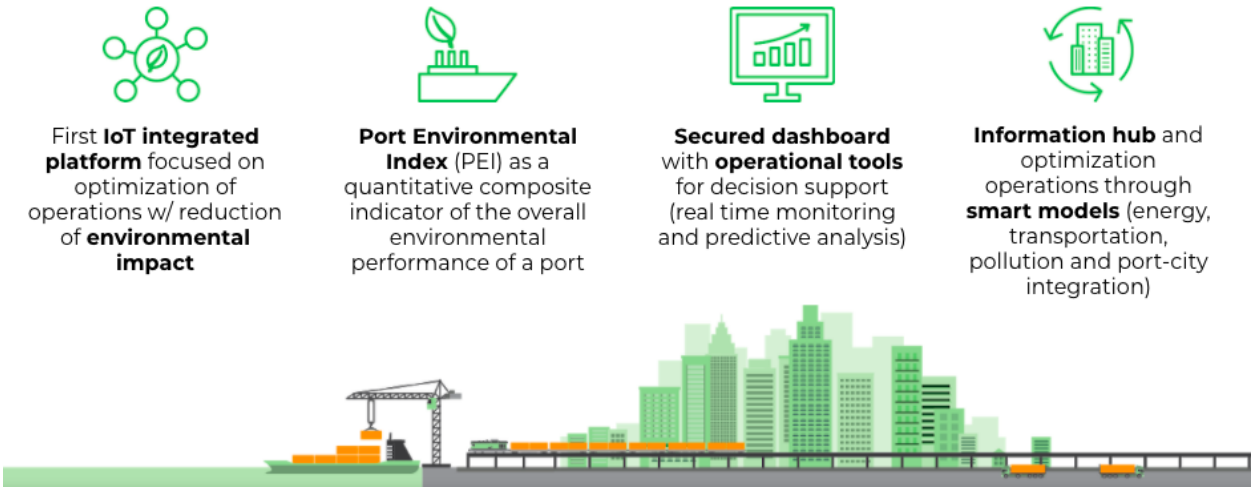
IAPH Sustainability Awards 2021 / Collaborative Project – PIXEL Ports

PIXEL is the first modular solution combining strong methodology and smart technology for small and medium port ecosystems enabling optimization of operations through Internet of Things (IoT) while reducing environmental impact.

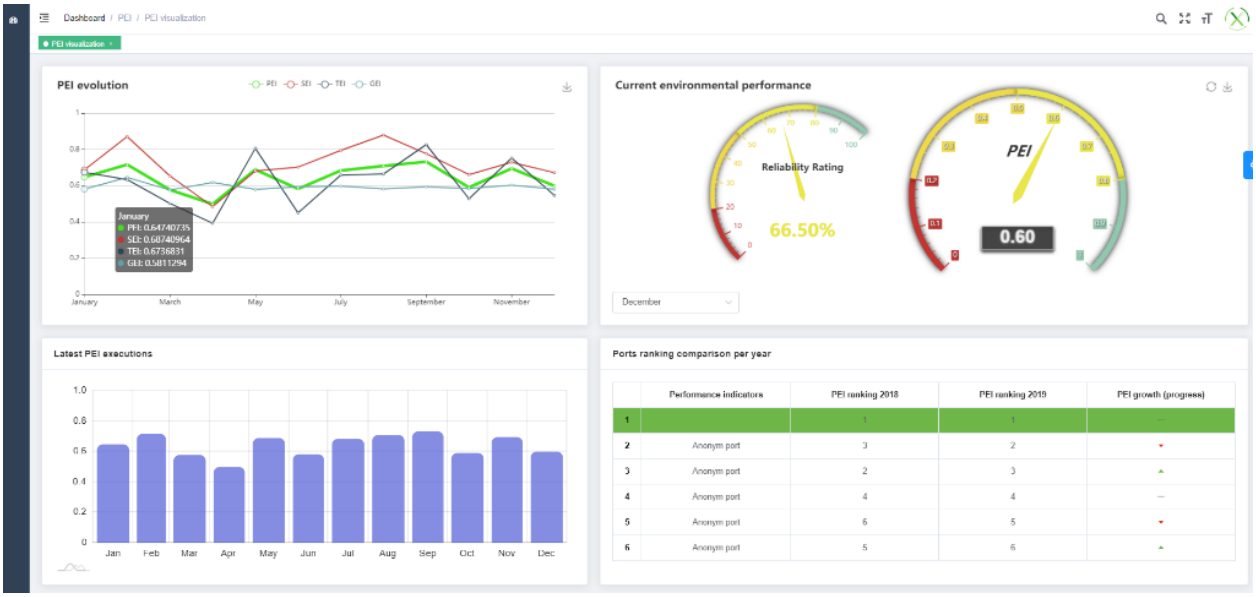


PIXEL monitors in real-time the environmental performance of ports, terminals or vessels, based on the sensor infrastructure and open data, while providing tools to improve the planning of port operations.

