

IoT applications for environmental leverage in European ports & innovative technologies for efficient intermodal transport
The PIXEL project

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PIXEL — Where IoT meets the Port of the Future

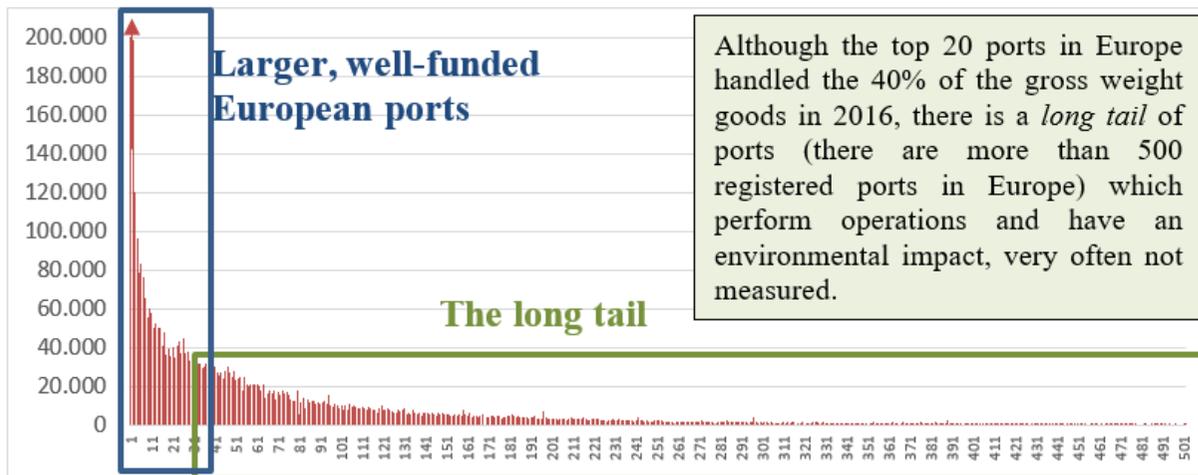
- Topic: MG-7-3 - The Port of the future
- Total budget: 4,890,222.50 €
- Duration: May 2018 - April 2021 (36 months)
- N° partners: 15 - From 7 countries : Spain, Slovenia, Italy, France, Croatia, Greece & UK



PIXEL Partners



Context



Gross weight of goods transported in European Ports in 2016 (in tonnes) — Source: Eurostat.

It is not practically feasible to measure, analyse and manage heterogeneous data in ports



Ports are prevented from optimising processes



Environmental impact increasing

- Data interchange among agents and systems within (mainly small and medium ports) limited to official documentation and services of the Port Authorities
- An effective integration of operational data is far from optimal in the majority of ports
- Increasing levels of data suitable to be measured affecting environmental impact

PIXEL at a glance

Vision

A Port of the Future in which small and medium ports are also innovators in terms of environmental sustainability

Mission

To bring the Sustainable Port of the Future paradigm to the complete spectrum of ports

Objectives

- Enable the IoT-based connection of port resources, transport agents & city sensor networks
- Achieve an automatic aggregation, homogenization & semantic annotation of multi-source heterogeneous data from different internal and external actors
- Develop an operational management dashboard to enable a quicker, more accurate and in-depth knowledge of port operations
- Model and simulate port-operations processes for automated optimization
- Develop predictive algorithms
- Develop a methodology for quantifying, validating, interpreting and integrating all environmental impacts of port activities into a single metric called the Port Environmental Index



Project outputs



First **IoT integrated platform** focused on optimization of operations with reduction of **environmental impact**



Port Environmental Index (PEI) as a quantitative composite indicator of the overall environmental performance of a port



Secured dashboard with operational tools for decision support (real time monitoring and predictive analysis)



Information hub and optimization operations through **smart models** (energy, transportation, pollution and port-city integration)

