Port Digitalization Through an Activities Scenario Model as a First Step for a Digital Twin of Port

Towards a smart hyperconnected era of efficient and sustainable logistics, supply chains and transportation

IPIC 2021 - 8th International Physical Internet Conference

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This Communication is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°769355

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Port IoT for Environmental Leverage

PIXEL: Port IoT for Environmental Leverage

TOPIC: MG-7-3 – The Port of the future

Duration: May 2018 – September 2021

15 partners from 7 countries

First **IoT integrated platform** focused on optimization of operations w/ 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)

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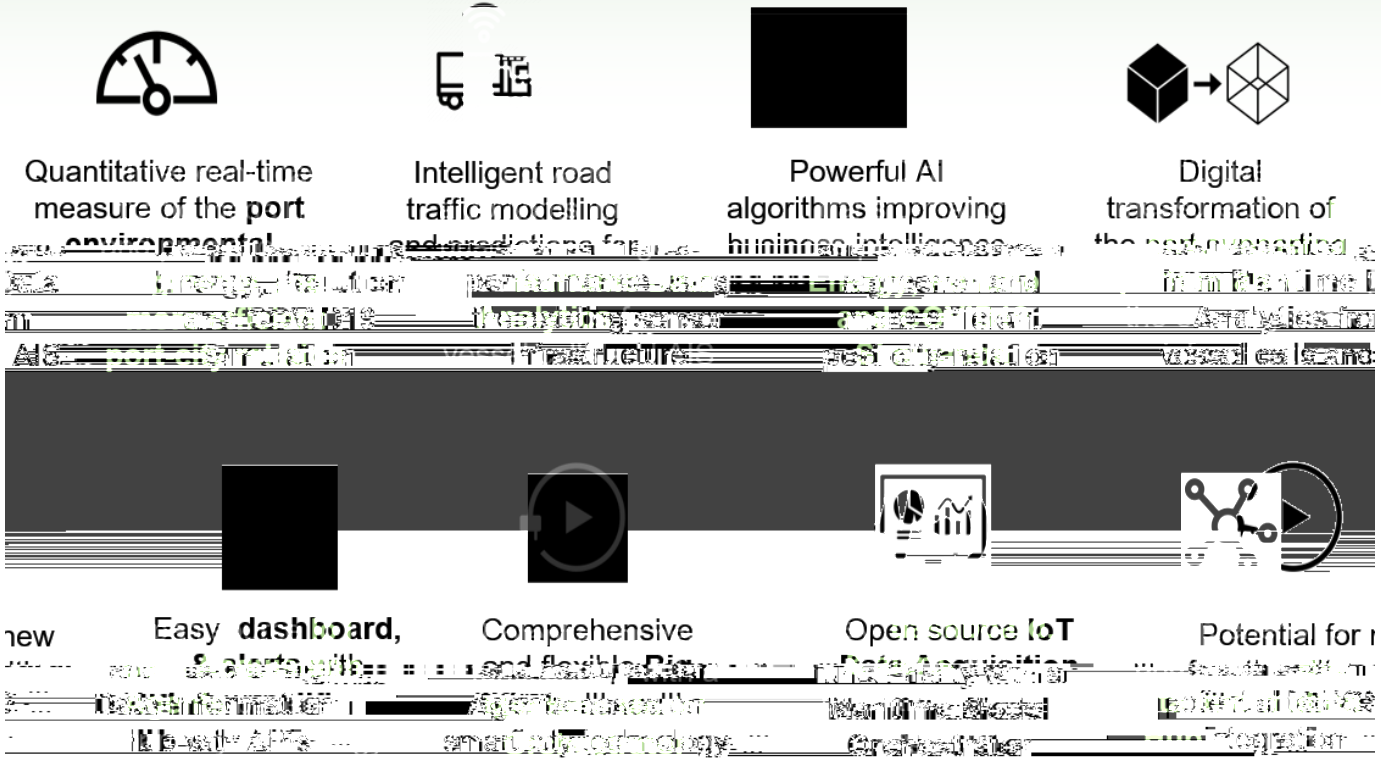
What is PIXEL ?



