quantity of energy consumed during port operations depending on the type of cargos and vessels, as well as the quantity of photovoltaic electricity produced in the same time, and to size the electricity network needed in the port area to encourage self-consumption
- designing predictive algorithms for port traffic evolution
- calculating the GPMB's PEI

4.2.4. Expected impacts

GPMB expects several relevant impacts:

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. Higher rate of renewable energy, more affordable energy, more predictable activities, less maintenance costs, new digital services, all highlighted by a PEI… PIXEL sets the foundations for port development in all those domains.
2. Thanks to the availability of PEI, GPMB can strengthen its energy transition strategy and contribute to better citizens/port relationships in order to raise the acceptance of port industrial activities

The Use Case of GPMB shall demonstrate that Port Community Systems are not only regulatory tools: they are communication tools enabling people working in a port to share information and data in order to improve port operations efficiency in a collaborative way.

4.2.5. Use case KPIs

Regarding the KPIs expected to reach within PIXEL in this use-case, is worth to mention that the following figures (in Table 4) are only a rough estimation considering we are still in month 4 of the project. Data has been extrapolated from the first established goals (during proposal) and adjusted to current reality. The impacts have been more detailed textually, but the final figures are still being evaluated by the teams. These estimations will be finally described and particularized for the next deliverable (D3.4).

Table 4. 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	15100 t (to be confirmed)	GPMB has integrated the "High Quality of Life" program of Bordeaux Metropolis: the appropriate collective actions will be carried on in this frame.
	Fine particles emission (NOx, SOx…)	To be determined	-
	Rate of renewable energy in the energy mix of the port	0%	Depending on the outcome of PIXEL, investments to produce of photovoltaic electricity could be realized and then increase the rate of renewable energy of GPMB.
	Environmental leadership (Green Marine Indicator)	1	3 to 5
	PEI adoption	No	Yes
	PEI improvement	Not measured	GPMB's actions regarding reduction of impacts of port activities will naturally improve its PEI.
Reduction of operational and infrastructural costs	Electricity consumption of the port authority	0.5 GWh	Process optimizations will be studied after major reorganization which is on-going.
	Electricity consumption of the port area (Bassens)	3.3 GWh	One of the outcome of PIXEL is the required organization to adjust electricity consumption to the photovoltaic electricity production capability. Then, consumption optimizations will be expected.

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)
	Number of end-users	0	20-50 in a first stage

4.3. Detailed description of the Use case

4.3.1. Common works

4.3.1.1. Evaluating the current situation of the port

Like all the use cases, the use case of the Port of Bordeaux will start by evaluating the current situation thanks to the results of the following questionnaires:

- **environmental maturity of the port**
- **modelling and data analysis**

4.3.1.2. Enabling the IoT platform

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.

4.3.2. Specific actions of the use case

4.3.2.1. Definition of scenarios: the energy consumption of five port operations processes

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 9. Bassens terminal

A higher definition picture of the scenario represented in Figure 9 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 a 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.

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.

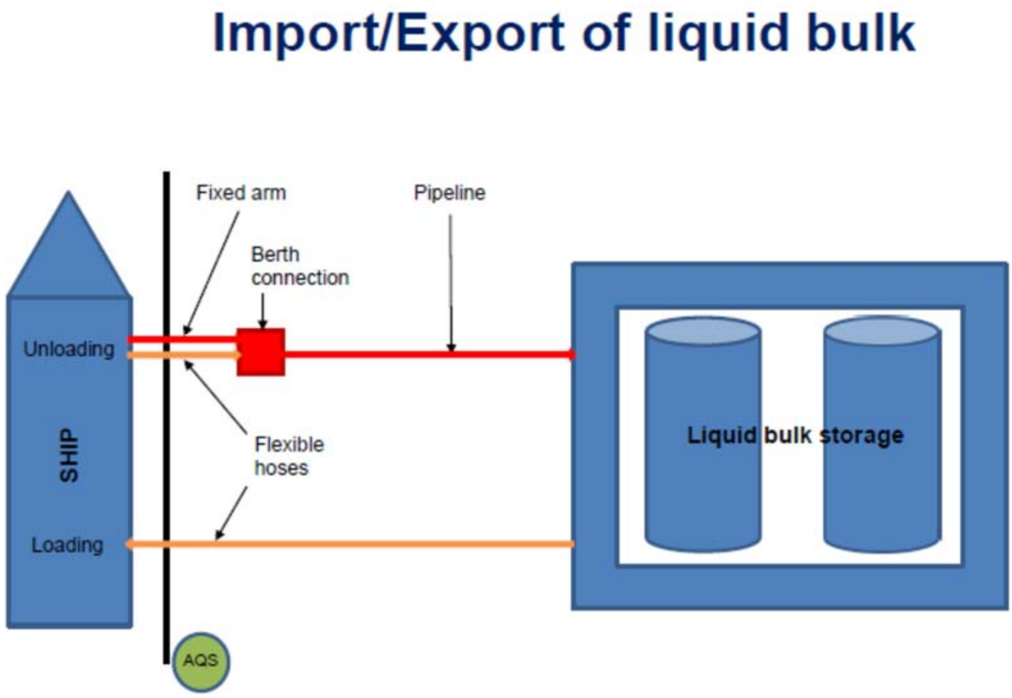


Figure 10. GPMB scenario 1: Import/Export of liquid bulk

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.

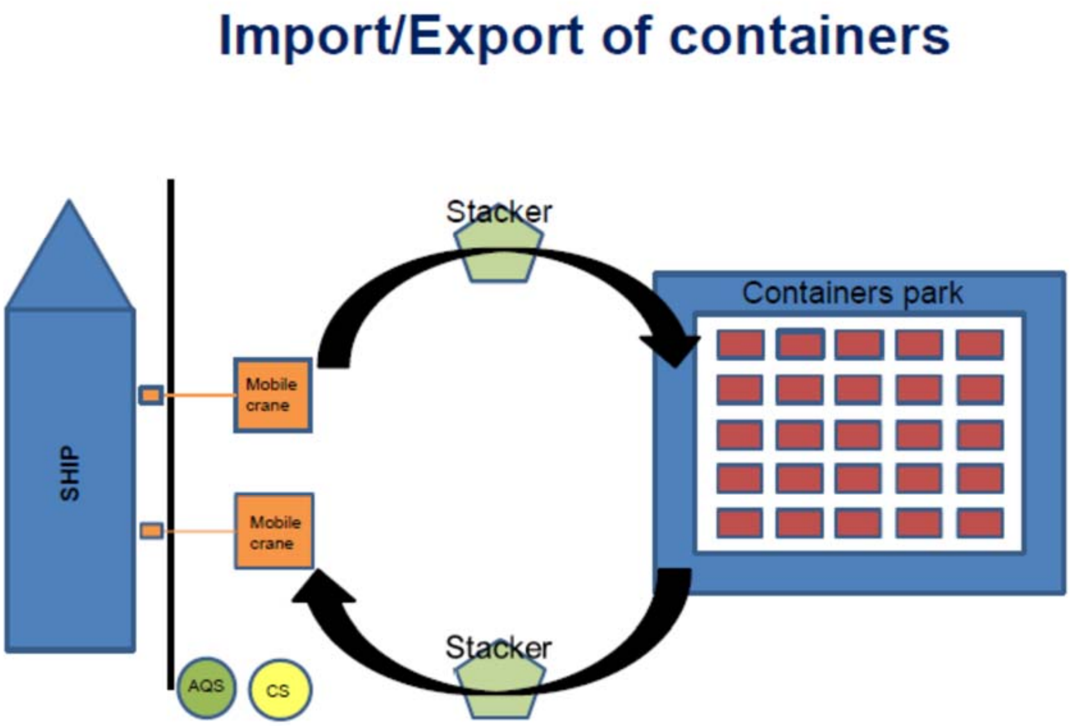


Figure 11. GPMB scenario 2: Import/Export of containers

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).

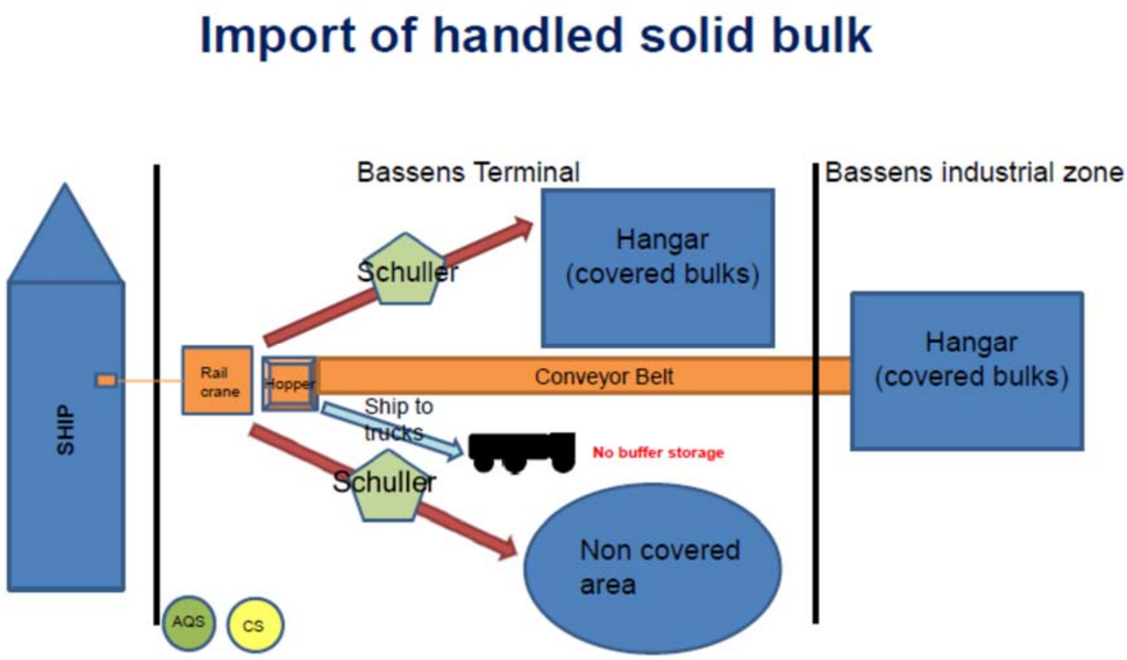


Figure 12. GPMB scenario 3: Import of handled solid bulk

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 ...

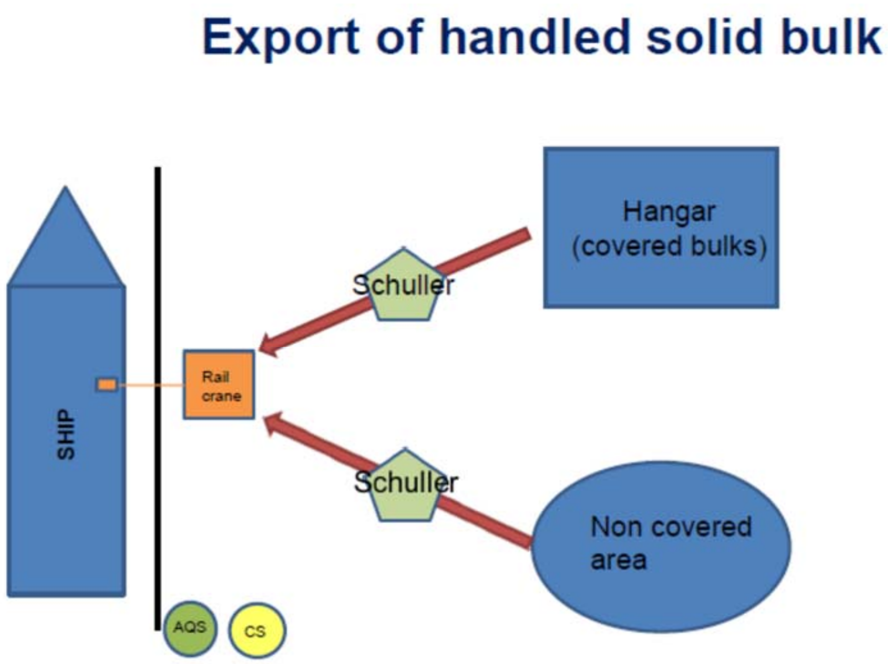


Figure 13. GPMB scenario 4: Export of handled solid bulk

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.

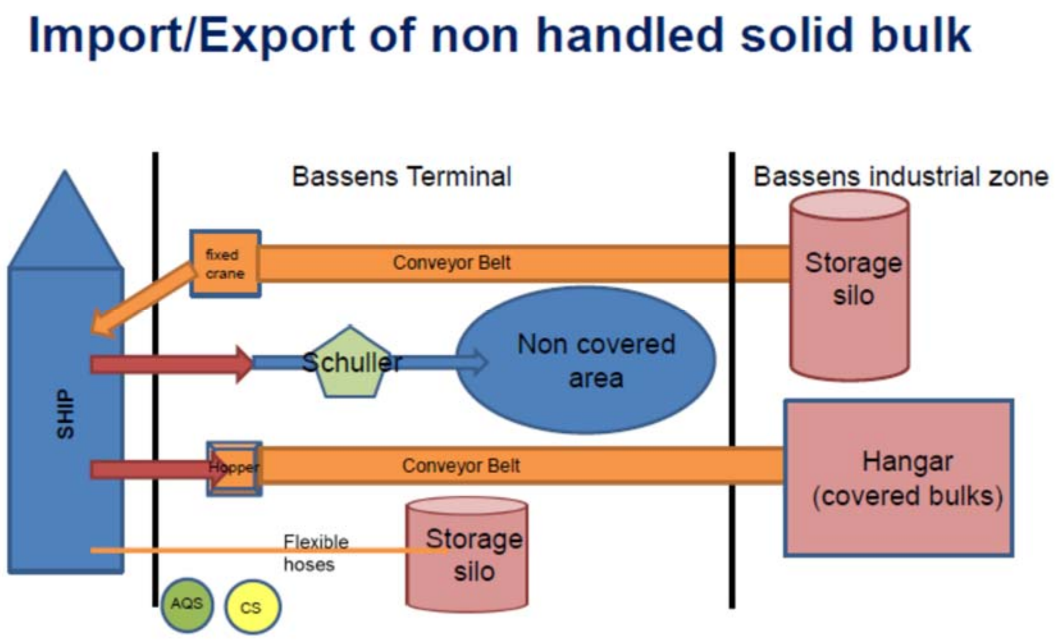


Figure 14. GPMB scenario 5: Import/Export of non-handled solid bulk

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.

4.3.2.2. Integration of systems

4.3.2.2.1. Connecting new sensors to PIXEL

The measurements coming from the new sensors must be sent to PIXEL platform. Data exchange protocols need to be defined and then implemented. This will be further studied in D3.4 and designed and implemented in technical work packages WP6 and WP7.

A specific focus will be done concerning the electricity consumption sensors and how to connect them to the IoT platform. Many sensors in Bassens are already connected to the port's TCP/IP network with fiber optic.

4.3.2.2.2. Connecting old sensors to PIXEL

Sensors connected to a TCP/IP network is not a usual situation in ports. So, in order to connect a few old-fashioned sensors (without any communication stack but serial connection) to the IoT platform, GPMB will guide CATIE and ORANGE **to develop or to find on the market** a more modern "PC" (see chapter "Sensors and existing networks"). 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).

4.3.2.2.3. Connecting VIGIEsip to PIXEL

Appropriate data formats to send port's traffic statistics, expected port calls and sensors data to the PIXEL platform will be defined. These formats can rely on existing formats (XML files used between VIGIEsip and AP+).

4.3.2.2.4. Enlarging the sources of data

GPMB would like to be sure that its new dredge, l'Ostréa, will have positive effects on air quality thanks to its LNG motorisation.