There is a lack of tools for environmental impact assessment, and the integration of operational data in the majority of ports is not optimal. In addition, different the level of digitalization in ports differs and considerable gaps are identified between large and small ports. Built on state-of-the art interoperability technologies, PIXEL centralises data from different information silos where internal and external stakeholders store their operational information. PIXEL leverages an IoT-based communication infrastructure to voluntarily exchange data among ports and stakeholders to achieve an efficient use of resources in ports. This is achieved through the provision of an easy-to-use, open source, smart platform for operational data interchange in ports and its surroundings.

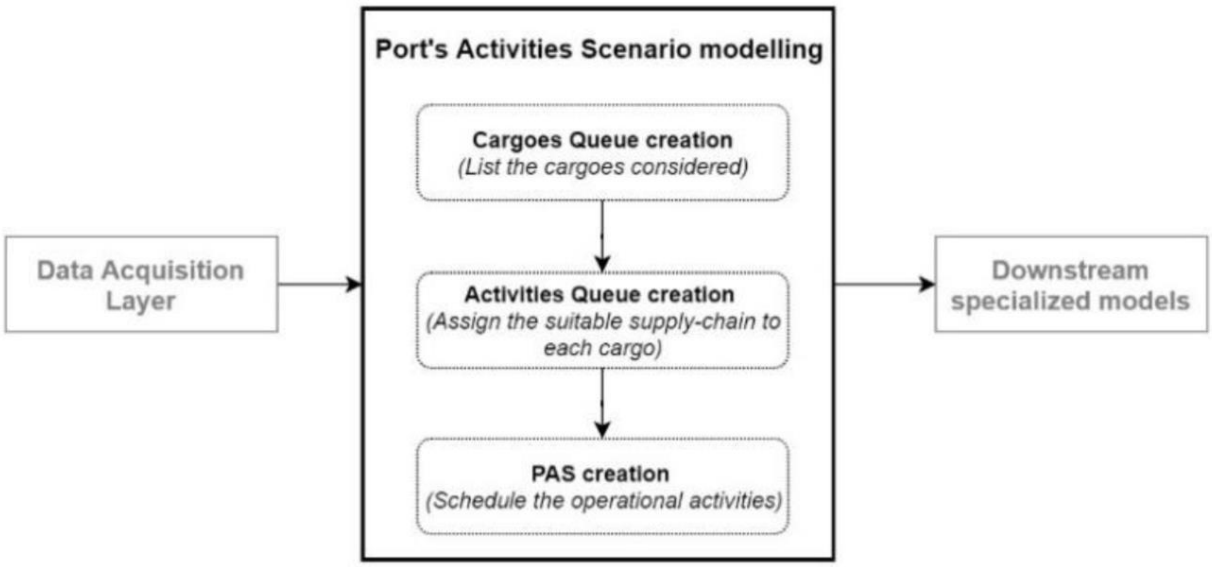
PIXEL provides tools and guidelines leveraging technology with a unique approach: creating a single environmental metric for ports and modelling and optimizing processes after gathering all available information.

- ★ Port Environmental Index (PEI) - a global quantitative environmental index fed on a variety of data types (including real-time), allowing ports to access the progress of their own environmental performance. This method enables flexibility and scalability in monitoring environmental performance in real-time through the IoT infrastructure at the port.

