

# 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

IPIEC 2021 - 8th International Physical Internet Conference

June 14-16, 2021 | Virtual



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



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



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



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



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



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# What is PIXEL ?



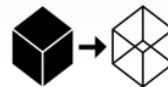
Quantitative real-time measure of the **port environmental performance** using the existing sensor infrastructure



Intelligent road traffic modelling and predictions for a **greener and more efficient port-city relation**



Powerful AI algorithms improving business intelligence from **Maritime Data Analytics** from vessel calls and AIS



Digital transformation of the port supporting **Energy, Pollution and COVID19 Simulation**



Comprehensive and flexible **Big Data Information Hub** with APIs



Open source **IoT Data Acquisition Agents** based on smart city technology



Potential for new functionality with a **Maritime Model Orchestrator**



Easy **dashboard, & alerts** with potential to PCS integration



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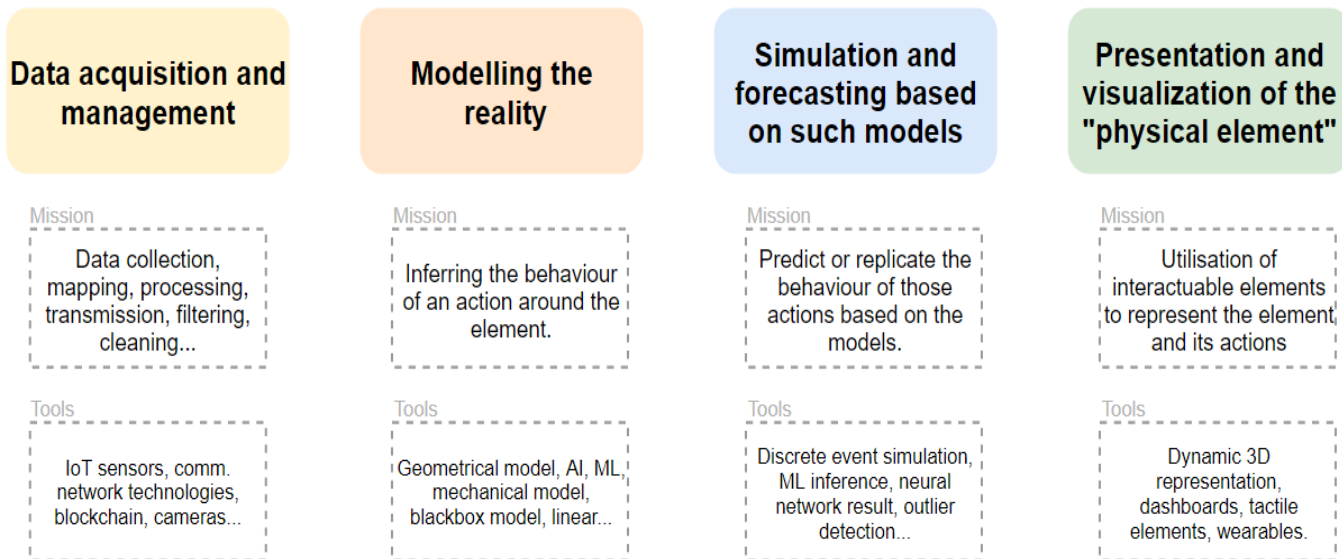
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# PIXEL Platform a first step for a Digital Twin of Port

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



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# PIXEL Platform a first step for a Digital Twin of Port

## Security Framework

### Information Hub

Storage, Long-term persistence

Indexing, catalogue

### Operational Tools

Models

Predictive algorithms

### Dashboard

Widgets

Global framework

### Data Acquisition Layer

Agents to retrieve "daemon data"

Agents to retrieve "batch data"

Pre-processing

Agents to retrieve periodic data

**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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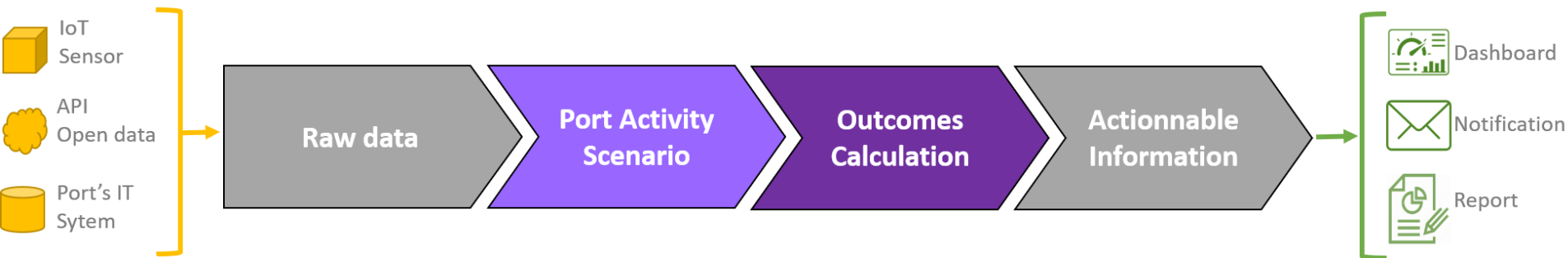
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# The Port Activity Scenario (PAS) model

**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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# The Port Activity Scenario (PAS) model

**Boat Planning**

Start	Type	Tonnage
16/05/18 12:15	Cereal	6502
25/05/18 23:06	Sol.Bulk	15284
29/05/18 16:32	Sol.Bulk	
02/06/18 05:57	Liq.Bulk	
...	...	

**Supply Chain**

Dock	Sequence
452	{Crane1 > Conv.Belt3 > ...}
421	{Pump4 > ...}
421	{Pump2 > ...}
310	{Hopper > ...}
...	