In Bordeaux, the air quality monitoring is performed by an association, ATMO Nouvelle-Aquitaine. So the Port of Bordeaux will get in touch with ATMO Nouvelle-Aquitaine:

- to contribute to the air quality monitoring (by enhancing the set of sensors) of the Ostrea operations in a first stage, and of the overall port industrial activities in a second stage
- to define some new processes to get air quality data (Open Data) automatically from them

4.3.2.3. Equipment purchasing

In order to achieve the complete integration of existing systems and to connect new types of sensors, equipment will be purchased.

4.3.2.3.1. Enhancing the set of sensors

A **weather station** will be purchased in order to calculate the theorical 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.

Depending on our discussions with ATMO Nouvelle-Aquitaine, it may be necessary to buy an **air quality sensor** to extend their network.

4.3.2.3.2. Bringing new communications functionalities to old sensors

Instead of changing our tide level sensors (approx. 2500€ per unit) to add new communications abilities (with new standards such as 5G), it will be much more useful to develop the equipment described in *"3.3.2.2.2. Connecting old sensors to PIXEL"* and then to buy the required components, or to purchase such an equipment if it exists on the market.

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.

4.3.2.4. Implementation of PEI

To go beyond a common questionnaire and to exploit the specific partnership with the Port of Québec, the Port of Bordeaux will **implement the Green Marine program**[5] to assess this North American initiative and to bring inputs and feedbacks to the WP5 leader.

A common and international repository of environmental indexes should be developed in order to boost green maritime supply chains. Certification of "green corridors of transportation" could be one of the ideas to be deepen.

The implementation of PEI by GPMB will be focused on the air quality aspects especially to highlight the impacts of the LNG dredge, Ostréa.

[5] https://www.green-marine.org/wp-content/uploads/2014/01/2018_Summary_PortsSeaway.pdf

4.3.2.5. End-user results expected

4.3.2.5.1. Creating predictive algorithms

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

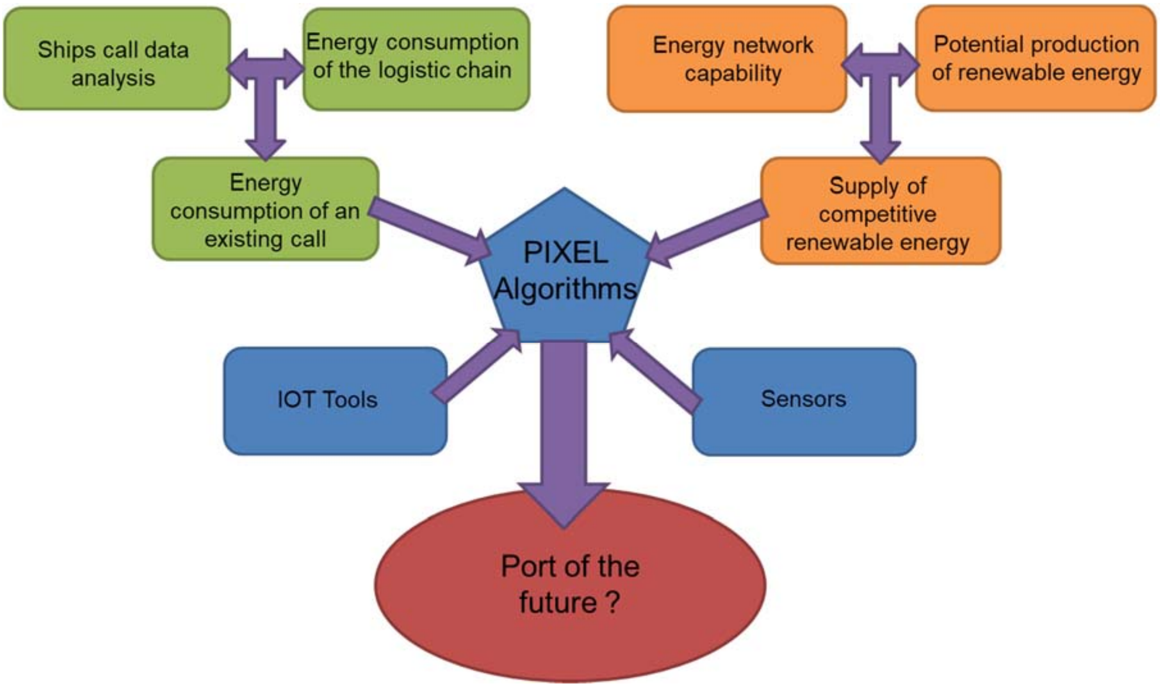


Figure 15. PIXEL algorithms from GPMB use-case point of view

A report based on the results of the algorithms will be released to advice GPMB on its future investment decision.

4.3.2.5.2. Implementing new beta functionalities in VIGIEsip (PCS)

Then 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.

A **beta version of VIGIEsip** integrating data form PIXEL will be released and be assessed by the project group.

4.3.2.5.3. Better acceptance of port activities in Bordeaux

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 environment.

This will be a useful input to WP9.

4.3.2.5.4. "Sensors IoT connector"

As an end-user, GPMB expects the design of a "sensors IoT connector" able to replace the PC described in chapter *"Sensors and existing networks"* and, in a next stage, the industrialisation of the fabrication of these connectors: GPMB should be one of the first customers.

4.3.3. Actors and interactions

The patterns identified are characterized by the presence of four sources of actors evolving on the logistic chains described above. 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…)

4.3.4. Use Case constraints (pre-conditions)

The use case presented requires to have available a number of data and parameters previously targeted in order to make this model replicable, namely:

- From the port authority:
  - Ship's call statistic data in order to build up a forecast model based on types of goods, seasonality, call's duration, wharf number, etc…
  - Current sensors data (bathymetry, energy consumption, etc..)
  - Electric network data
  - Coordination/complementarity with the port call management program: VIGIEsip
- From ATMO Nouvelle-Aquitaine:
  - Position/location of sensors
  - Data on pollutants collected

5. Use case of the Port of Monfalcone

5.1. Context conditions

5.1.1. Economic, geographical and urban 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 export flows but is also one the preferred door for goods coming from Eastern Europe, in particular raw materials, wood and chemical products, both by rail and by road.

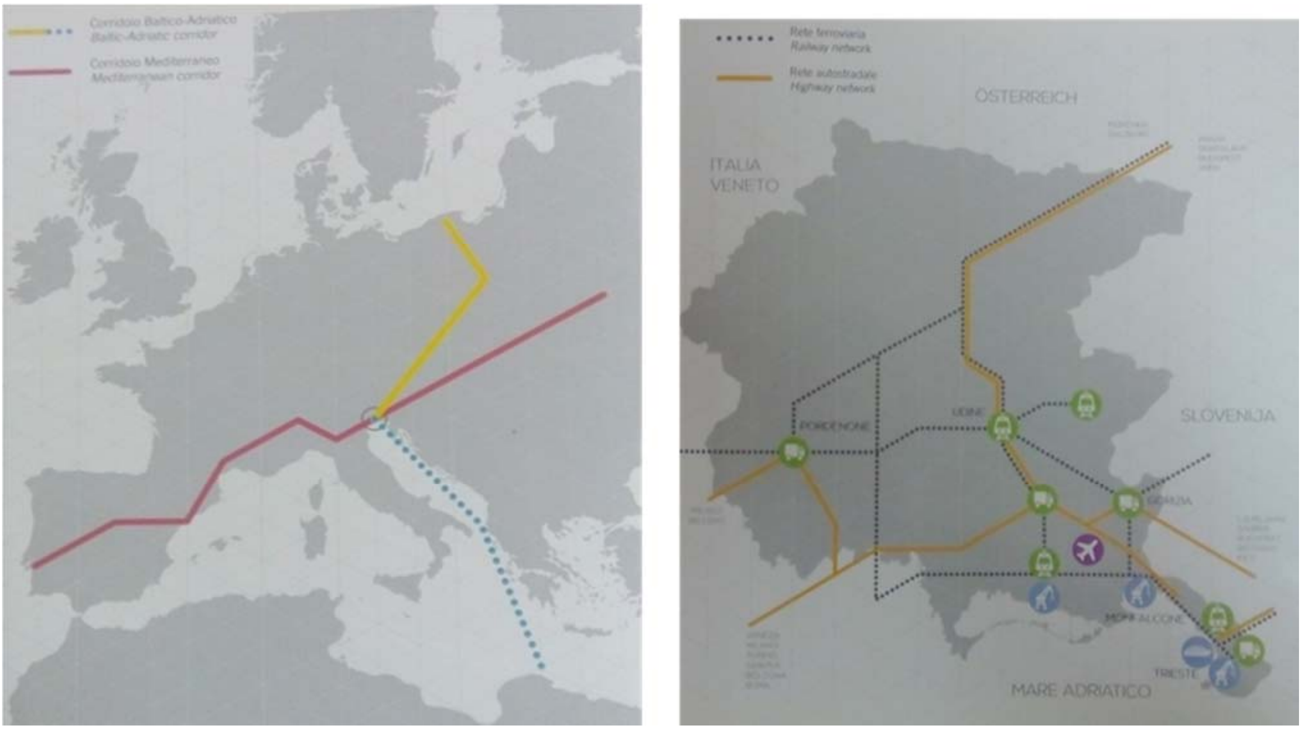


Figure 16. Crucial situation of Friuli Venezia Giulia region

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’s one of the most interesting gate to and from the central Europe market.

Figure 17. 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.

5.1.2. Regulatory context

5.1.2.1. Legal status of the port

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 infrastructures 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 missions is the management and the development of the intermodal terminal of Gorizia, covering a whole surface of approximately 600,000 sqm. The owner of the areas is the Municipality of Gorizia.

5.1.2.2. Local regulations

There are no specific local regulations impacting on PIXEL.

5.1.3. Technical context

5.1.3.1. Premises & infrastructure

The Port of Monfalcone has an operating area of 750.000 squares meters, 66.000 sqm of warehouses and sheds and 480.000 sqm of open customs storage areas. The port's access canal, with a length of 4,500 mt, has a depth of 11.7 mt. The commercial wharf is 1,500 mt long, a maximum draft of 10.9 mt 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).

Figure 18. Port of Monfalcone

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. The intermodal Terminal, totally managed by SDAG, includes:

- 20.000 sqm of paved areas
- A 3.000-sqm joint warehouse
- 5 railway tracks
- RO-LA system

5.1.3.2. Sensors and existing networks

Each lane of the entry gate of the Port of Monfalcone has 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 19. 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.

5.1.3.3. ICT systems

The existing information system, called SILI Integrated logistic informated system, has been developed by FVG region within 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 zone 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 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.

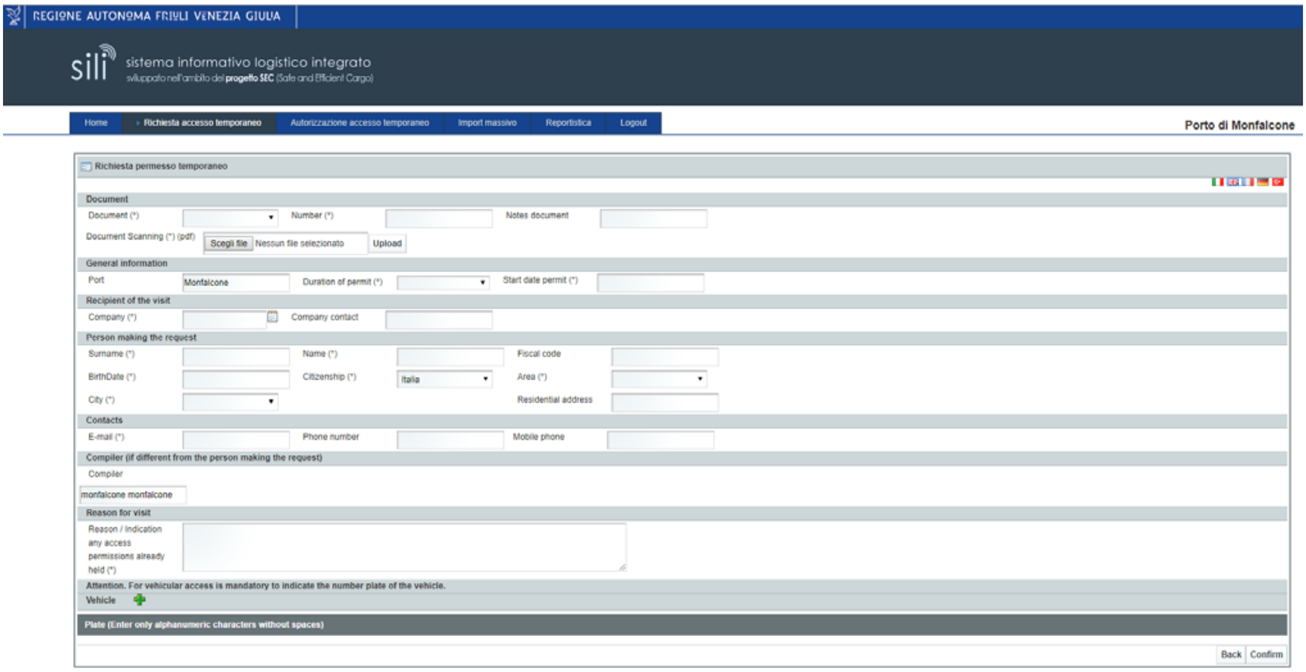
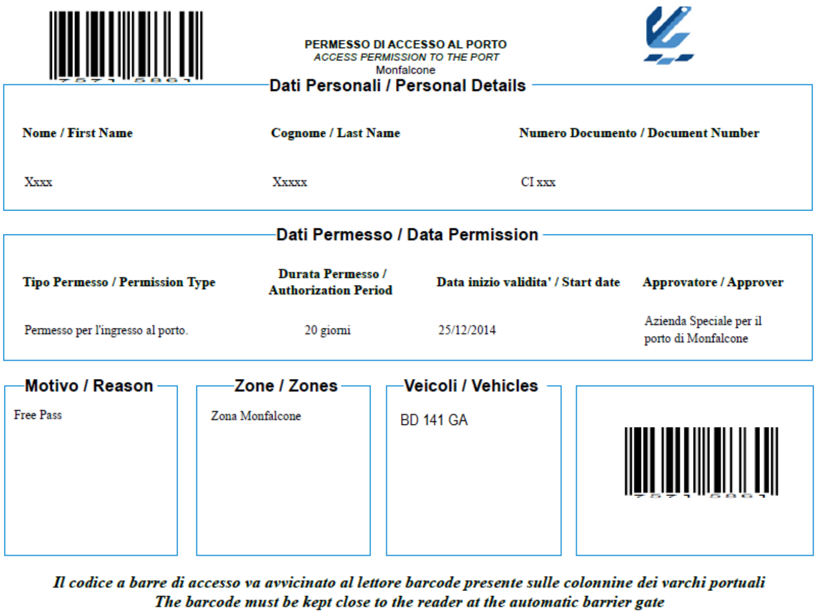


Figure 20. SILI program – ICT system to interact with PIXEL

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	Zone / Zones	Veicoli / Vehicles
Free Pass	Zona Monfalcone	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 21. 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 the picture below, some results generated from SILI regarding vehicle entrance to Port of Monfalcone is shown:

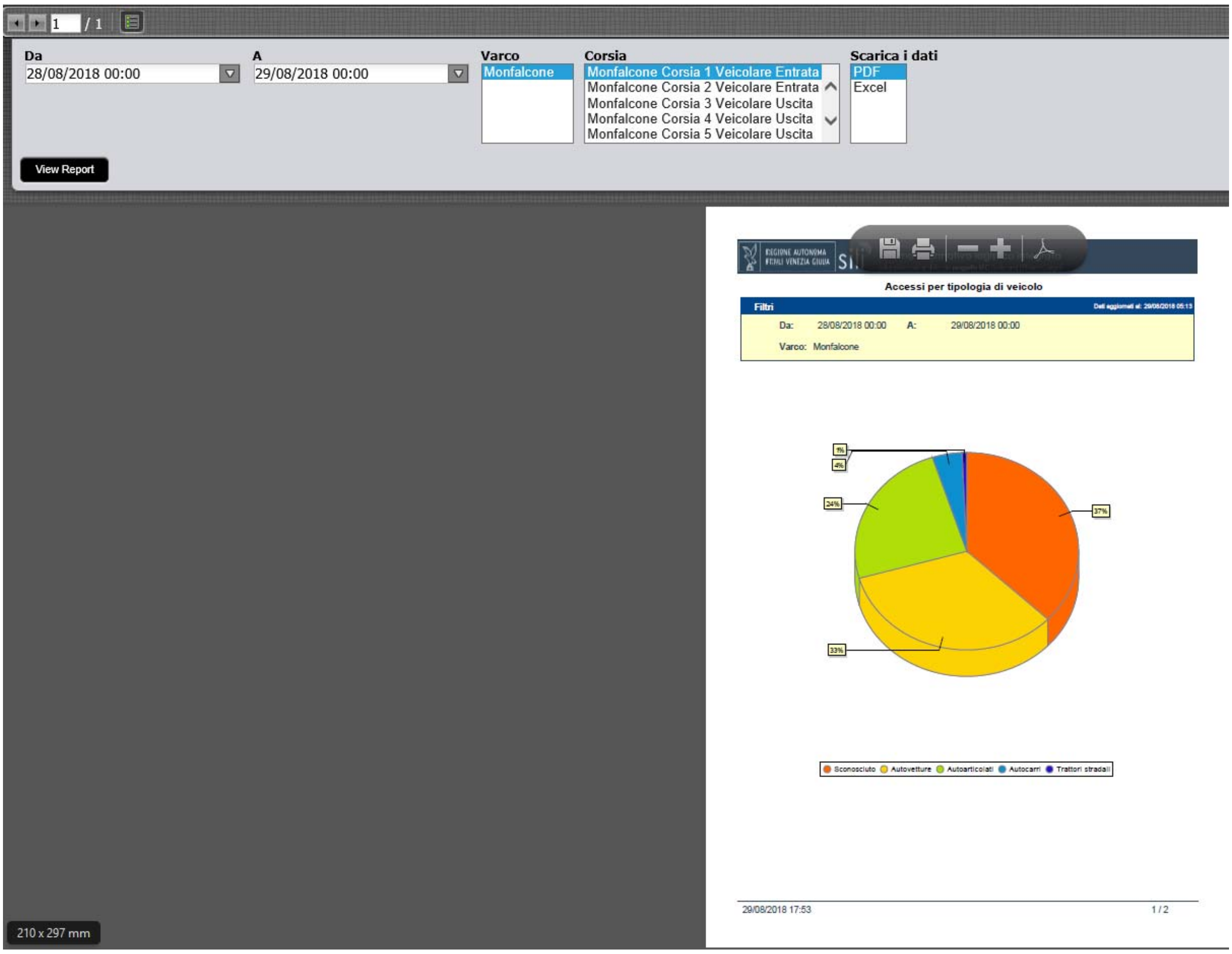


Figure 22. Results of SILI currently available at Port of Monfalcone

At the moment SILI system is not available for SDAG.

5.1.3.4. Data availability

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

- Number of passages
- Passages classified for nationality
- average number of passages classified for 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.

5.1.3.5. 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.

5.1.4. Expectations about PIXEL

The use case of the Monfalcone Port consists is taking advantage from PIXEL solution in order to handle the freight traffic in urban and surrounding area, through the creation of a network based on IoT platform to share data and make interoperable different type of information system and sensoring. The final result of the use case is to understand and measure the benefit coming from new model of logistic solutions and the related impact on the environment.

The Monfalcone Port use-case aims to implement PIXEL to allow a shared management of the traffic, by:

(i) Sharing the requests to access to the port with SDAG, in order to distribute the vehicle among Monfalcone and SDAG premises.
(ii) Using sensor to know the availability in the parking area of the Port
(iii) Managing the accesses to the port based on the days of the week, triggering the use of the SDAG premises;
(iv) Detecting and forecasting peak of traffic that could create congestion in the port and urban areas and address it to dedicated services area or to the railway transport;
(v) Monitoring and mitigating risks deriving from dangerous goods transport by implementing specific parking areas;
(vi) Integrating an infrastructure to monitor road and railway traffic;
(vii) Applying all data to predictive algorithms in order to simulate the impact on the environment of a shared traffic management; such as: CO2 impact in the urban area, road traffic and related accidents, waste disposal costs, urban mobility planning.

5.2. Summary of the use case

5.2.1. Improvements / problems to be solved for the port

Despite of the efforts and investments of FVG region, a regional logistic platform is still missing; ports and inland ports haven't a joint coordination and this means issues that must be solved.

5.2.1.1. Lack of common services

Despite the area of the Friuli Venezia Giulia Region is not much extended and the freight traffic influence the functioning of the regional ports and interport operators such as Monfalcone Port 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 compare to the services demand.

5.2.1.2. 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 not 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 happen in each regional organization.

5.2.1.3. Congestions in port areas due to the presence of high numbers of trucks, 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 congestions event 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. In this way, when the port receives a lot of service request that generate a lot of traffic in the port area can redirect these calls to other regional structures.

5.2.1.4. Reduced use of rail and inland-ports services

The incomplete monitoring system of the freight traffic in the Friuli Venezia Giulia 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 highest 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 toward multimodal transport, in particular railway, and improving the services provided to the truck drivers using all regional resources such as inland port service provider.

5.2.1.5. Environmental and security risks: congestion and lack of monitoring activities on ADR (Dangerous goods) flows

The ADR 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 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 address the truck toward another way. So, a more detailed and shared ADR traffic data could help the traffic forecast and to improve the management of this transport.

5.2.2. Objectives of the use case

The objectives of the Use Case of the Port of Monfalcone are the following:

- Data sharing between port of Monfalcone and SDAG to reduce bottlenecks and congestions in port areas and to promote the use of railways where necessary
- Reinforce the security related to ADR transport through the operability of data with regional stakeholders and in connection with SILI project
- Collect data on Regional logistic flows to support the activities of the Regional Environment and Health Observatory
- Collect and analyse data on Regional logistic flows to support the activities of the Regional Government to evaluate specific programs to promote rail logistic solutions as well as the implementation/expansion of other logistic infrastructures

5.2.3. Overview

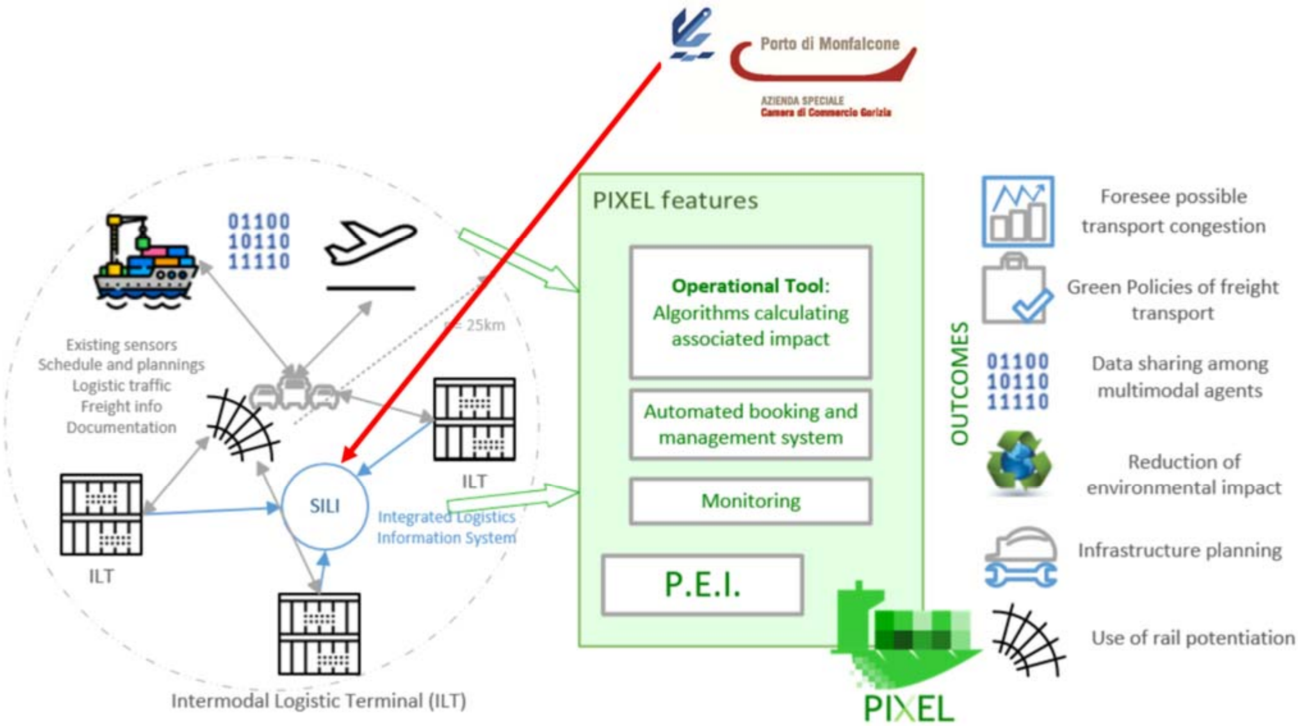


Figure 23. Port of Monfalcone use-case overview

The technical implementation of PIXEL in the Port of Monfalcone will be carried on by adopting the following key technologies:

- ICT infrastructure for data sharing
- IoT solutions to manage automated booking and re-routing systems
- Algorithms calculating impact and predictive algorithms
- Integrating SILI monitoring system with PIXEL

5.2.4. Expected impacts

The use case expects several relevant impacts:

- On health and environment thanks to:

  - Monitoring and re-routing of dangerous goods
  - Provision of data to improve the correlation between air pollution and specific diseases
  - Reduction of CO2 emissions and acoustic pollution in port surrounding areas
- On port operations/port managing by
  - Providing a better distribution of the waste costs
  - Developing "on-time" and "on -demand" logistic integrated services
- On regional management thanks to:
  - Better road planning to reduce urban and extra urban traffic
  - Regionals joint planning and managing of flows towards and from port areas
  - Joint spatial planning with a reduction of land consumption;
  - Integration between multimodal services automatically triggering and monitoring rail services.

5.2.5. Use case KPIs

Regarding the KPIs expected to reach within PIXEL in this use-case, is worth to mention that the following figures (in Table 5) are only a rough estimation considering we are still in month 4 of the project. Data has been extrapolated from the first established goals (during proposal) and adjusted to current reality. The impacts have been more detailed textually, but the final figures are still being evaluated by the teams. These estimations will be finally described and particularized for the next deliverable (D3.4).

Table 5. Port of Monfalcone 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	2680 T	The project should help to both monitor and reduce this indicator.
	Fine particles emission (NOx, SOx…)	Not measured	-
	Rate of renewable energy in the energy mix of the port	None	Implement through PIXEL and PEI measures to improve
	Environmental leadership (Green Marine Indicator)	1	4-5, for the global PIXEL project outcome
	PEI adoption	-	2
	PEI improvement	-	-
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	It will depend on the PIXEL implementation, but enough to achieve the objectives
	Number of types of data (sensors) connected to the local IoT platform	0	5 (tidal level, energy consumption, weather, wind speed, air quality)???
	Number of end-users	0	50

5.3. Detailed description of the Use case

5.3.1. Common works

5.3.1.1. Evaluating the current situation of the port

Like all the use cases, the use case of the Port of Monfalcone will start by evaluating the current situation and, to do so, by filling the following questionnaires:

- **environmental maturity of the port**
- **modelling and data analysis**

5.3.1.2. Enabling the IoT platform

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

5.3.2. Specific actions of the use case

5.3.2.1. Definition of scenarios

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 scenarios described in this section. In the following picture the general scenario of the Port of Monfalcone use-case is depicted:

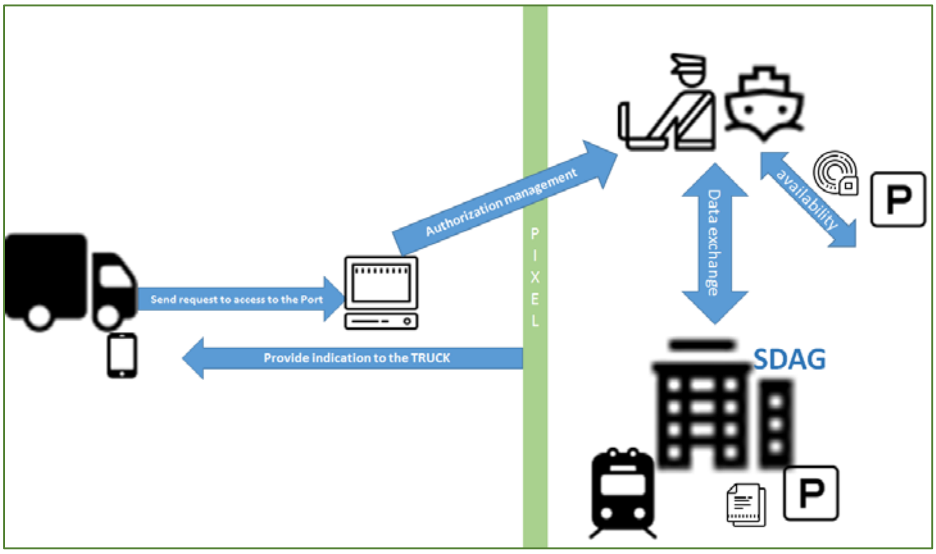


Figure 24. Port of Monfalcone general scenario

- If the trucks entering to the Port are not registered with the annual permit yet, it needs to be authorized by the SILI system.
- The 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.
- 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.
- The model to be developed will have the aim to re-route the trucks toward SDAG or trigger an automated re-routing with different logistic solutions in the case of serious congestions.

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

1) the parking area of Monfalcone is free, the carrier receives the authorization to access to the port area
2) 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 address the truck toward an alternative solution avoiding the congestion of the port and of the surrounding area. At the same time the information is shared with other truck companies already authorized propose analogue solutions
3) the truck is intercepted in order to understand what are its needs and it is addressed towards different terminal in the regional territory and/or toward intermodal transport triggering the use of the railway.

5.3.2.2. Equipment purchasing

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 25. Monfalcone parking area

5.3.2.3. Integration of systems

The main integrations detected are between SILI system (integrated with parking sensors) and PIXEL platforms.

The type of interaction are:

- Applicant (truck driver/carrier) 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
- SILI system (evolved by PIXEL) suggests the best modal transport (railway or road transport) and the possible parking area.
- Applicant/truck driver is intercepted by an app and receive indications.

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

- o if there is availability 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

- 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.

5.3.2.4. Implementation of PEI

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.

5.3.2.5. End-user results expected

The main result expected is to minimize the congestion in the port area. Common end users, mainly truck companies and agencies, will benefit from minor congestion in terms of time, fuel consumption and from a better planning of the logistic solution to be used. 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.

5.3.3. Actors and interactions

The actors involved are:

1) 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
2) Public authorities working at Port of Monfalcone: they interact with ASPM, shipping companies located within the Port and ASPM
3) Shipping companies located within the Port of Monfalcone: they interact with ASPM, shipping companies located within the Port and ASPM and carriers/drivers to arrange for loading/unloading operations
4) Rail operators: they interact with drivers/carriers and SDAG to arrange for shuttle-rail services
5) Road network managers: they interact directly with PIXEL platform to provide data about congestions
6) FVG Region and Environment and Health Observatory: they interact directly with ASPM, SDAG and PIXEL platform to analyse the data collected referring to environment

5.3.4. Use Case constraints (pre-conditions)

The use case involves many actors along the whole supply chain: carriers directed to the port (mainly located in non-EU countries), road infrastructure managers, municipalities, port authorities, port and inland port terminal operators, shipping companies. So it is necessary to clearly identify the benefits for each of them to ensure their participation.