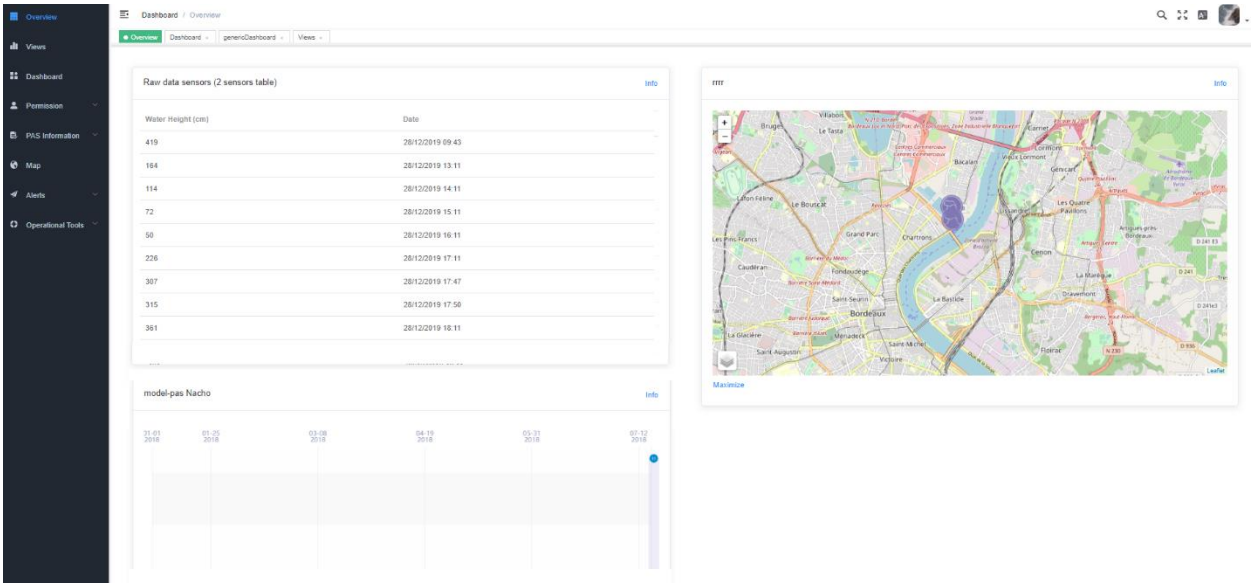


- ★ Port Activity Scenario (PAS) - models port activities based on vessels calls and use of handling equipment specifications in order to establish an operational description of the port activities related to cargo handling. This digitalization of the port activities and know-how over time enables simulation through what-if scenarios, allowing for specialized computational models for energy consumption and production, environmental pollution,

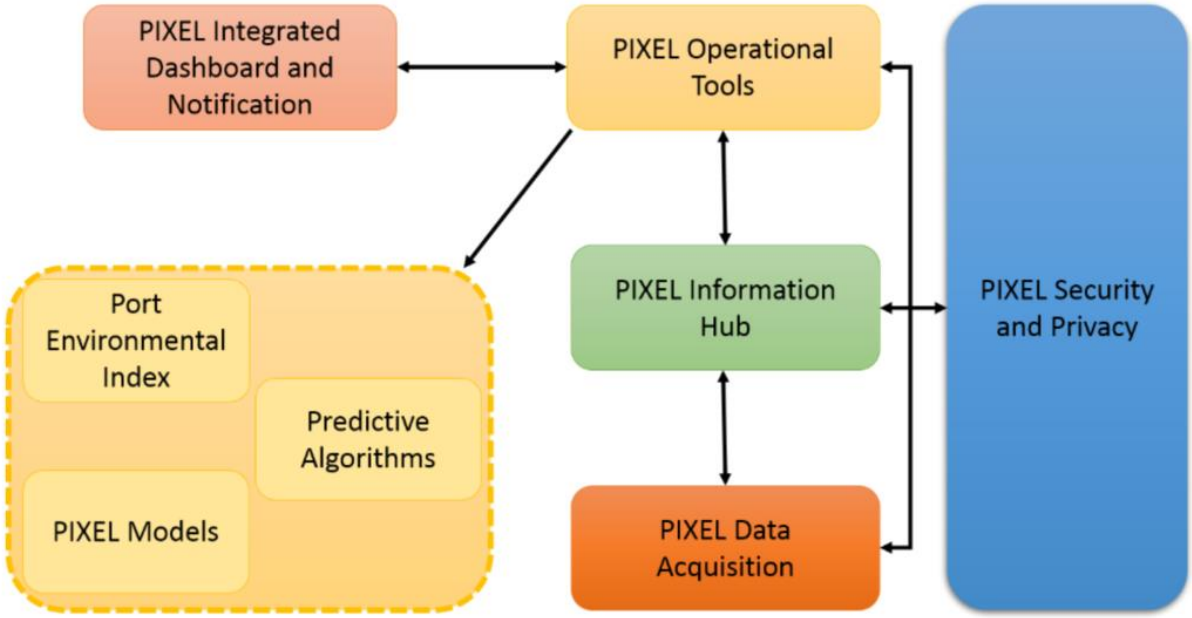
or COVID-19 restrictions. It also allows for the integration of new computational models to address other priorities.