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PIXEL Platform a first step for a Digital Twin of Port

A Digital Twin is a digital representation of an existing physical element that aimed at modelling and monitoring its behavior and status

Data acquisition and management	Modelling the reality	Simulation and forecasting based on such models	Presentation and visualization of the "physical element"
Mission: Data collection, mapping, processing, transmission, filtering, cleaning...	Mission: Inferring the behaviour of an action around the element.	Mission: Predict or replicate the behaviour of those actions based on the models.	Mission: Utilisation of interactuable elements to represent the element and its actions
Tools: IoT sensors, comm. network technologies, blockchain, cameras...	Tools: Geometrical model, AI, ML, mechanical model, blackbox model, linear...	Tools: Discrete event simulation, ML inference, neural network result, outlier detection...	Tools: Dynamic 3D representation, dashboards, tactile elements, wearables.

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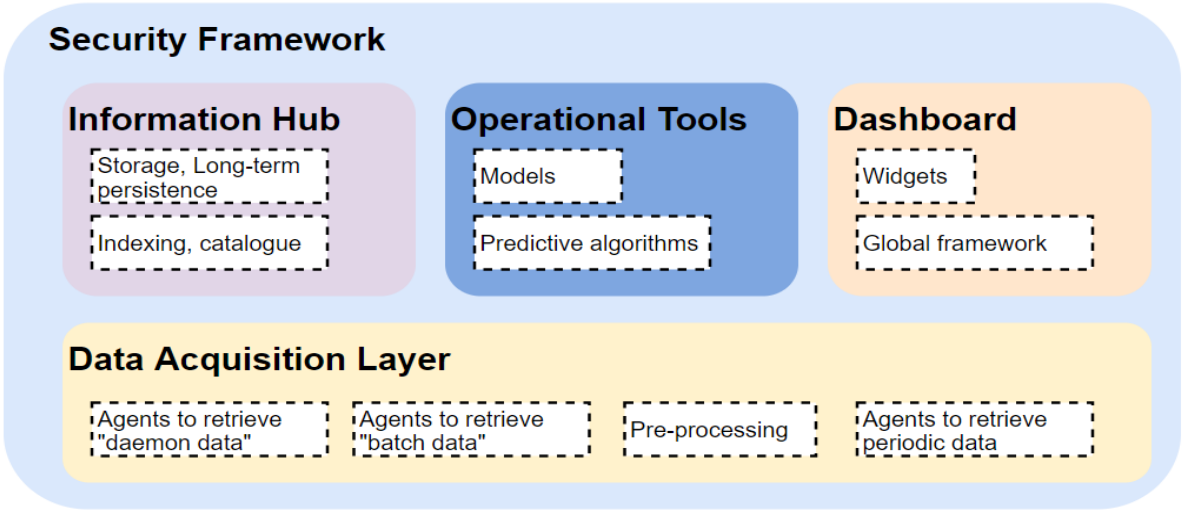
PIXEL Platform a first step for a Digital Twin of Port



Secure IoT solutions for port ecosystem operations

Modular system allowing to integrate with existing systems

Pluggable data collection agents to easily add new data sources

Powerful **big data engine** addressing the specific challenges of ports

Customizable to **add new computational models**

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The Port Activity Scenario (PAS) model

Approach: **Convert raw data into actionable knowledge through chained elementary transformations.** Tools to calculate, estimate or predict impacts on energy consumption, transport networks and environmental pollution of port activities

Build the PAS

- For the considered set of hypothesis, list every port operations and project them across the time

Calculate the outcome

- For every activity of the PAS, determine the resources use and externalities.