6. Use case of Port of Piraeus

6.1. Context conditions

6.1.1. Economic, geographical and urban 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.

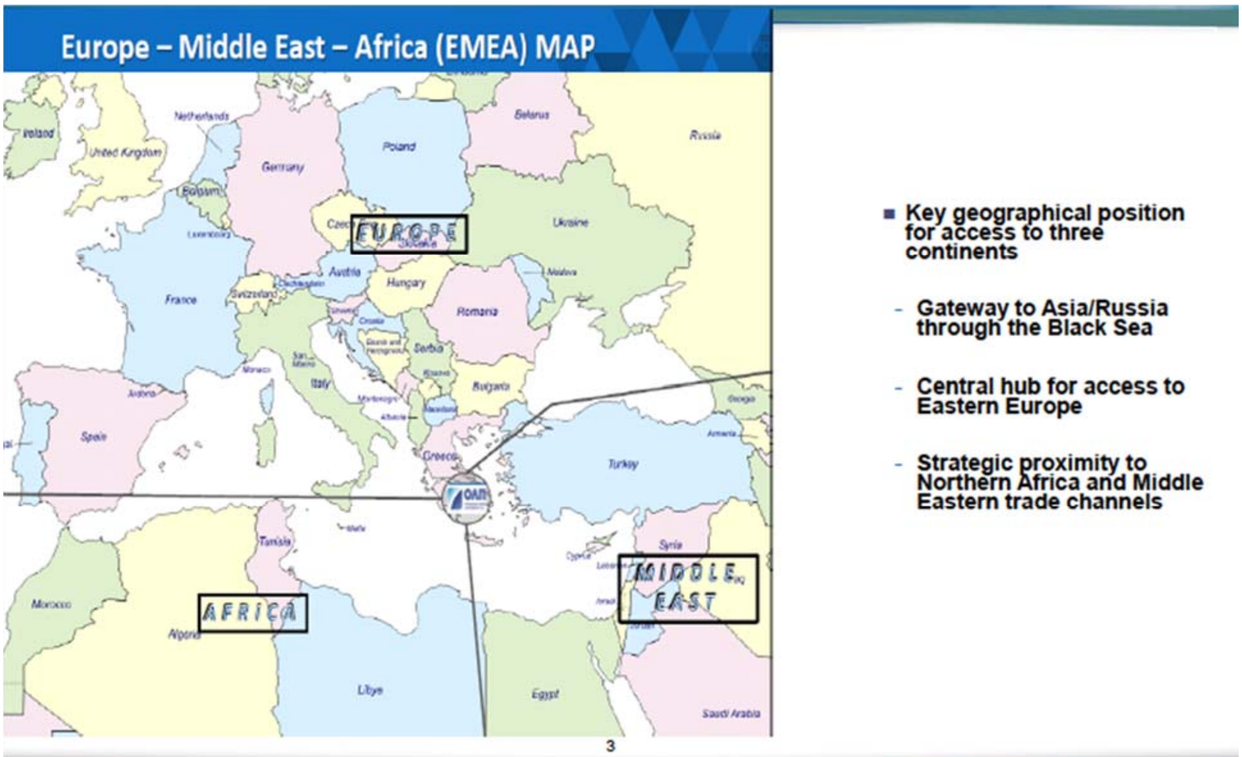


Figure 26. Geographical situation Port of Piraeus

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.

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.

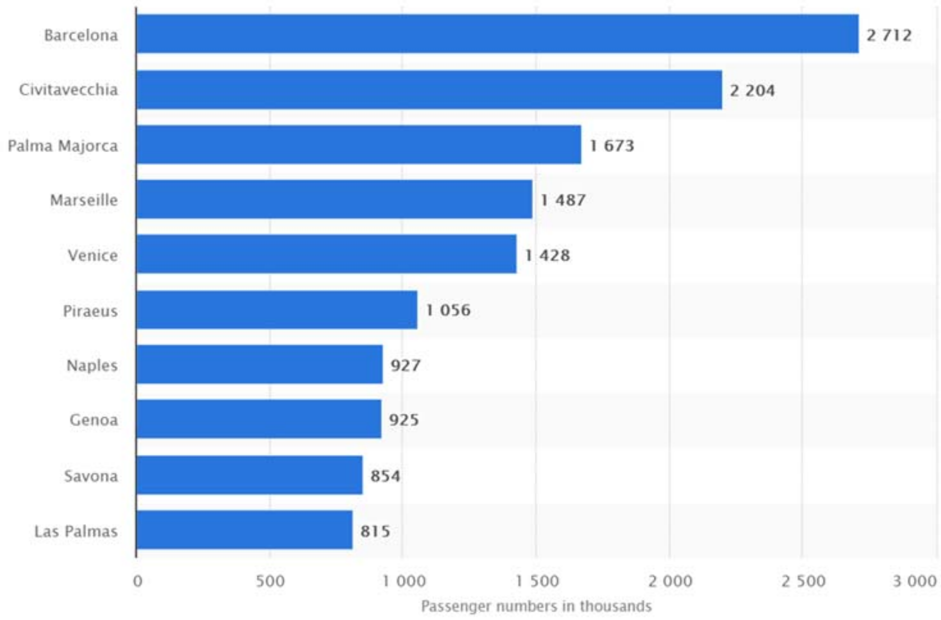


Figure 27. Most passenger-volume European ports 2017

6.1.2. Regulatory context

6.1.2.1. Legal status of the port

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.

6.1.2.2. Local regulations

PPA has adopted the national and European environmental legislation and standards

Regulatory drivers:

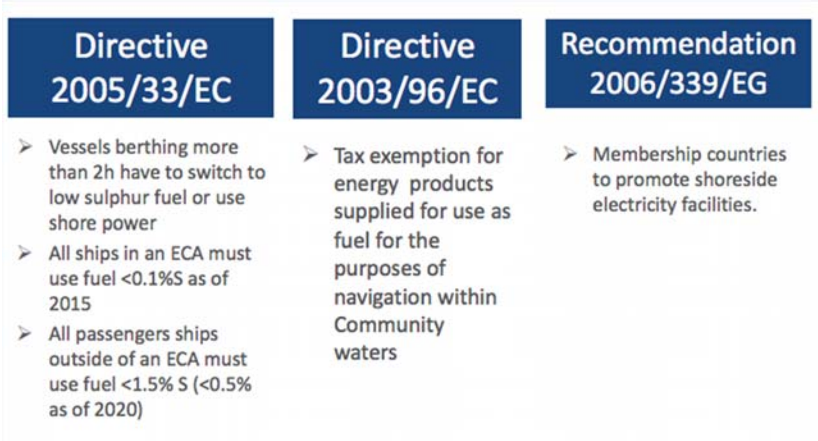


Figure 28. Regulatory drivers affecting Piraeus Port

Directive 2014/94/EC:

Alternative Fuel: A minimum infrastructure to be implemented through national policy frameworks along the TEN-T corridor for:

- Electricity
- Liquefied Natural Gas (LNG)
- Compressed Natural Gas (CNG)
- Hydrogen

National initiatives for alternative fuels:

National Framework for Alternative Fuel Infrastructures developed by the Ministry of Transport aimed to define and specify the required implementation rules and technical specifications of the National Policy Framework for the development of the alternative infrastructure market fuels in the transport sector and implementation of the relevant infrastructure. (Legisl. 77226/1-31/10/2017)

Figure 29. Alternative fuels regulation

6.1.3. Technical context

6.1.3.1. Premises & infrastructure

The Piraeus Port area map is shown in the figure below exhibiting the port terminal locations

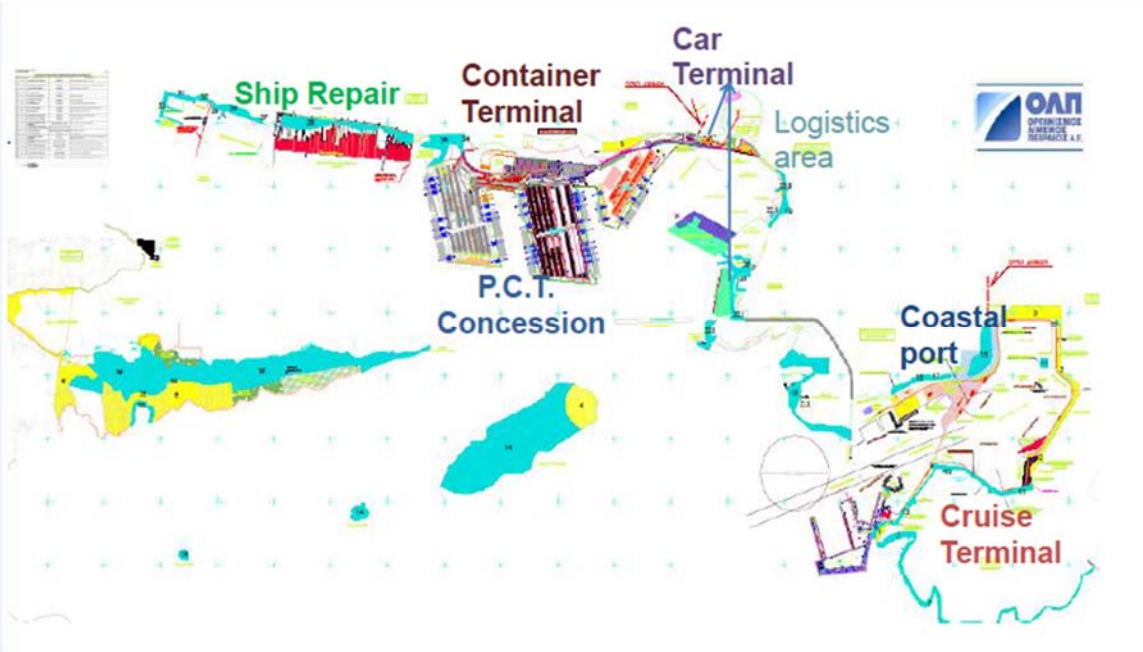


Figure 30. Piraeus Port premises

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 center 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

6.1.3.2. Sensors and existing networks

The network infrastructure currently available at the Port of Piraeus and its surroundings is depicted in the following figure:

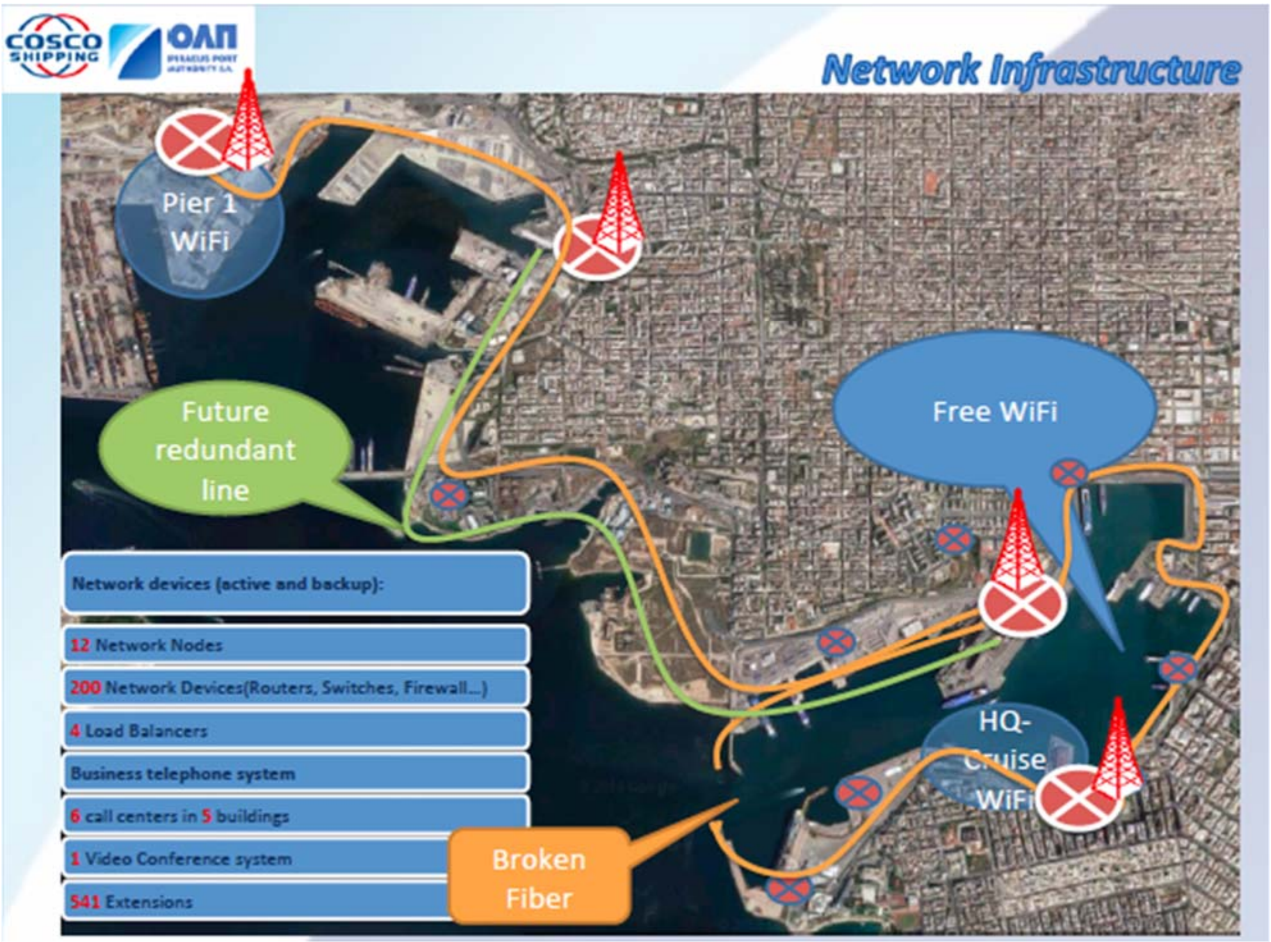


Figure 31. Port of Piraeus network infrastructure

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.

Air quality

The PPA SA has an air quality station installed in the port's N-NW zone (next to the passenger and cruise ship terminal), which is used to control air quality, in collaboration with the 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 32. The Air Quality Monitoring Station in PPA SA port area.

In order to implement this monitoring program, an Air Quality Monitoring Station has been installed in the N-NW area of the Central Piraeus Port (Passenger and Cruise Terminals), in collaboration with the National Technical University of Athens (NTUA - School of Chemical Engineers), fully equipped for the inventory of air pollutants' concentrations on 24 hour basis. The aim is, by assessing the monitoring station inventories, to result in useful information about the levels and distribution of air pollutants in the atmosphere, as well as to identify the main air pollutant sources.

Noise quality

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.

Water quality

In collaboration with the University of Piraeus (Greece) and the University of Cardiff (UK), PPA SA implements a water quality monitoring program. Twice a year (for the last 10 years), the water and the sediments are analysed in different parts of the port (between 38 and 40 sampling points). The parameters analyzed are: pH, turbidity, salinity, BOD, COD, enterococci, E. coli, total coliforms, TDS, and heavy metals.

Figure 33. Noise measurements at PPA SA container stevedoring area

Waste management

In relation to waste management, the PPA SA has a waste management system for the collection and management of waste generated in offices, workshops, passenger terminals, warehouses, etc., which is operated in collaboration with companies responsible for the collection (approved by the competent authority). In addition, the PPA SA is equipped with facilities for the reception of waste from ships (MARPOL I, II, III, IV, V, and VI) for all types of ships and with 24-hour availability. An innovative technology has been implemented in the cruise terminal for the reception of sewage from ships. By means of this system, the cruise ships discharge their wastewater directly to a network connected to the municipal sewer system, via which it is directed to the wastewater treatment plant in Athens (located in Psittallia). This enables savings in unloading times for the cruise ships, as well as savings in energy and fuel, which in turn give rise to reductions in atmospheric emissions and truck traffic (the unloading was previously carried out by tankers).

6.1.3.3. ICT systems

The PPA ICT system consists of the Port Management Information System (PMIS). The PPA ICT system consists of the Port Management Information System. 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 34. 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 physical operational procedures are rather complex (see Figure 1) and requires extensive information flows. The associated operational environment incorporates numerous management activities that can be distinguished into three groups:

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.