**Machine Specification**

Energy	Cons.	Debit	Status
Electric	4.5 (kW)	52 (cont./h)	Ok
Fuel B405	15 (L)	32 (T/h)	Ok
Fuel H56	28 (L)	125 (m³/h)	HS [dates]
Electric	31 (kW)	32 (T/h)	Ok
...	...	...	...

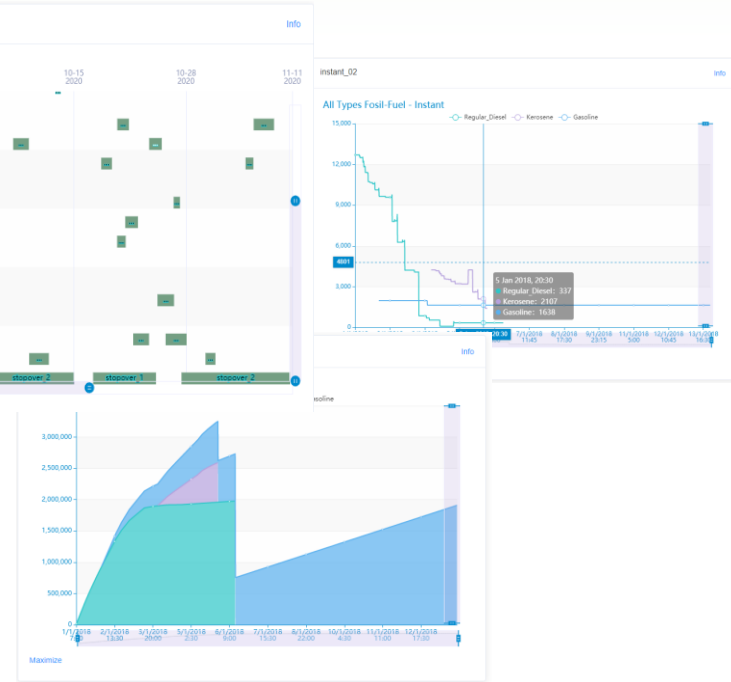


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# Contribution to the Physical Internet Roadmap

- 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.



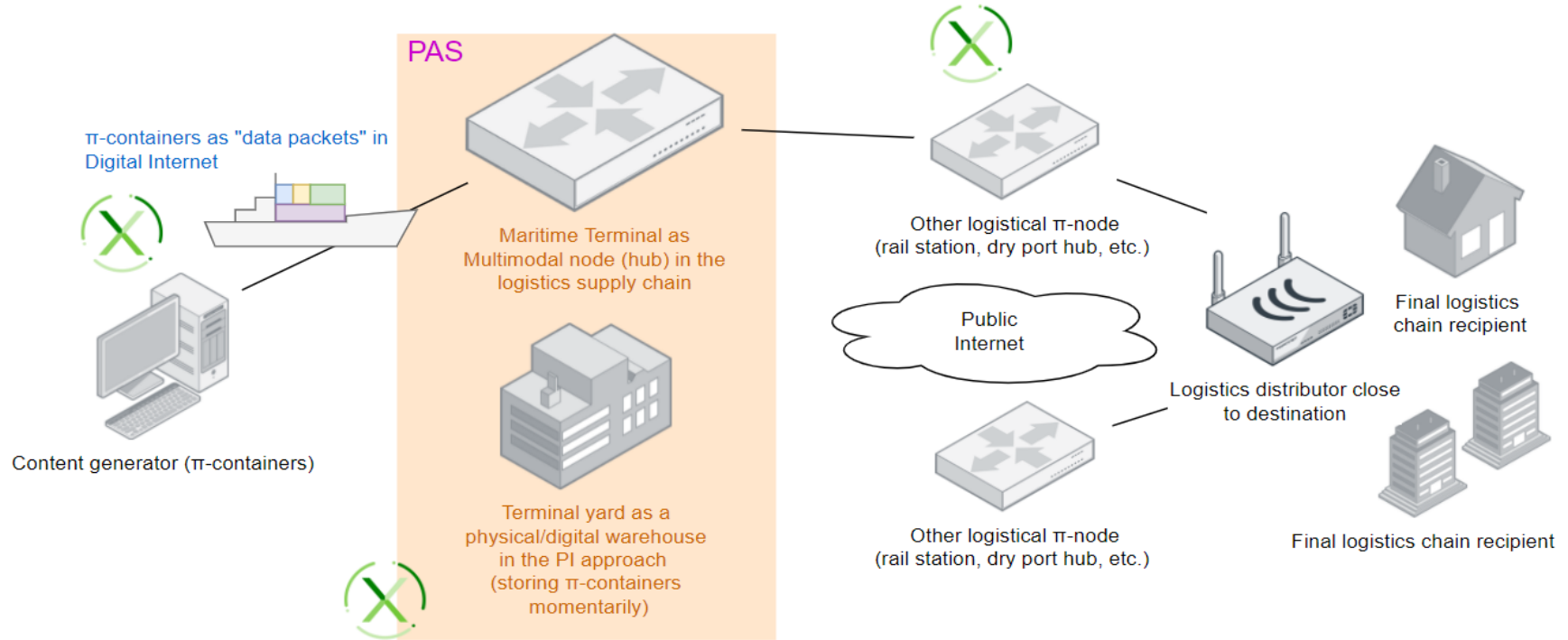
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# PAS as a node of the physical internet



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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,

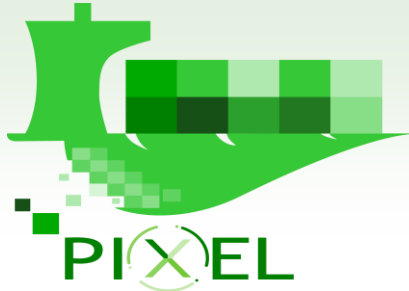


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