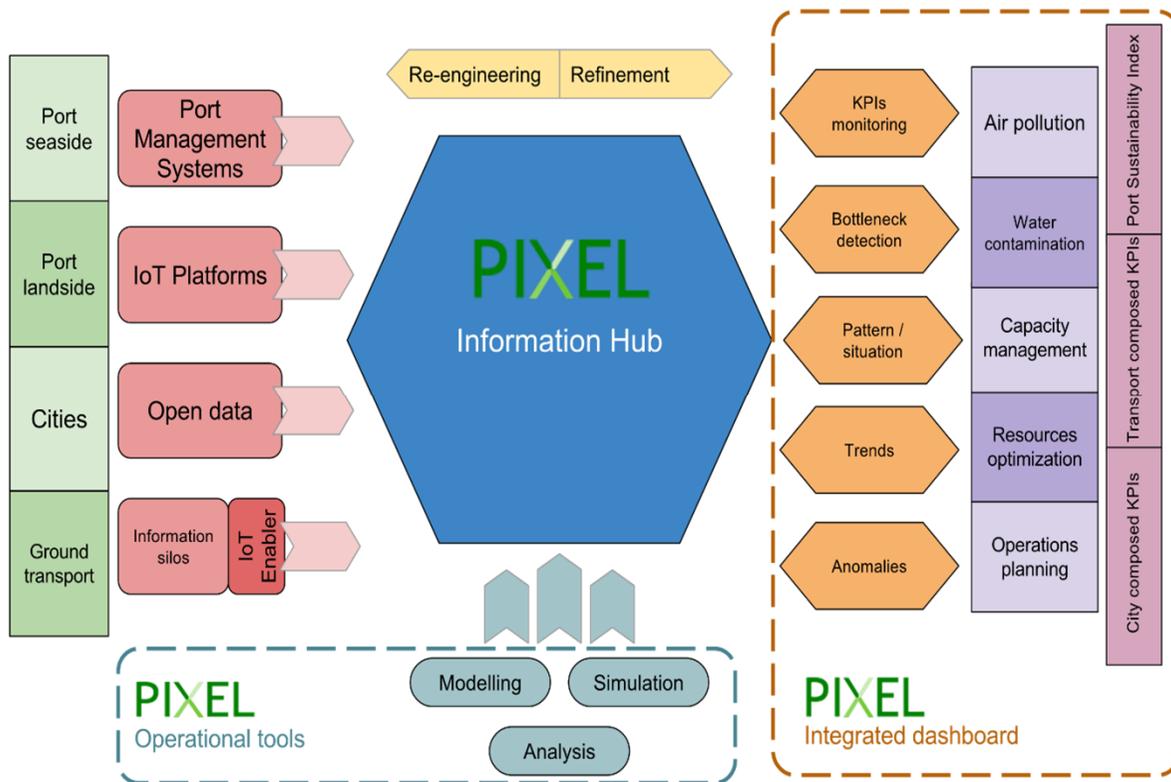
PIXEL Ambition

“PIXEL will go beyond the state of the art regarding Environmental Impact modeling and controlling and inter-port KPIs and relevant information sharing”

- **Predictive algorithms for reducing the environmental impact in ports**
 - ✓ Machine learning techniques to be used: data preprocessing: normalization, outlier & anomaly detection and cleaning of data
- **Information sharing with ICT Infrastructure**
 - ✓ Not only creating a widely available cloud environment (PIXEL Information Hub) gathering heterogeneous data but also applying it to the port-city operations field
- **Enable Environmental Management for Small Ports**
 - ✓ Port Environmental Index as global indicator of the impact in ports
- **Multi-modal transport optimization**
 - ✓ Effective integration of data coming from transport companies, city sensors and services and the ports systems, allowing major advantages in traffic forecast, time estimations or synchronization of services provided by IoT-based operative solution
- **Ambitious use-cases**
 - ✓ Clearly-defined KPIS expected to be improved thanks to PIXEL outcomes



An IoT platform for port environmental leverage



- Capabilities

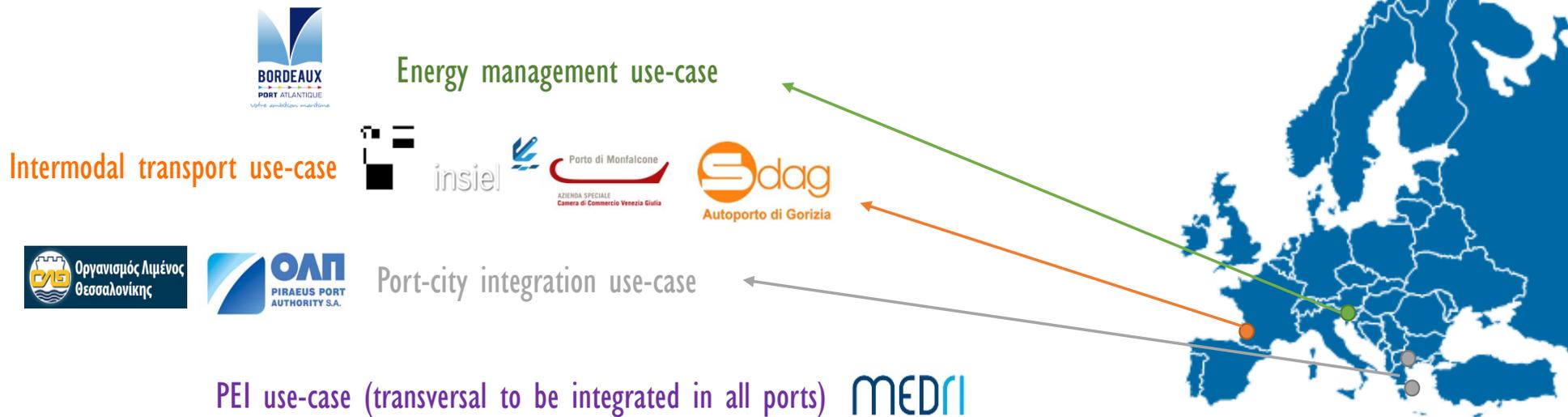
- Heterogeneous information from heterogeneous sources
- Systems integration
- Enabling technologies
- Modularity and extendability
- HMI
- KPIs assessment