The PMIS consists of the following software/hardware:

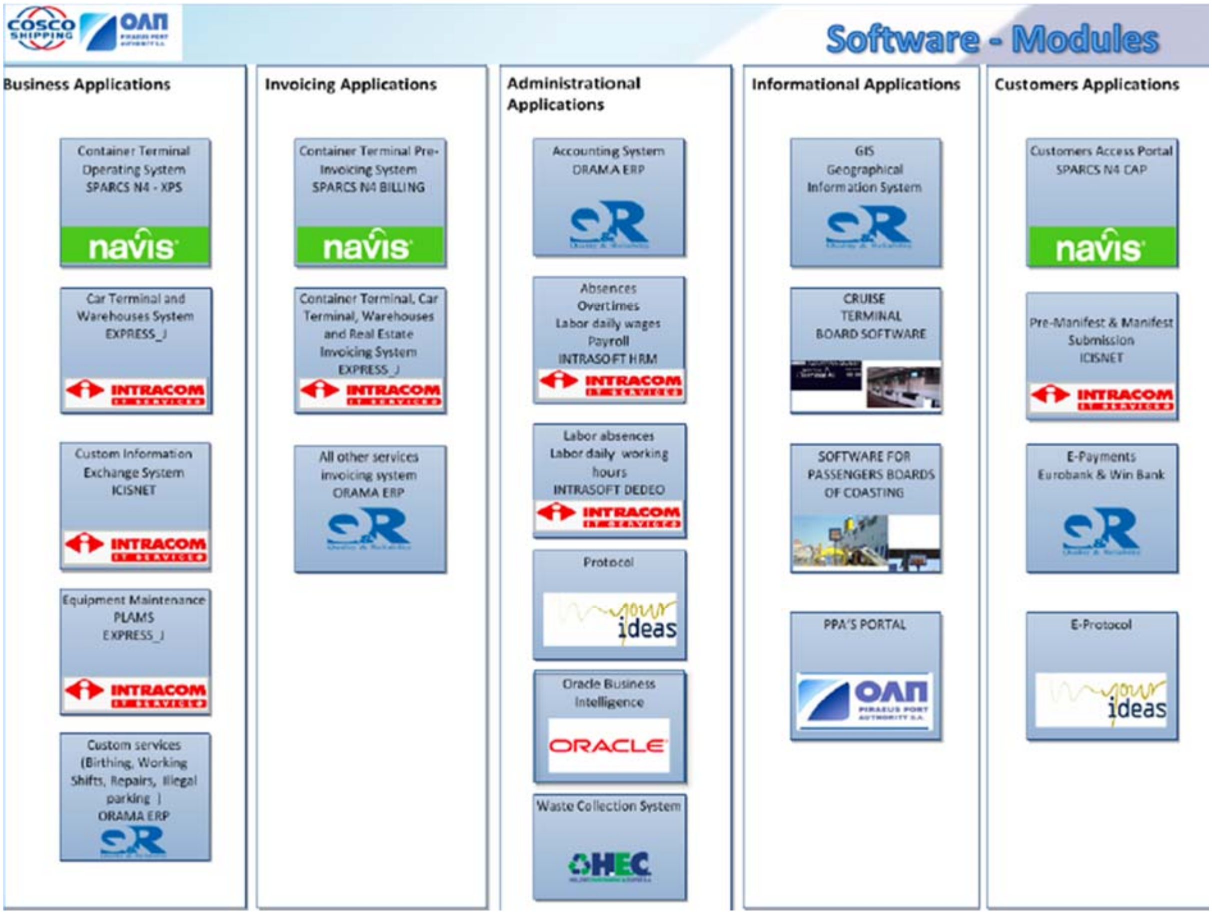


Figure 35. Port of Piraeus PMIS' features (1) - Application

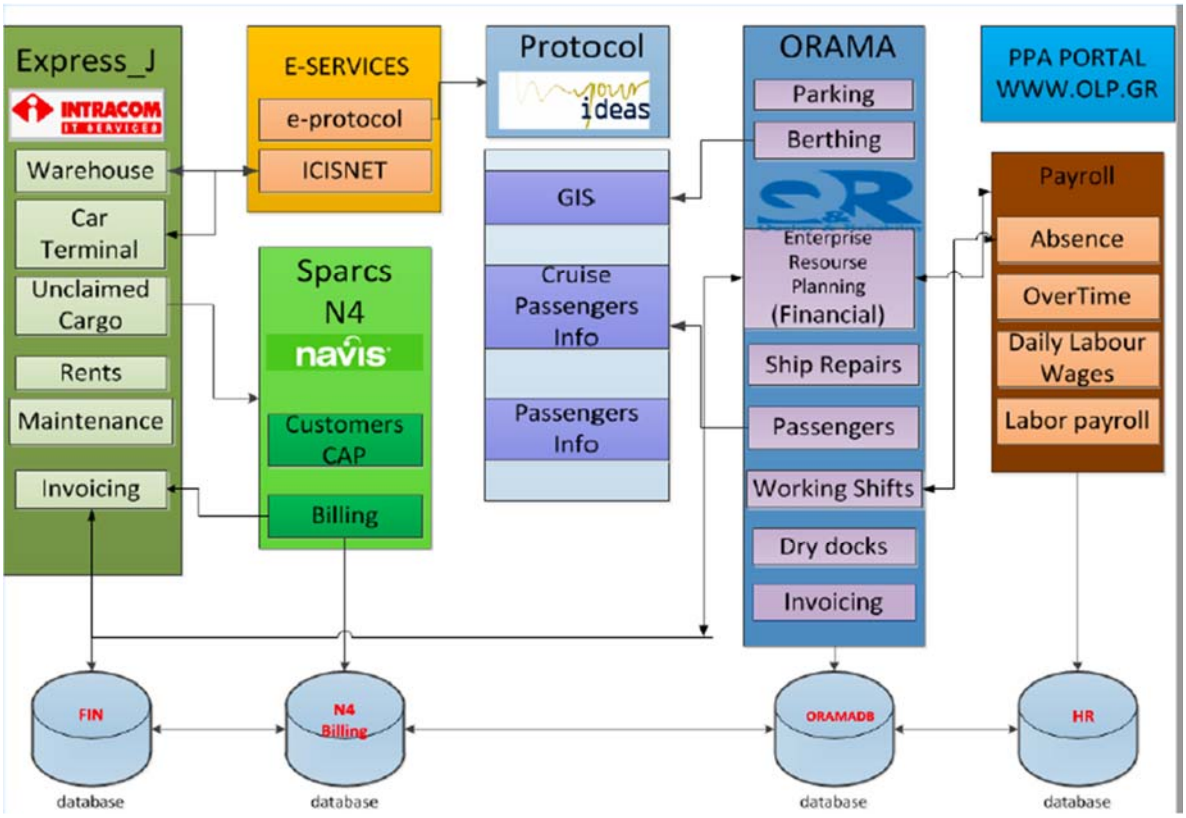


Figure 36. Port of Piraeus PMIS' features (2) – Systems and services

The associated 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.

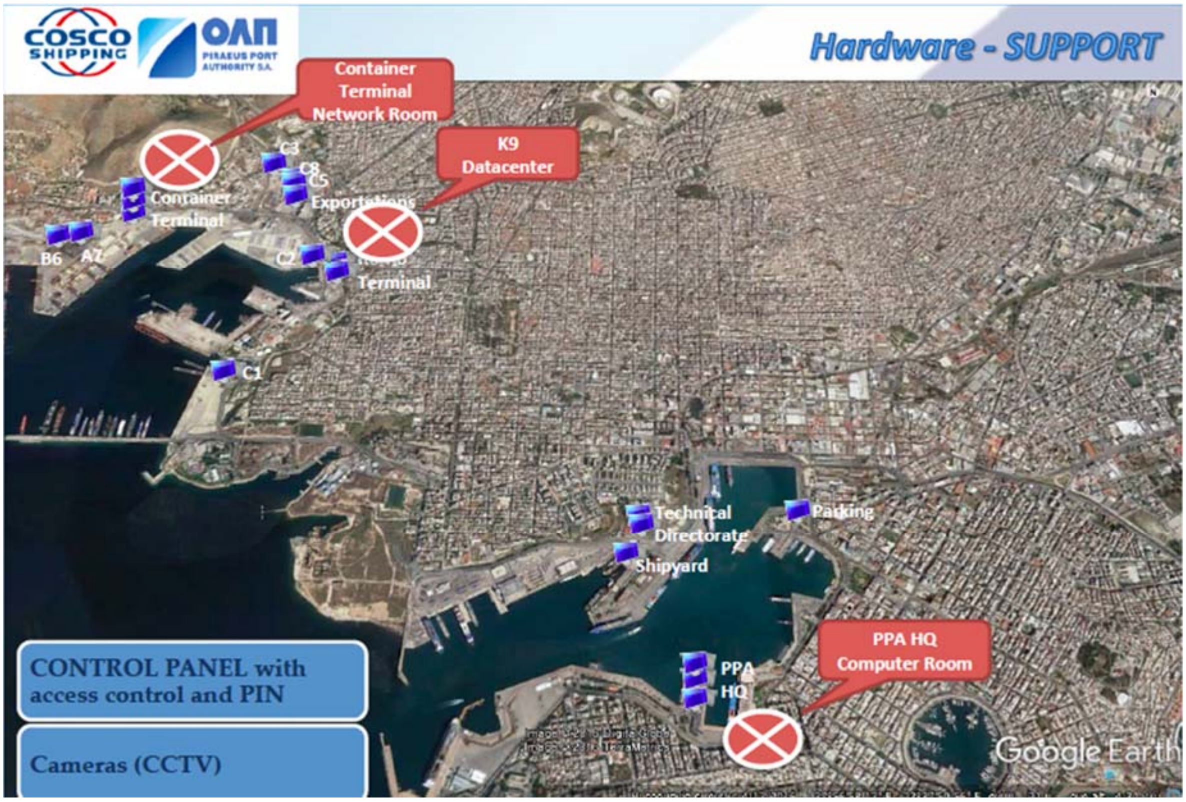


Figure 37. Port of Piraeus PMIS' features (3) – Hardware support

6.1.3.4. Data availability

Data is maintained in a network of more than 100 servers

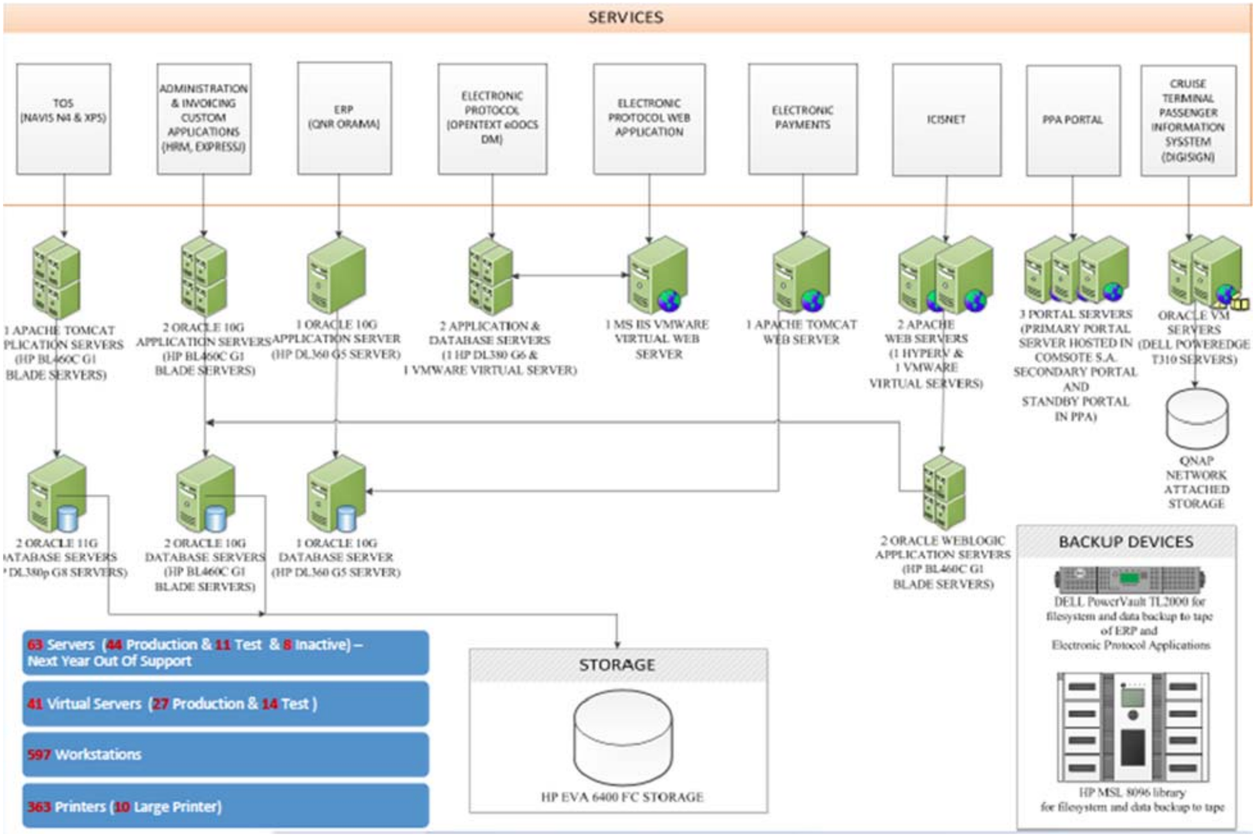


Figure 38. Server and storage structure in Port of Piraeus network

The general principles that guide the Architecture Design of the 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 achieve 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.

The proposed physical architecture for PIXEL consists of the three clusters, SAN, as well as their backup and interconnections with FC network connections and are shown in the following figure:

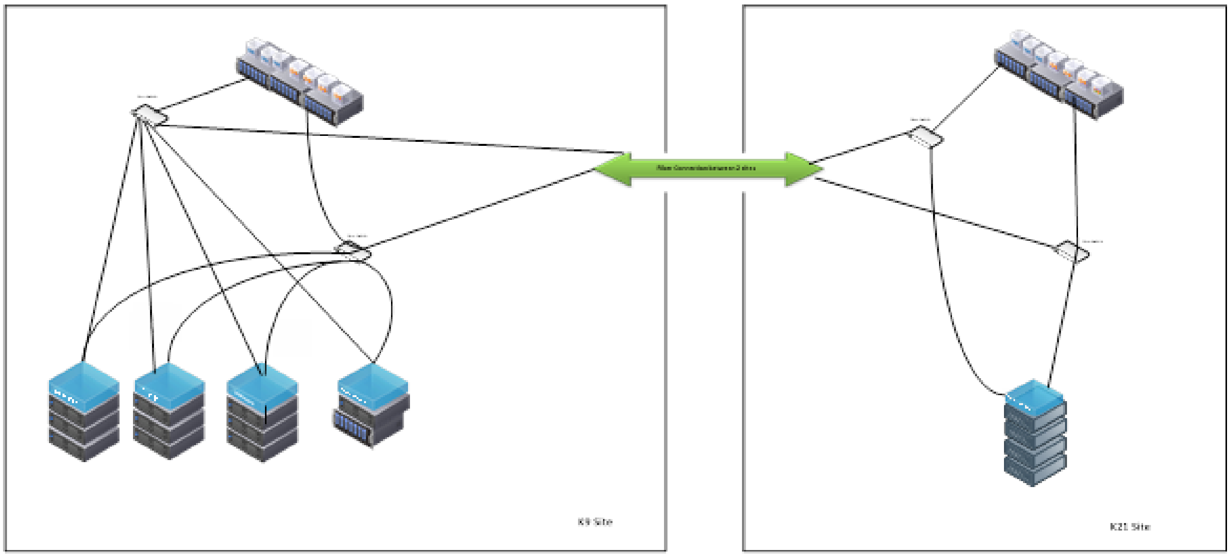


Figure 39. PPA's proposed ICT physical architecture

Three distinct clusters are implemented as follows:

- **Cluster 1** refers to the Oracle databases of the company and specifically to the databases of NAVIS, Express_J, HRM and Orama ERP applications, namely DBFIN01, DBFIN02, DBN4A, DBN4B and ORAMADB. It is emphasized that these databases will not move into a virtual environment. These databases remain on physical servers. As it can be seen from the current status of PPA, at present NAVIS databases (DBN4A and DBN4B) are installed in a high-availability environment by utilizing Oracle RAC 11g.In the context of the Project, the Contractor will undertake the consolidation of DBFIN01, DBFIN02, DBN4A, DBN4B and ORAMADB RDBMS on Oracle RAC 12c Grid Infrastructure.
  Functionally through consolidation the following should be achieved:
  - All applications can be served by all nodes of the cluster infrastructure at any time without requiring the use of multiple different database servers.
  - Load balancing. It should be possible for the new user to connect to the cluster node with the least load.
  - In the case of a large process that requires lots of resources to share the load on all nodes of the cluster.
  - When adding new nodes to the cluster, changes / interventions to the applications, the database schema, or the business logic code should not be required. The new nodes that are added to the cluster architecture become active and directly participate in serving the load of existing applications without requiring any change in the code / enterprise logic of the applications and the database schema.