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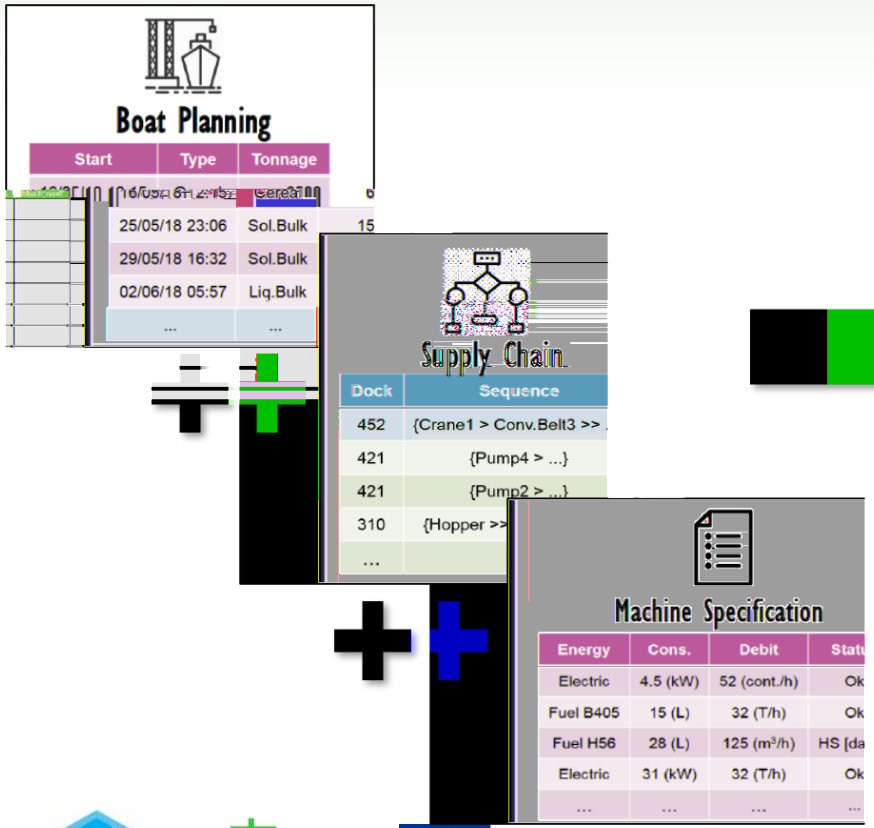