★ Maritime Data Analytics (MDA) - Powerful algorithms feeding on different types of data sources (AIS, FAL forms and smart cameras) that improve the business intelligence at the port from the traffic at the sea (enhancing ETA/ETD and other optimizations of vessel traffic and manouvering) and on the road (forecasting and avoiding congestion at the port gate and throughout the city using better the paring availability) with machine learning methods.



★ Big Data Engine (BDE) - fitting the most demanding data needs of all stakeholders in the maritime industry, modular and flexible by plug'n'play FIWARE data collection agents, and ready for 3rd party integration through REST API and integration with Port Community Systems. It was built in a lean product development process with decision-makers of small, medium and large ports to fit the data challenges of most European ports.

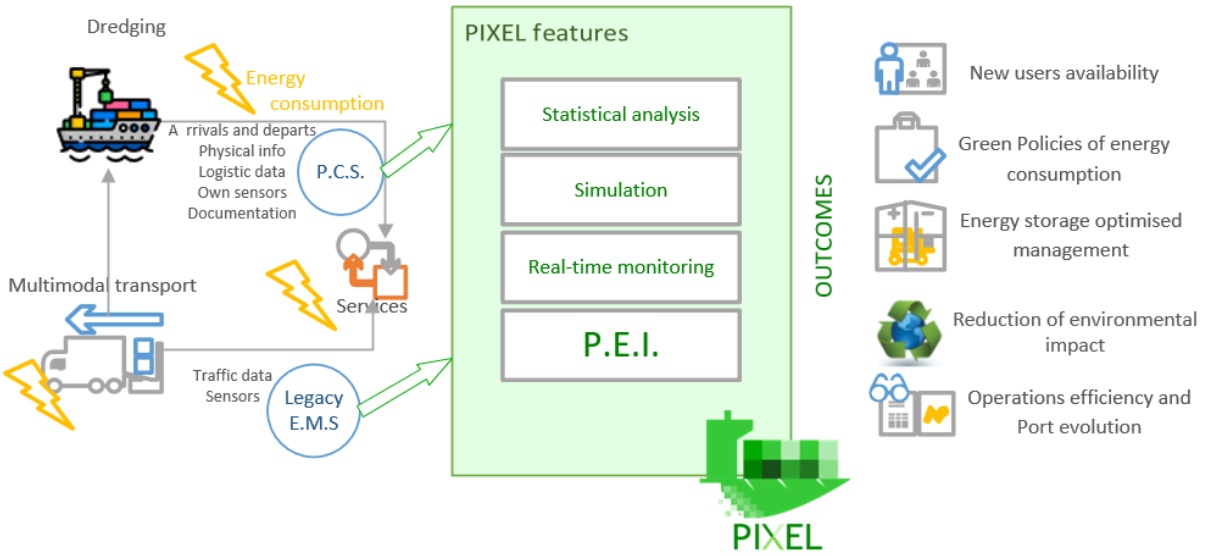


Through application in a series of pilot cases in the ports of Bordeaux, Monfalcone, Piraeus and Thessaloniki, PIXEL is demonstrating improvement in selected port performance indicators (e.g. 5% in energy consumption, 6% average cost per passenger, 85% in average waiting time for vessels and trucks).