  A total of **24 core and 1536GB of RAM** are required to implement the database cluster. Detailed technical specifications for the required servers are presented in the following paragraphs:
- **Cluster 2** will include the Oracle Application servers and the test of Oracle environments. These systems will go to the latest version of virtualization environment. This cluster will consist of at least 60 cores and 1536 GB of RAM.
- **Cluster 3** includes the rest servers of PPA, after their transfer to the latest version of ESXi VMWare virtualized platform This cluster will consist of at least 84 cores and 1536 GB RAM.
  - Storage Area Network including two flash technology storage systems with 39.2 TB usefull capacity and synchronous replication, located in two different Data Rooms. The SAN also includes two FC Switches on each site. The two SANs will be directly connected with dedicated fiber optics.
  - Backup System includes one tape library and a backup server with adequate internal storage for backup to disk

6.1.3.5. Environmental management

PPA provides high quality, efficient and safe port services and contributes to local and national economy by achieving sustainable growth. It provides the link between the Greek islands and the mainland and with its ongoing investment plan aims to be established as the most important HUB, Logistics, Cruise, Container and RoRo center in the East Mediterranean. PPA applies an Integrated Quality & Environmental Management System in compliance with the requirements of the ISO 9001:2015 and ISO 14001:2015 standards and is fully committed to meet its customers' needs and expectations, prevent pollution and mitigate any adverse impact the port operations may have on the environment, fulfil its compliance obligations and enhance the effectiveness of the applied Integrated Quality & Environmental System. PPA's main objective is to continuously improve the standards of services provided along with the environmental performance.

PPA has achieved an ''EcoPorts port'' status and has joined the Ecoports network (www.ecoports.com). The Ecoports network consists of European ports that have self-assessed their environmental performance, according to the ESPO (European Sea Ports Organization) methodology, Ecoport Self Diagnosis Method (SDM). The assessment criteria have been established by ESPO, based on the European port sector benchmark of environmental performance and the main requirements of international environmental standards, such as ISO 14001 and PERS (Port Environmental Review System). Ecoports network partners are European ports with a diversity of activities and size, whereas Piraeus Port consists the biggest Mediterranean Port among the partners of the network.

The Environmental Management Standard that PPA implements, has been certified since 2004, according to the European Environmental Management System PERS (Port Environmental Review System) of ESPO. Being developed by ESPO for ports, PERS is a well-established Environmental Management Standard within the European port sector, designed to deliver effective port environmental management, whereas the organization of the environmental management system according to the PERS requirements is certified by the independent certification authority of Lloyd's Register.

In 2017, PPA has been recertified (for the fifth time since 2004) for the implementation of the Environmental Management System in line with the principles and the requirements of the revised edition of PERS (version 5). In the framework of PERS, PPA has elaborated and implements a specific Environmental Policy, whereas is in a continuous process for the registration of the environmental aspects related to its port activities and seeks for the continuous improvement of its environmental performance, according to European and international standards, in order to protect the environment and preserve the natural resources for future generations.

6.1.4. Expectations about PIXEL

Framed in achieving the new port concept in a very efficient way, PPA aims these PIXEL advantages to be developed:

(i) capacity of the solution to suppose an improvement of the access to the seaport,
(ii) make use of PIXEL to the mitigation of traffic-related impacts on the environment,
(iii) to facilitate transport intramodality in passenger traffic
(iv) incorporate innovative methods to overcome bottlenecks in the transportation network creation of a positive awareness of sustainable transportation methods and
(v) to incorporate new methodology for mobility planning and management for small ports.

6.2. Summary of the use case

6.2.1. Improvements / problems to be solved for the 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 data providers to publish real time data, and policy makers to exercise control over the perspective of the mobility in a city or small region. 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.

Open and Linked Data Publishing: The PIXEL solution 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). Such data will become available via the PIXEL solution, enabling their access via appropriate APIs. Value Added Services: The stakeholders will use PIXEL value added services 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 in real time changes in the mobility context due to city events via the real-time status detection services
- ingest transportation means routes status and locations via by the PIXEL Operational Tools
- 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

6.2.2. Objectives of the use case

The Port of Piraeus 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. PIXEL will lead PPA to: efficiently implement sustainable, cost-effective an environmentally friendly measures regarding transport demand around port area and mobility. On the other hand, Port-City use-case's contribution to PIXEL is enable Information Hub to be used to integrate data from different transport planning systems (port, road and train), IoT-enabled city and port services to improve synchronization of mobility services and improve the awareness of the general public.

A list of the objectives and improvements that PPA relies on this use-case is the following:

- Allow for time window based deliveries in cruising logistics, saving > 20% of waiting time by eliminating jams, shortening waiting port queues etc.
- Reduce GHG by means of rationalizing the traffic in big cities (Piraeus, Athens) ca. 5% when fully deployed.
- Perform real time re-routing by city traffic events or accidents, 100% in vehicles connected to PIXEL platform.
- Reduce man-efforts to manage last mile deliveries, 10-15% of time saved for personnel.
- Reduce energy waste by 10-15% due to better SC planning and execution in city.

Additionally, PPA will deliver a complete solution to all actors in city logistics and multimodal transport, letting them to engage and receive significant advantages, such as the reduction of costs and GHG, improved transportation and city traffic, and more efficient use of logistics resources and of the port's facilities. Furthermore, PPA will:

- Enhance visibility and awareness through PIXEL platform advanced monitoring tools.

- Reduce accident risks offering a seamless perception of logistics to vehicle drivers.
- Improve collaboration and logistics operators with the City and authorities.

6.2.3. Overview

The port city integration use case approach for PPA will focus in passengers.

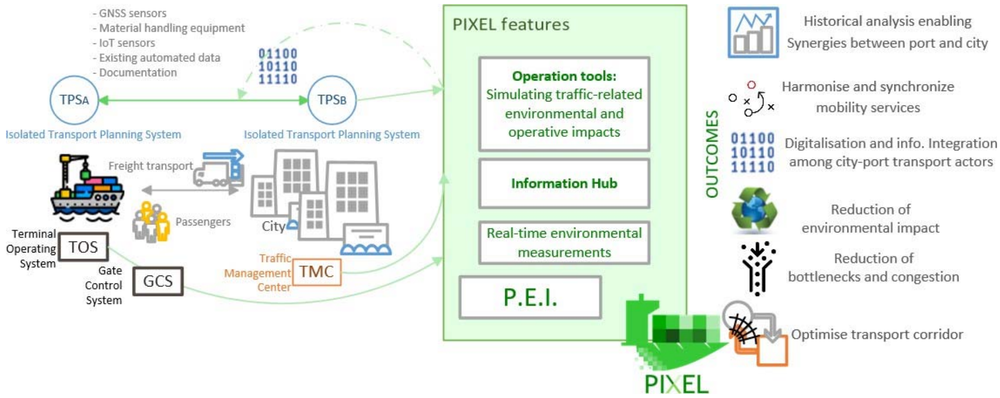


Figure 40. PPA use case overview

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.

This use case will follow the ITU Smart Sustainable Cities approach to expand the concepts to the particular case of the Port Cities, bringing all the benefits of this wide community and extending the scope to the ports and port-city relation.

6.2.4. Expected impacts

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 given in the next section will be applied in the PPA pilot case to collect and analyse data using the assigned measurable indicators (KPIs). A simulation environment will be used for configuring the different models to be tested in the LLs (alternative what if? operational scenarios). The KPIs and measurements will in turn be linked to the PIXEL interventions in the LLs, which will be serving as showcases for the project KPIs. The data for analysis of impact, in addition to traditional techniques, as surveys, questionnaires etc. will be gathered, cleansed and integrated via the 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. PIXEL will support improvements across the entire supply chain up to the online customer's home. Depending on the specific context, there are different opportunities for PIXEL enabled innovative

The outcome of the PIXEL project is expected to provide a reduction on the impact due to climate change and the environment of PPA port activities, their operational and infrastructural costs, improvement of logistics efficiency and better integration of the port in the surrounding socio-economic area, including city-port relations and the smart urban development of Port Cities. Furthermore, realisation of these activities and achieving this impact also will entail attention to environmental and climate-related concerns.

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

- Capacity of the solution to suppose an improvement of the access to the seaport,
- Make use of PIXEL to the mitigation of traffic-related impacts on the environment,

- To facilitate transport intramodality in passenger traffic
- Incorporate innovative methods to overcome bottlenecks in the transportation network creation of a positive awareness of sustainable transportation methods and
- to incorporate new methodology for mobility planning and management for small ports.

6.2.5. Use case KPIs

Regarding the KPIs expected to reach within PIXEL in this use-case, is worth to mention that the following figures (in Table 6) are only a rough estimation considering we are still in month 4 of the project. Data has been extrapolated from the first established goals (during proposal) and adjusted to current reality. The impacts have been more detailed textually, but the final figures are still being evaluated by the teams. These estimations will be finally described and particularized for the next deliverable (D3.4).

Table 6. Port of Piraeus 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	108300 T, to be recalculated	Reduction between 15 ~ 20 %
	Fine particles emission (NOx, SOx…)	To be calculated	Reduction between 15~ 20 %
	Rate of renewable energy in the energy mix of the port	5%	10%
	Environmental leadership (Green Marine Indicator)	1	4-5
	PEI adoption	Not measured	1
	PEI improvement	Not measured	Improvement 30 ~ 50 %
Local adoption of PIXEL solution	Local IoT platform implementation	No	yes
	Number of sensors / devices connected to the local IoT platform	0	It will depend on the PIXEL implementation, but enough to achieve the objectives
	Number of types of data (sensors) connected to the local IoT platform	0	Air quality, Meteorological data
	Number of end-users	0	15

6.3. Detailed description of the Use case

6.3.1. Common works

6.3.1.1. Evaluating the current situation of the port

Like all the use cases, the use case of the Port of Piraeus will start by evaluating the current situation and, to do so, by filling the following questionnaires:

- **environmental maturity of the port**

- **modelling and data analysis**

The current environmental situation of the Port of Piraeus is described in the PERS (Port Environmental Review System) of ESPO reporting documents.

6.3.1.2. 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 their existing and new clients. Furthermore, it will enable the development of simulation modelling tools for detailed analysis and predictions on passengers flows (per transport mode), including their emissions, port turnaround times, emissions in port operation;

6.3.2. Specific actions of the use case

6.3.2.1. Definition of scenarios

The PPA PIXEL use case scenario consists of the following steps

- 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.
- 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. Reviewing of the analysis of the port of Piraeus situation, the objectives of the MC and identification of the factors to achieve the expected result on improving key KPIs.
- 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.
- Deployment of the PEI to the PPA PIXEL MC: Data gathering, analysis of barriers to PEI implementation and corrective actions sought.
- Collaborating with other PIXEL pilots: Make the PPA pilot case experiences available to other PIXEL pilots.
- PPA pilot execution results generalization: Standardized reporting for the replicability of the PPA pilot case to other ports.
- MC impact assessment: Evaluation report on the technical performance, the investment and operational costs, the user acceptance, information security and robustness. The evaluation will utilize the PPA use case results
- Report on the Business & economic impact assessment: assessment elaboration of the impacts of the ICT solutions implemented within the PPA PIXEL pilot case

6.3.2.2. Equipment purchasing

4.500,00 euro would be required to purchase sensors that measure the air quality through the station that is installed in the port's N-NW zone (next to the passenger and cruise ship terminal), which is used to control air quality. This station continuously collects data on the concentrations of certain parameters (BTEX, CO NOx, SO_2, O_3, PM_{10})

6.3.2.3. Integration of systems

The integration of the PMIS of Port of Piraeus (NAVIS) 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 PIXEL platform. Data exchange protocols need to be defined and then implemented.

6.3.2.4. Implementation of PEI

In the use case the PPA will demonstrate how an environmental measurement, such as PEI, can rapidly build a system and a data network using the PIXEL platform, to enable information exchange for passengers and travellers and the planning of road itineraries, allowing both logistics providers and travellers to collaborate and to plan the despatching of orders and deliveries, maximizing the assets utilization and at the same time reducing emissions and costs.

6.3.2.5. End-user results expected

In this use-case, the first end user identified is the port itself. The main functional results expected from PIXEL by the port are:

1. Promote the synergies between PPA and the City of Piraeus in order to foster and implement sustainable mobility management's measures
2. Harmonize and synchronize mobility services in and around the port area terminals
3. Integration of digital information among the city-port and transport actors
4. Reduction of traffic generated environmental impact
5. Reduction of bottleneck and congestion in the greater port city Piraeus road system
6. Optimization of the transport corridor

In the next iteration of this document (deliverable D3.4 to be released in M9) will contain a more thorough analysis of possible end-users (directs and collateral) of PIXEL product in the context of this use-case.

6.3.3. Actors and interactions

The Actors are shown in the Figure 41:

The list of actors identified in a first stage for this use-case is :

- Piraeus Port Authority:
  - IT & BPS Department
  - Port Security, Safety & Environmental Protection Department
  - Strategic Planning and Marketing Department
  - Port Passenger Terminal
  - Port Cruise Terminal
- Ministry of Transport
- Ministry of Mercantile Marine
- Public transport companies
- The City of Piraeus

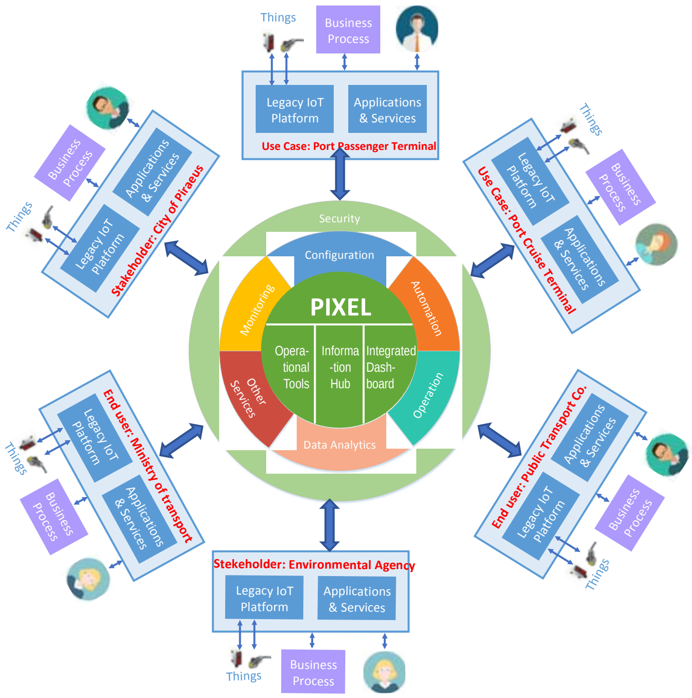


Figure 41. Port of Piraeus' actors and interactions

6.3.4. Use Case constraints (pre-conditions)

The use case involves many actors along the whole supply chain, so it is necessary to clearly identify the benefits for each of them to ensure their participation:

- From the different divisions of PPA:
  - Air quality -meteorological Sensor data access and availability
  - Data availability to the port PMIS networks
  - Coordination with the port departments
- From the public transport company:
  - Availability of data for the itineraries of transport means
- Ministry of Mercantile Marine
  - Ship arrival/departure data
- The City of Piraeus
  - Agreement on the development of Mobility Management synergies

7. Use case of the Port of Thessaloniki

7.1. Context conditions

7.1.1. Economic, geographical and urban context of the use case

Thessaloniki is the major port for northern Greece and is also the transit gateway for the southern Balkans. It is part of the Trans -European Core Transport Network. It 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. The terrestrial port zone of ThPA S.A. covers an area of 1.55 million sq. m. and extends along 3.5 km. The infrastructure includes 6 piers spreading on 6,200 meters of quays and berth depth up to 12 meters.