- Design

- Security-by-design
- Scalability

PIXEL Use-cases

- Three small & medium ports to demonstrate the validity of the project results & one large to assure its scalability
- Confronting varying environmental issues
- Employing different integration scenarios

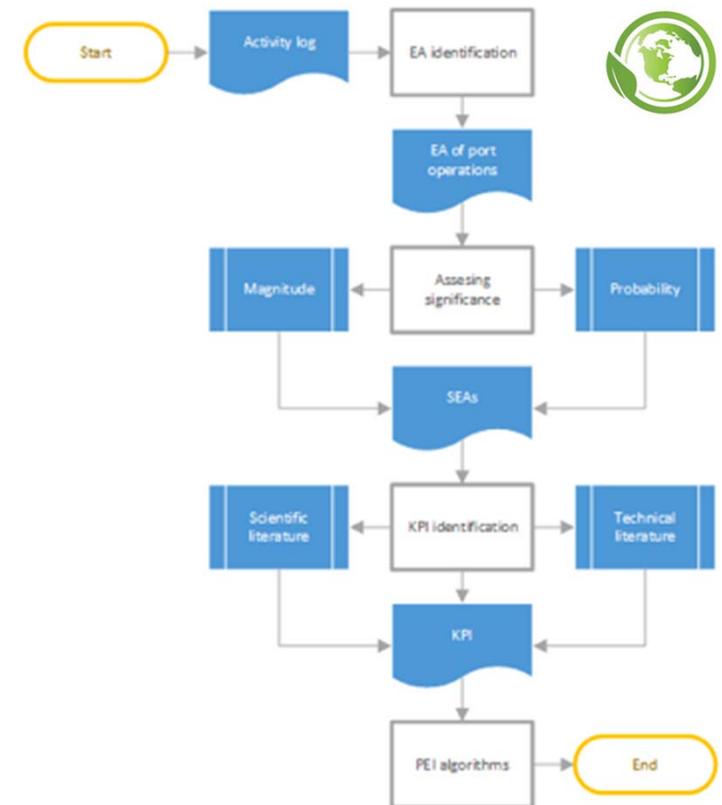
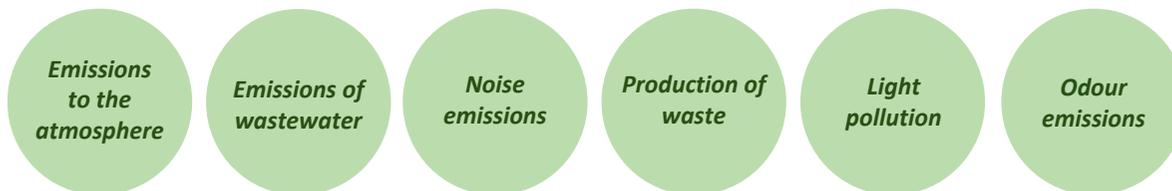


An IoT-facilitated Port Environmental Index

Today's environmental challenges must fit real global needs, enhanced by legislation and standards - Ports need a clear understanding of their **overall environmental performance**

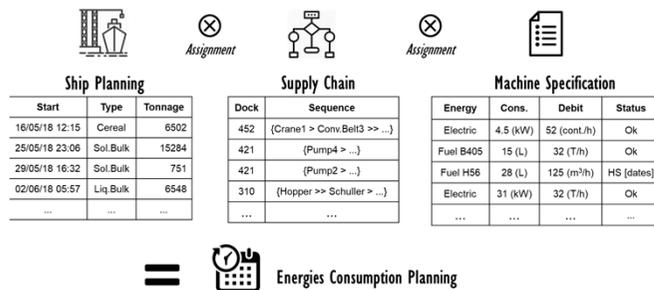
Ports can **optimise their use of resources** to include the appropriate monitor of environmental-related activity and act on it