Energy demand prediction: Stakeholder: Grand Maritime Port du Bordeaux

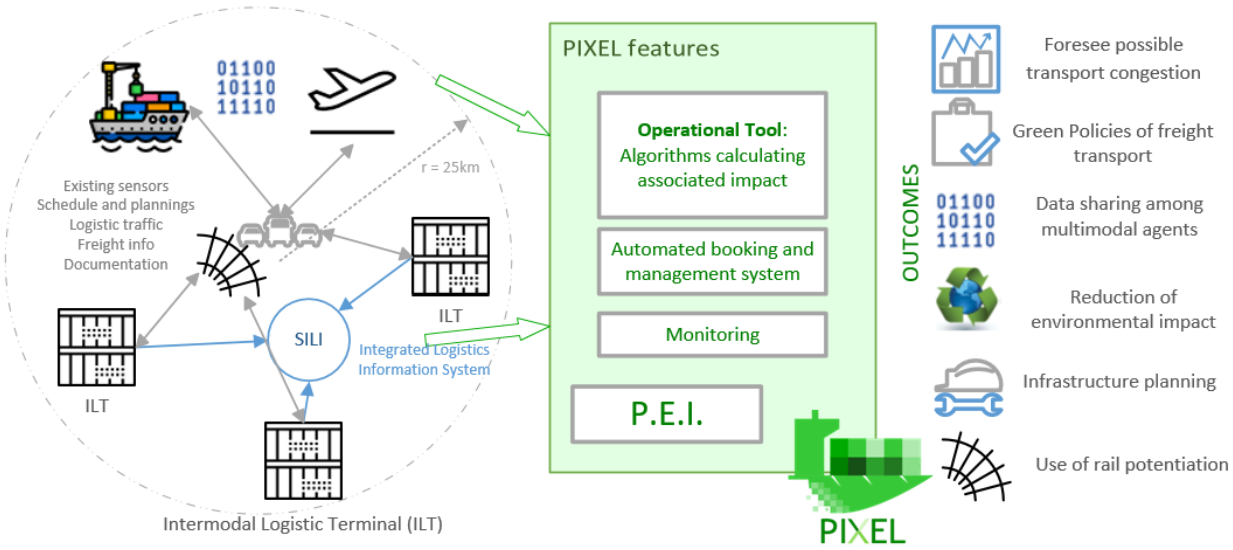
Operational and environmental objectives	PIXEL assessment traits targeted
• To adequately dimension the renewable energy networks (especially storage) • To optimize the resources based on the management centered in the self-production	– Development of standard interfaces between PIXEL and PCSs – Interoperability of already existing and new sensors – Implementation of open data exchange mechanisms

• To propose new green policies of energy consumption inside the port • To develop services with over produced energy • To reduce the carbon footprint impact over the city • To propose innovative strategies for the development of ports through to Big Data analysis	– Design and execution of predictive algorithms for port traffic evolution – Design and execution of predictive algorithms to estimate the real-time quantity of energy consumed and produced by the port



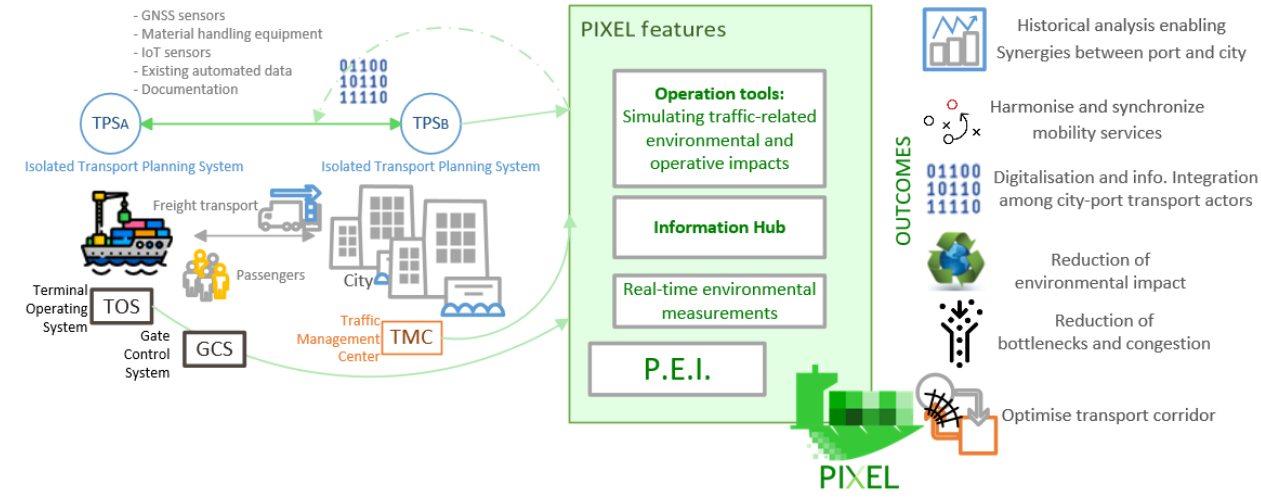
Hinterland intermodal exchange: Stakeholder: Port of Monfalcone

Operational and environmental objectives	PIXEL assessment traits targeted
• Better road planning to reduce urban and extra urban traffic • Providing a better distribution of the waste costs • Monitoring and re-routing of dangerous goods • Reduction of CO_2 emissions and acoustic pollution in port surrounding areas • Disposition of tools to improve the correlation between air pollution and specific diseases • Creating synergies with the other players of the surrounding areas	– Multi-agent inter-modality integration – Integration with SILI system – Algorithms calculating impact and predictive algorithms – Data gathering coming from video-surveillance cameras – Dangerous goods and other environmental hazardous aspects dealt with