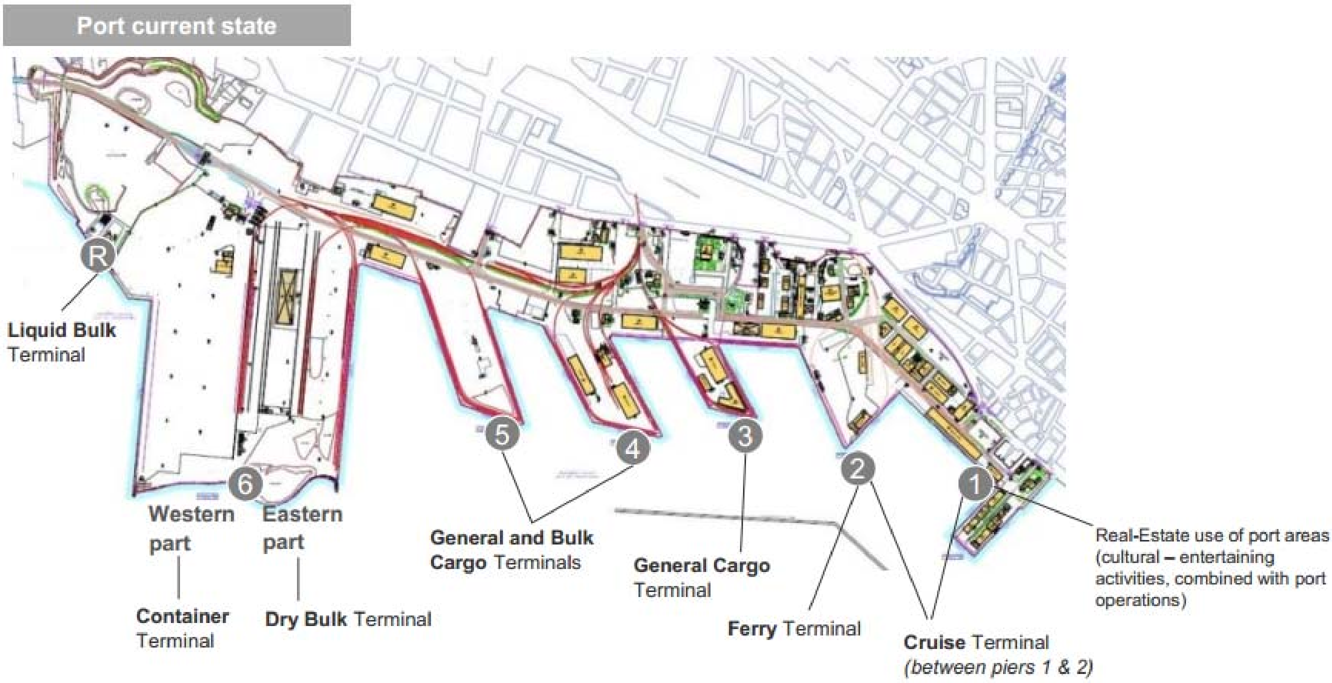


Figure 42. Port of Thessaloniki geographical situation

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 centre of the city of Thessaloniki. Approach of the ships is accomplished through a natural channel of substantial depth, not needing thus any further deepening.

The port enjoys a privileged position being located at the crossroad of land transportation networks, as follows: East to West (Egnatia Motorway), South to North (PATHE Motorway Patras-Athens-Thessaloniki-Evzoni or Idomeni) which continues towards the north, not only as an eastern corridor - Eastern Mediterranean, of the Central network of the Trans-European Transport Networks (TEN-T Core Networks Corridor Orient - East Med), but also as the pan-European route Ten X.

Figure 43. Port of Thessaloniki connections and situation

The port is located in the western part of the city. It is stretched from the western entrance of the city to its center. Moreover, it is located close to the industrial area and the logistic centers of the city. On a daily basis, more than 1.000 trucks and 6 vessels are served at the port of Thessaloniki.

7.1.2. Regulatory context

7.1.2.1. Legal status of the port

Thessaloniki Port Authority SA acts as

- **Administrator** of the Port of Thessaloniki, and
- **Provider of Integrated Port Services** within the Port of Thessaloniki

The State supervises all activity within the Port of Thessaloniki and all activities within the land and sea zone of the Port of Thessaloniki

In March 2018, the company "South Europe Gateway Thessaloniki (SEGT)", completed the acquisition of a shareholding of 67% of Thessaloniki Port Authority SA. SEGT is a consortium formed of three complementary companies:

- Deutche Investment Equity Partners, a German investment fund
- Terminal Link, an International Terminal Operator (a joint venture between CMA CGM Group and China Merchant Group)
- Beltera Investment Ltd, a strong investment company, investing in Northern Greece.

ThPA SA should ensure that all works commissioned by it and conducted within the Port of Thessaloniki

Comply with any and all

- applicable standards,
- specifications
- safety, security, environmental requirements

7.1.2.2. Local regulations

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 following regulations are of interest:

- 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 describes critical values for air quality.
- Governmental Decisions 37393/2028/29.2.2003 and 9272/471/12.3.2007 which includes critical values of noise.

7.1.3. Technical context

7.1.3.1. Premises & infrastructure

The Port Land Zone is the total of terrestrial (sheltered and outdoors) areas within the Port Area. By reference to the different operations and activities accommodated in the Port, ten distinct sectors of the Port Land Zone are identified. Five of which, from Pier 3 to Pier 6 accommodate the various port activities. The activities in these sectors will be analyzed in the PIXEL project.

7.1.3.2. Sensors and existing networks

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

Air Quality Monitoring Station

The sensoring equipment that is currently installed and functioning in the Port of Thessaloniki for the measurement of air quality are depicted in the next figures:

Figure 44. Air quality monitoring equipment in Thessaloniki (1)

Figure 45. Air quality monitoring equipment in Thessaloniki (2)

Table 7. 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

- 2 times a year (every 6 months) sea water sampling in 4 prefixed points.
- Measured variables: 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

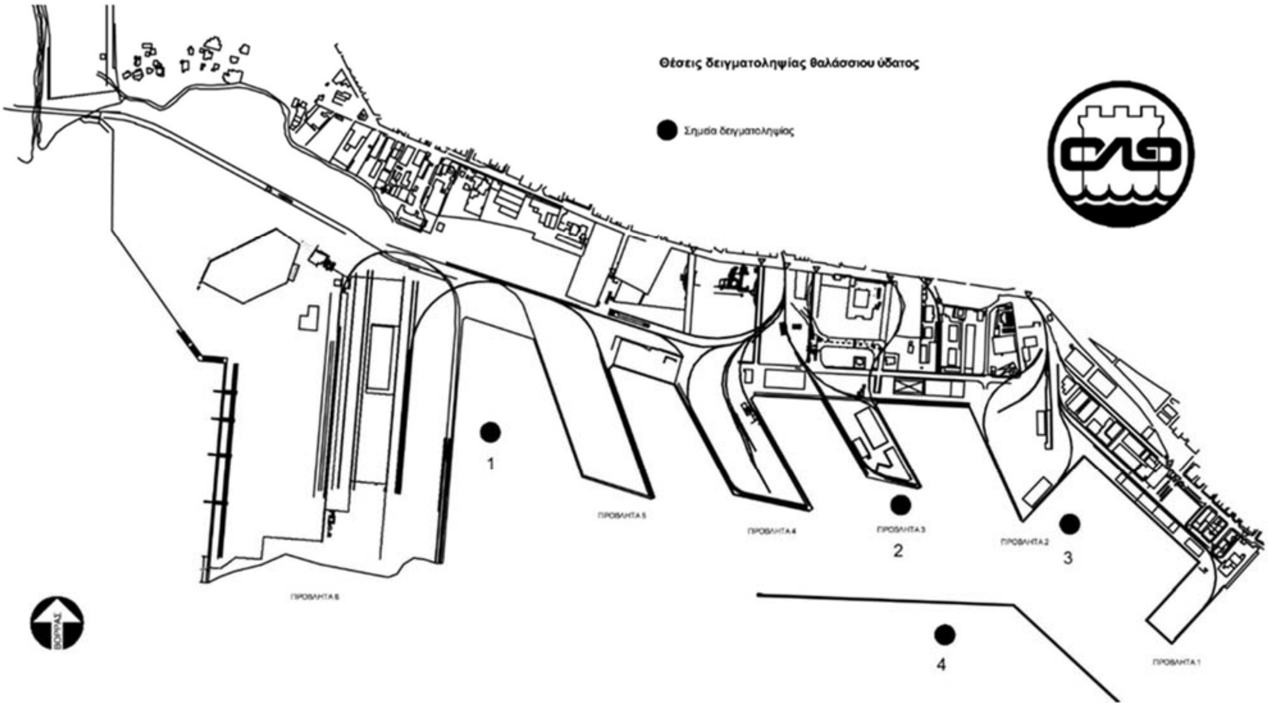


Figure 46. Port of Thessaloniki's Sea Water Quality Monitoring sensors

Noise Measurements

- Once a year in May - 24hour measurements in 10 prefixed points in the perimeter of the Port.
- Production of Noise Maps according to NoMEports - Noise Management in European Ports.

Figure 47. Port of Thessaloniki's Noise Measurements distribution map

The data of the above measurements complete the data obtained from the installed **weather station** and the **windmeter.**

7.1.3.3. ICT systems

Infrastructure Overview

- The available equipment is considered state-of-the art and is characterised by high performance and reliability.
- Computer equipment at ThPA SA is regularly updated.
- Two main computer rooms exist with the necessary supporting infrastructure.
- More than 15 buildings are connected with fiber optics cable using the latest equipment technology.
- Extended wireless network covers the container terminal.
- Virtualization infrastructure runs on physical servers.
- IP surveillance cameras of latest technology are in place
- Cameras 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.
- For Container operations a Terminal Operating System (FRETIS) is used.
- Other systems in place including EDMS (Electronic Document Management System), Human Resources Management, Statistics and Milestone VMS (Video Management Software) for surveillance cameras.
- Fuel management system
- 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.

7.1.3.4. 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:

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

Sample of data presented in web site (currently only in the Greek section) is depicted in the next figure:

Γενικά Στοιχεία Μεθόδου					
Αρχή δειγματοληψίας	01/03/2018		Διάρκεια δειγματοληψίας	31	days
Λήξη δειγματοληψίας	31/03/2018		Διακοπές / Διαλείμματα	-	days
Εκτέλεση δειγματοληψίας από:	-				

Ημερομηνία	PM10 24ώρη Μέτρηση	PM10 Ημερήσια οριακή τιμή	PM10 Valid	PM2.5 24ώρη Μέτρηση	PM2.5 Ημερήσια τιμή στόχος	PM2.5 Valid
	μgr/m³	μgr/m³		μgr/m³	μgr/m³	
01/03/2018	**101.5**	50	yes	**53.9**	25	yes
02/03/2018	**105.3**	50	yes	**70.6**	25	yes
03/03/2018	**58.5**	50	yes	**43.6**	25	yes
04/03/2018	**28.1**	50	yes	**11.6**	25	yes
05/03/2018	**48.3**	50	yes	**27.0**	25	yes
06/03/2018	**49.5**	50	yes	**32.0**	25	yes
07/03/2018	**72.0**	50	yes	**28.9**	25	yes
08/03/2018	**42.7**	50	yes	**13.0**	25	yes
09/03/2018	**40.4**	50	yes	**14.3**	25	yes

Figure 48. Sample of available data Port of Thessaloniki

Regarding live wind meter, data can be reached from the following URL: https://weather.thpa.gr/. And the result that can be currently observed is depicted in the next figure:

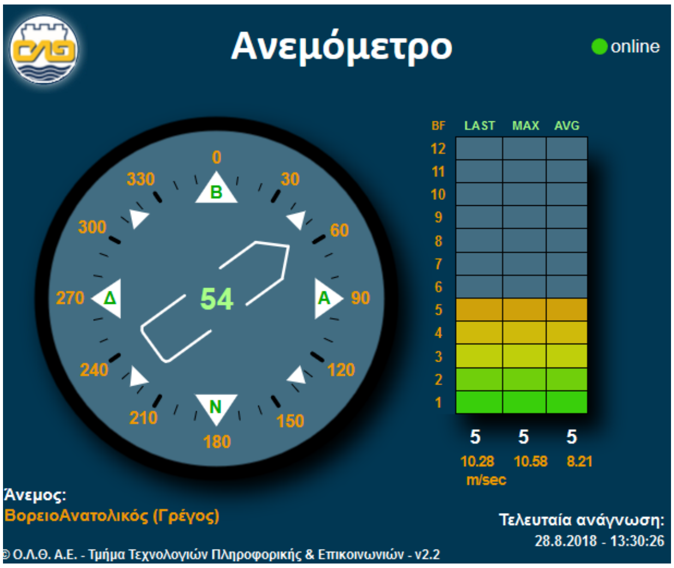


Figure 49. Live wind meter data THPA

7.1.3.5. Environmental management

ThPA SA has

- an approved plan in place for the management of ship waste, as well as an emergency plan for handling oil spills and hazardous materials
- approved environmental protection plan for operations
- all recyclable waste is being recycled
- water quality is regularly tested to ensure the standard of the aquatic environment
- installed equipment for measuring atmospheric pollution is in place
- sound pollution tests are conducted on a regular basis

- operating machinery fleet for conventional cargo is parked close to operations filed. This minimise transport distance, reduce gas consumption, emissions and any resulting pollution.

7.1.4. Expectations about PIXEL

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

(i) To optimize the traffic between the city and the port area

(ii) To reduce pollution, queues, energy consumption etc.

(iii) To integrate existing systems and devices (already installed and new) with the broader platform of PIXEL.

7.2. Summary of the use case

7.2.1. Improvements / problems to be solved for the port

PEI implementation of ThPA SA will focus on air quality 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 optimize inbound and outbound truck flows and mechanic equipment movements

7.2.2. Objectives of the use case

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

7.2.3. Overview

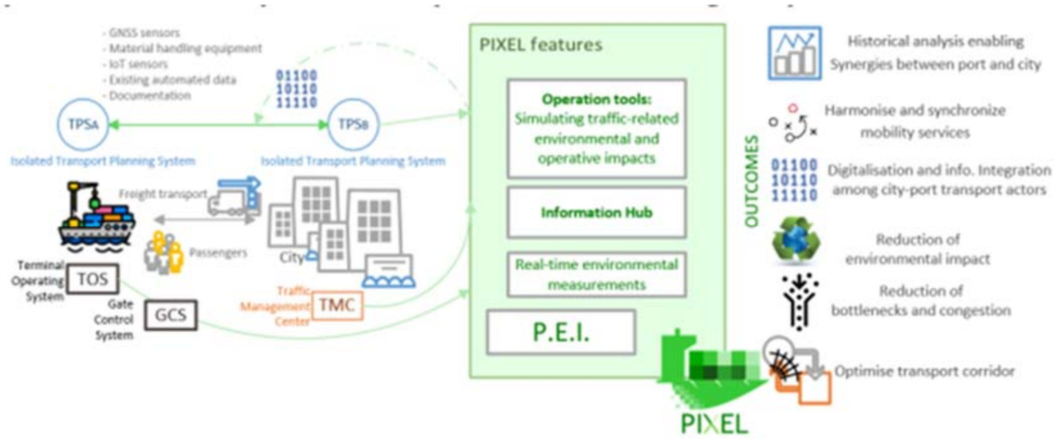


Figure 50. Port of Thessaloniki use-case overview

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, energy consumption and noise.