The Port Environmental Index is a global indicator of the impact in ports that permits the ports to have a **real-time measure of their environmental footprint and to plan actions** to reduce it to desired levels



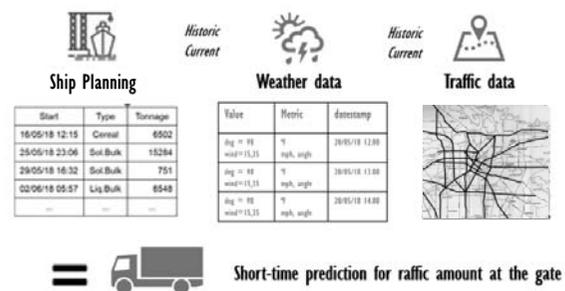
PIXEL predictive models

Energy demand model



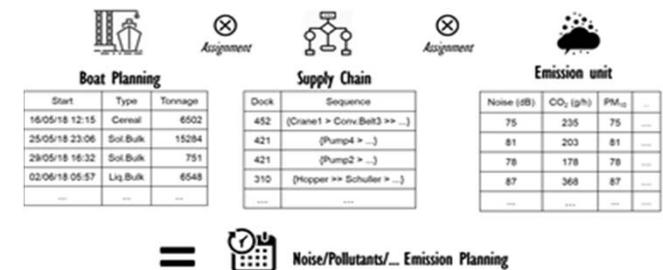
- Predicts energy consumption based on a mixed use of equipment specifications (e.g. handling equipment), real-time consumption sensors and meteorological conditions (e.g. berths lighting & building heating requirements)
- Forecasts solar energy production based on irradiance data and weather conditions (sensor measurement or satellite-based tools)
- Balance energy consumption and production

Port-city and multi-modal traffic model



- Road traffic prediction of potential bottlenecks at the port gates
- Includes current traffic data in the city so that upcoming traffic jam are detected,
- Embeds sensors/information of gates' status
- Incorporates weather conditions that can impact sea-based traffic

Emissions model



- Emissions inventory
- Pollutants in air, water & soil
- Forecasts pollution end-points in time & space

When talking about a greener ports & maritime sector ...

Gaining synergies with relevant research & innovation synergies in adjacent areas, is critical

PIXEL is focusing on:

Information sharing with ICT Infrastructure

- ✓ Creating a widely available cloud environment (PIXEL Information Hub) gathering heterogeneous data in the port-city operations field
- ✓ Taking advantage of IoT applications as an efficient automatic data feeding mechanism for port operations

Predictive algorithms for reducing the environmental impact in ports

- ✓ Machine learning techniques used: data pre-processing, normalization, outlier & anomaly detection and cleaning of data

Enabling Environmental Management for Small & Medium Ports

- ✓ Port Environmental Index as global indicator of the impact in ports

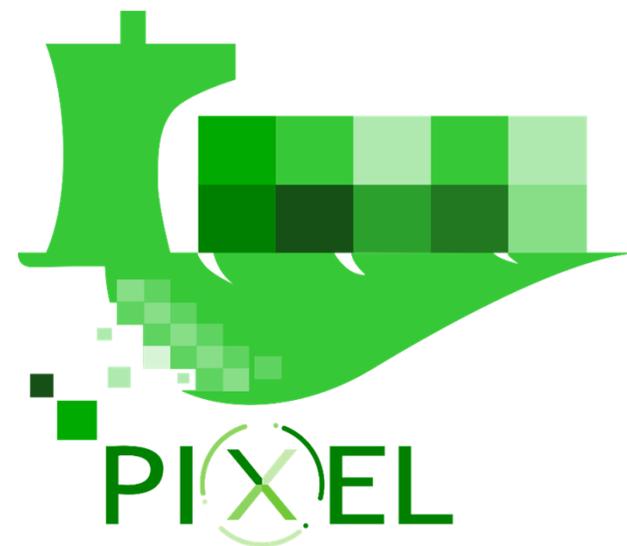
Multi-modal transport optimization

- ✓ Effective integration of data coming from transport companies, city sensors and services and the ports systems, allowing major advantages in traffic forecast, time estimations or synchronization of services provided by IoT-based operative solution

Considerable **synergies** can be gained by considering **research & innovation results from other areas**, such as:

- Greening maritime operations
- Automating port terminal processes





Thank You + Questions?



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