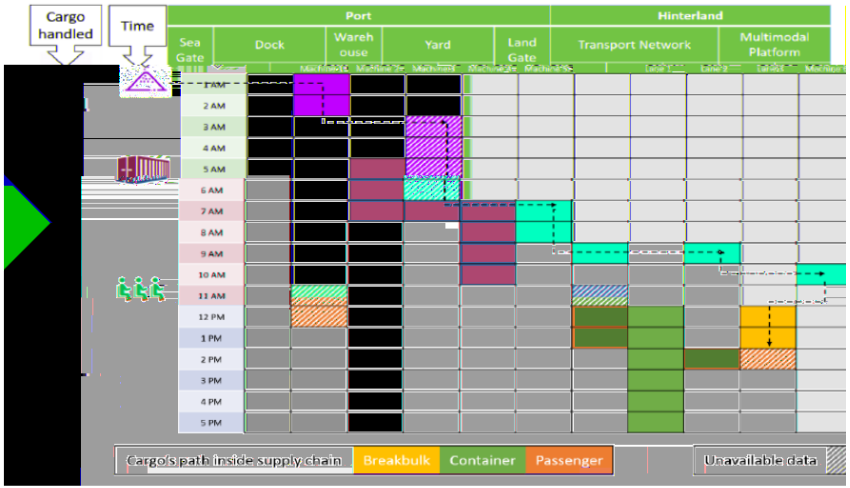

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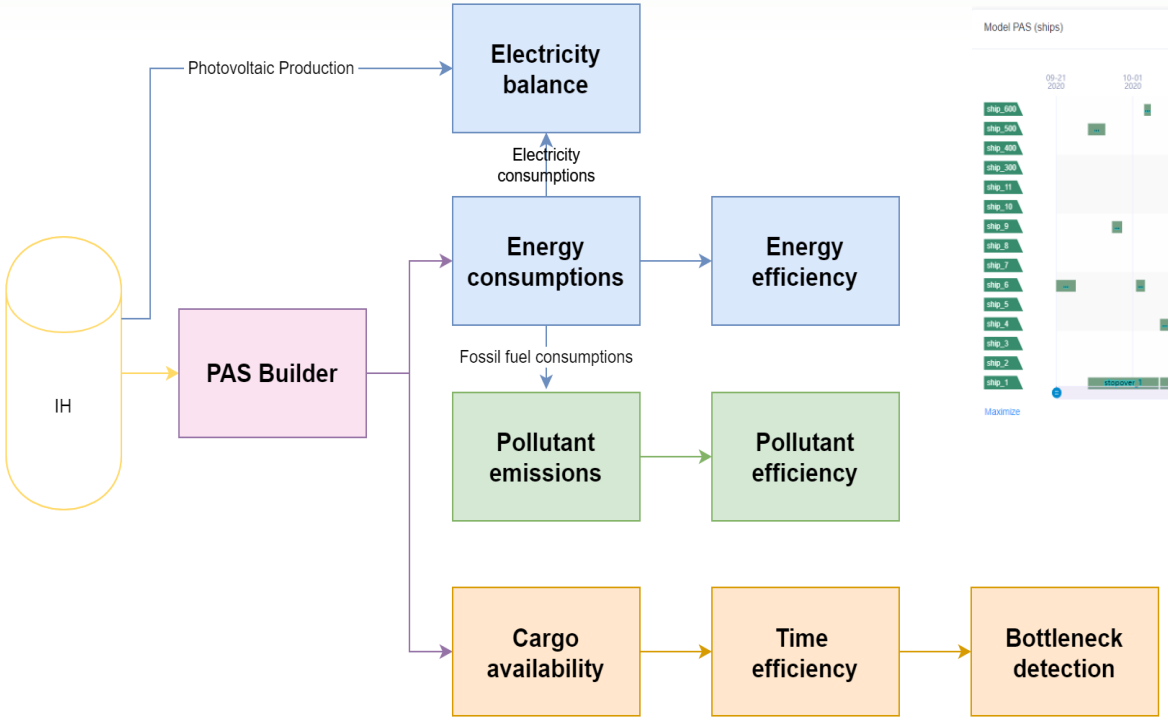
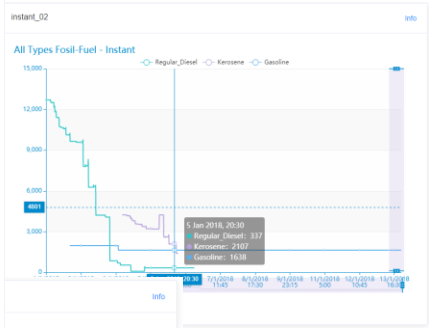
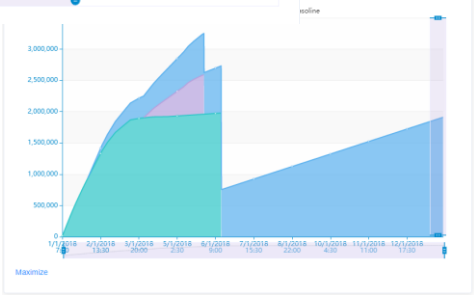
PAS as an element for logistics innovation







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Contribution to the Physical Internet Roadmap

- IoT framework to achieve end-to-end communication and sharing of data/processes between diverse entities and actors of the logistics supply chain.

- PIXEL is prepared to bundle the components of the PI (pi-containers, pi-trucks, pi-trailers, pi-conveyors, etc.) as data pieces to be managed by the Context Brokers and Information Hubs (single-instance per each deployment in a node).