7.2.4. Expected impacts

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 nr) with new PIXEL data will try to develop new solutions in order to reduce environmental impact without affecting productivity.

The use case expected impacts are the following:

- Monitoring and optimization of inbound and outbound truck traffic
- Reduction of CO2 emissions and acoustic pollution in port surrounding areas
- Optimization of port’s mechanical equipment use
- Optimization of planning and managing in port areas

7.2.5. Use case KPIs

Regarding the KPIs expected to reach within PIXEL in this use-case, is worth to mention that the following figures (in Table 8) are only a rough estimation considering we are still in month 4 of the project. Data has been extrapolated from the first established goals (during proposal) and adjusted to current reality. The impacts have been more detailed textually, but the final figures are still being evaluated by the teams. These estimations will be finally described and particularized for the next deliverable (D3.4).

Table 8. 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	
	Rate of renewable energy in the energy mix of the port	N/A	
	Environmental leadership (Green Marine Indicator)	1	1~5
	PEI adoption	0	Yes
	PEI improvement		Ports actions will contribute to the improvement of PEI
Reduction of operational and infrastructural costs	Electric energy consumption of the port authority	9,9 GWh	Aim will be 85% over total
	Total energy consumption	192 GWh	Possible decrease
Local adoption of PIXEL solution	Local IoT platform implementation	No	Yes
	Number of sensors / devices connected to the local IoT platform	0	It will depend on the PIXEL implementation, but enough to achieve the objectives
	Number of types of data (sensors) connected to the local IoT platform	0	At least 2
	Number of end-users	0	Stakeholders of the use case

7.3. Detailed description of the Use case

7.3.1. Common works

7.3.1.1. Evaluating the current situation of the port

Like all the use cases, the use case of the Port of Thessaloniki will start by evaluating the current situation and, to do so, by analysing the results of the following questionnaires:

- **environmental maturity of the port**
- **modelling and data analysis**

7.3.1.2. Enabling the IoT platform

The Port of Thessaloniki will analyse with the technical partners of the Consortium the appropriate IoT platform to be deployed by taking into account the existing equipment and devices.

7.3.2. Specific actions of the use case

7.3.2.1. Definition of scenarios

6.3.2.1.1. Port operations overview

The operations for both inbound and outbound cargo flow can be grouped around three major blocks: handling of cargo arrival, cargo storage in the terminal yard and final the operations regarding the cargo departure. The Figure 51presents the overall operational process for container handling within the container terminal of the port:

Overall operational process within the container terminal. Similar processes can be identified to conventional cargo terminal/

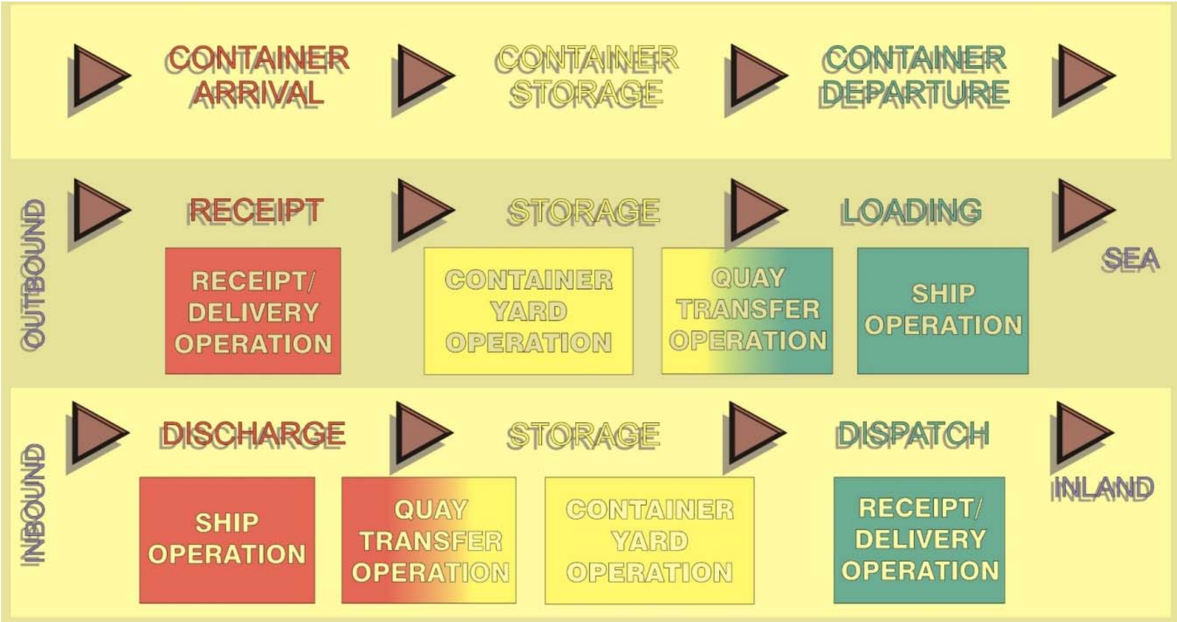


Figure 51. Thessaloniki port operations overview

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

- 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 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.

Trucks movements for each different operation will be analysed in order to meet objectives of the project. The details of which movements are of interest for PIXEL's sake will be described in next deliverable D3.4. The models to cover this analysis and the methods for their optimization will be performed in the WP4 (especially) and in other technical work packages further on in the execution of the project.

Currently there is one main gate to the Port - GATE 16, located at the west side of the port close to the adjacent industrial are 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 our damage documentation portal gates in which a weight in motion system is also installed. Data is stored in relational database.

Figure 52. 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 53.

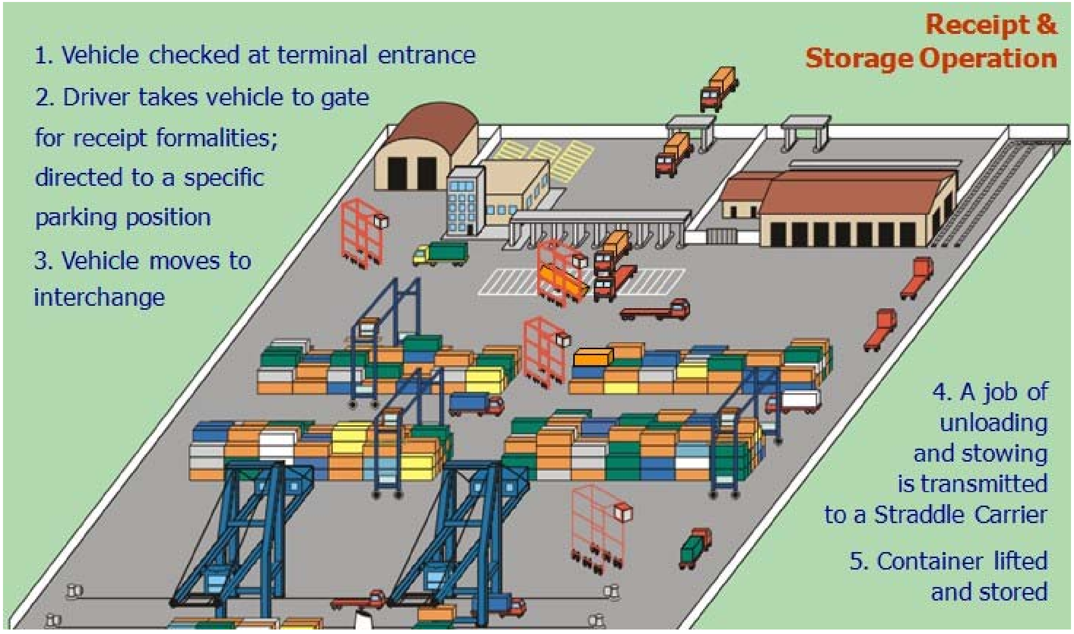


Figure 53. Port of Thessaloniki scenario 1

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 the picture below.

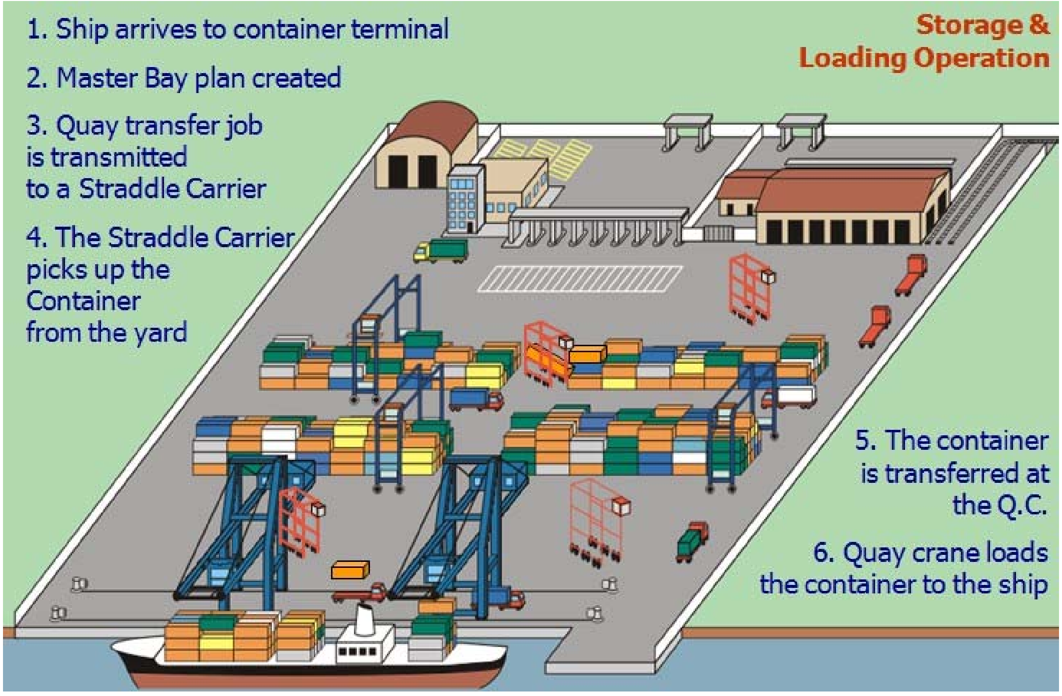


Figure 54. Port of Thessaloniki scenario 2

7.3.2.2. Equipment purchasing

Equipment will be purchased for measurement of PM_{10} and/or NOx

7.3.2.3. Integration of systems

The measurements coming from the new sensors must be sent to 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.

To incorporate technological components and harmonize the Greek Ports use-case with the global PIXEL system an effort will be made to homogenize and integrate data from several software sources.

In the Port of Thessaloniki:

(i) the Traffic Management Centre (TMC) of the city of Thessaloniki,
(ii) the Terminal Operating System (TOS) of the port and
(iii) the Gate Control System (GCS) of the Thessaloniki port.

This integration will facilitate fast gate in/out operations and alleviate traffic congestion by establishing a smoothed arrival/departure pattern for trucks to/from.

The use case will focus on the combined/integrated use of:

(i) the port's Terminal Operating System, managing all container operations in the terminal (arrival notifications, departures, container handling, etc.),
(ii) the port's Gate Control System, managing truck access by automated truck plate recognition, OCR in container codes, damage detection and weight in motion,
(iii) the city's Traffic Management Centre,
(iv) the port's automated material handling equipment (automated straddle carriers), based on the integration of GNSS and on-board sensors at data level,
(v) IoT sensors for traffic monitoring in the city,

(vi) IoT sensors for measuring environmental indices in the port area and
(vii) automated data capture and analytics.

7.3.2.4. Implementation of PEI

PEI implementation of ThPA SA will focus on the air quality aspects. Aim will be in collaboration with the ports operations stakeholders and the traffic management system of the city to optimize movements of trucks in order to minimize environmental impact of the trucks movements to/from the port and of the mechanical equipment used for the port operations.

7.3.2.5. End-user results expected

Knowledge of port's operations processes and to the data collected can be used for predictive algorithms in order to assess the current situation and optimize truck and mechanical movements.

The main expected results are

- Better insight of inbound and outbound traffic
- Reduction of the congestion in the port area.
- Reduction of fuel cost of ThPA mechanical equipment
- Reduction of noise in the port surrounding areas

All the aforementioned results can broadly affect all end users such as the port itself and all members of the port community.

7.3.3. Actors and interactions

Main actors identified at this point of the project who will play part of the Thessaloniki's use-case are:

- Shipping agents
- Customers
- Truck drivers
- Mechanical equipment drivers
- Stakeholders (the city's Traffic Management Centre).

7.3.4. Use Case constraints (pre-conditions)

No restrictions are identified up to now. Further studies will be made based on the questionnaires requested and under the action of task T3.2.

8. Further work

As it has been stated in section 1 of the deliverable, this document is only the first iteration of a global resource that will fully define PIXEL use-cases.

Some information that has not been included in this deliverable D3.3 (due to several reasons) will be completed and written for the following iteration of the whole specification. Table 9 shows the necessary evolution to be performed to reach D3.4 starting from D3.3.

Table 9. Rationale and scope of the deliverable

Topic covered by each port		To be developed in the next version (D3.4)
General context conditions	Economic, geographical and urban context	No – Fully completed in D3.3
	Regulatory context	Yes by taking into account T3.2 works
Technical context	Premises & infrastructure	No - Fully completed in D3.3 (except if the work plan of the use case has an impact on infrastructures)
	Sensors and existing networks	Yes (for sensors and networks that need to be connected to PIXEL)
	ICT systems	Yes (for systems that need to be connected to PIXEL)
	Data availability	Yes – This section will be improved in D3.4, particularizing the kind of data and under requests from WP4 and WP6 technicians.
	Environmental management	No – Fully completed in D3.4
Expectations about PIXEL		No - Fully completed in D3.4
Summary of the use case	Improvements / problems to be solved for the port	No - Fully completed in D3.4
	Objectives of the use case	No/Yes (in case of port policy changes)
	Overview	No – Except from particular requirements from technical WP leaders.
	Expected impacts	No/Yes (in case of port policy changes)
	Use case KPI(s)	Yes (may be impacted by PEI development)
Detailed description of the use case	Common works	Yes– Pending questionnaires and explanations from ports
	Specific actions	Yes (from general specifications to detailed UML specifications) – Technical details to be added
	Actors and interactions	Yes (from general flows descriptions to UML flows modelling) – Technical details to be added
	Use case constraints (pre-conditions)	Yes
Use case work plan	Use case development logic	Yes : must be added – Not existing in D3.3.
	Work plan	Yes : must be added – Not existing in D3.3
	Detailed timeline	Yes : must be added – Not existing in D3.3

Appendix A – Questionnaires

As it has been stated at different part of the documents, a part of the common work that all ports has been asked to be carried out is the completion of two questionnaires. 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.

In this appendix, the questionnaires that have been gathered so far are attached to the first iteration of the use-cases description deliverable. For the next iteration of this two-fold asset (D3.4), all questionnaires will be completed, and the knowledge generated.

A.1. Questionnaire templates

The templates that have been distributed to the stakeholders 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 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 an information exist on what type of waste is being generated (hazardous v. non-hazardous)?

(17) What is the approx. 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 with 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.

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	Deliverable D3.3
(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	Deliverable D3.3
(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 mirror" 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	M4
(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	M4
(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

These questionnaires will be submitted fulfilled in the next iteration of this outcome (D3.4 – Use-cases manual v2). The answers and conclusions gathered with these questionnaires will serve as an input for further WP4 and WP6 developments.