01100
10110
11110
Existing sensors
Schedule and plannings
Logistic traffic
Freight info
Documentation
r = 25km
ILT
SILI
Integrated Logistics
Information System
ILT
Intermodal Logistic Terminal (ILT)
PIXEL features
Operational Tool:
Algorithms calculating
associated impact
Automated booking and
management system
Monitoring
P.E.I.
PIXEL
OUTCOMES
Foresee possible
transport congestion
Green Policies of freight
transport
01100
10110
11110
Data sharing among
multimodal agents
Reduction of
environmental impact
Infrastructure planning
Use of rail potentiation

Port-city integration: Stakeholder: Port of Piraeus and Port of Thessaloniki

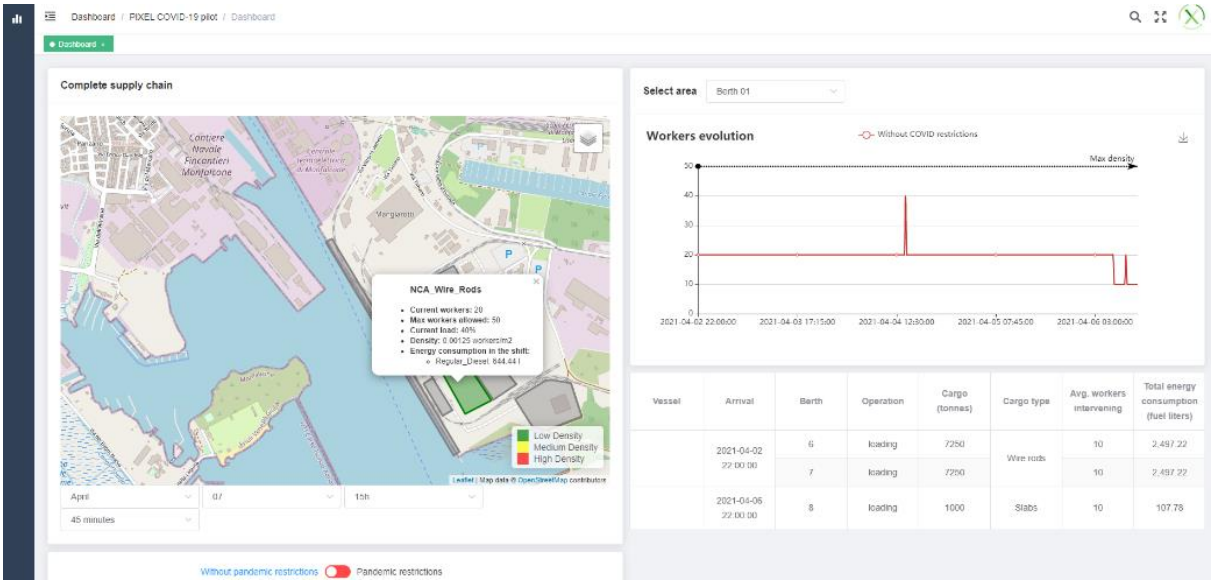
Operational and environmental objectives	PIXEL assessment traits targeted
• Improvement of the access to the seaport • Mitigation of traffic-related impacts on the environment • Facilitate transport intramodality in passenger traffic • Incorporate innovative approaches to overcome bottlenecks in the transportation net-work creation of a positive awareness of sustainable transportation methods	– Integration of PCS, PMS, TOS and new installed sensors both environmental and traffic-related – Design and execution of models for air and noise pollution calculation and prediction – Design and execution of predictive algorithms about traffic congestion



Terminal Schedule Analysis for Social Distance Maximization: Stakeholder: Port of Monfalcone

During the outbreak, PIXEL analysed altogether with the EC representative (appointed to the project) the possibility of introducing a new pilot in the project addressed to help maritime ports to improve prevention and management of pandemic situation.

Several options were discussed, and after a thorough observation of PIXEL traits and ports' needs due to the pandemic, a new task was devised to be included as a PIXEL pilot. The proposed pilot relates to an enhancement of the PAS model results (already available by PIXEL) to be deployed in the Port of Monfalcone.



Useful material:

- Videos of the project assets and innovations: https://www.youtube.com/channel/UCuV-XLjawh3CfsP3BYfITyg
- Open-source code repositories online:
  - GitHub: https://github.com/pixel-ports
  - Documentation: https://readthedocs.org/projects/pixel-ports/
  - PyPl: https://pypi.org/user/pixel-ports/