- Due to the multi-actor approach of the PIXEL platform, stakeholders could share information (easy-to-connect APIs) in real time, letting various profiles of port managers to analyze and visualize the information.

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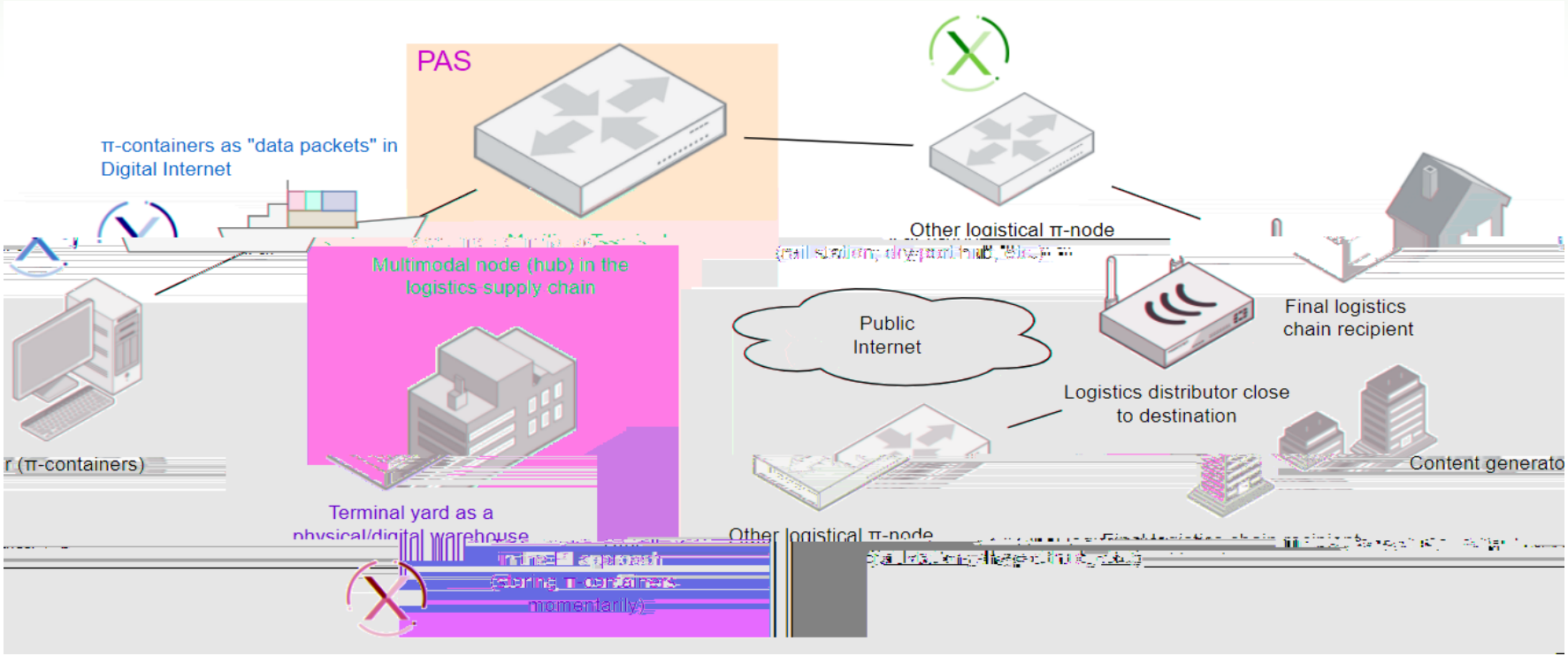
PAS as a node of the physical internet



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Conclusion

- An open-source IoT platform that allows to gather and store data coming from heterogeneous sources.
- PAS model is able to simulate and predict the port activities and can be seen as a first step towards a Digital Twin of a port.
- PAS allows to:
  - Predict the behavior of the pi-node (terminal) with regards to packet (pi-container) throughput;
  - Forecast how time it will take to operate each unit;
  - Know how much energy will be used to do so and the internal operations required,

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