



I²PANEMA

Bringing the value of IoT to ports

By bringing Internet of Things (IoT) solutions and added-value services to the world of ports, the ITEA project I²PANEMA (Intelligent IoT-based Port Artefacts Communication, Administration & Maintenance) has made their operations more efficient and sustainable across various business cases.

Despite an expected 50% increase in EU cargo by 2030, recent IT innovations have not yet reached their full potential in ports. As ports typically have limited growth potential, efficiency and sustainability are crucial to dealing with the challenges of increased demand, urbanisation, and labour management. To improve supply chain resilience and offer economic growth opportunities, IoT must be used to enable (networks of) smart ports.

I²PANEMA has focused on the development of new services for dealing with data in ports, leading to results in areas as diverse as container localisation, noise reduction and logbook digitalisation. By innovatively applying data analysis methods to new domains, the project aimed to secure (inter)national transport chains, thereby increasing supply chain resilience and promoting economic growth, the necessity of which was re-enforced during the recent COVID-19 restrictions. ITEA's end-user orientation played an important role in bringing many real ports into the consortium, allowing I²PANEMA to pursue one technology approach for nine business scenarios and demonstrate the wide applicability of its results.

Technology applied

The basis for I²PANEMA is a top-level architecture consisting of three layers. The Machine-to-Machine Communication Layer (MCL) contains sensors, actuators, and the communication infrastructure between these devices, while the IoT Interoperability Layer (IIL) translates,

routes and bridges between multiple systems in the MCL in order to provide a unified interface to the Data Management Layer (DML). This stores and processes the data provided, using machine learning to derive knowledge and actions. It also contains components for interaction with external systems and human users, such as data visualisation. Complementing this is the I²PANEMA reference architecture, which integrates the results from the business scenarios as a best practice document for software implementers to implement a smart port.



◀ Bringing IoT solutions and added-value services to the world of ports.
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To provide security by design, I²PANEMA has applied the DREAD/STRIDE approach to IoT security analysis and attuned this to the specifics of the project. These risk identification and assessment models (re)evaluated the threat landscape for all business scenarios and established a baseline for further threat resolutions. This can be applied to other IoT domains beyond ports, leading to possible benefits in future domains. Further strengthening

of the project's technological outputs has taken place through the creation of the ISO 4891 standard, which establishes a legal framework for digitised logbooks in the form of rules for data communication via smartphones. By opening vessels to smart applications, IoT and new stakeholders, the project aims to create an ecosystem that will allow new business to flourish.

Making the difference

I²PANEMA has demonstrated a wealth of strong results regarding technology, business, and society. At the port level, for instance, an application to predict the time of arrival for ferries in Hamburg has achieved a schedule deviation accuracy of within 15 seconds, leading to a 100% drop in the average processing time to trigger stop announcements. In

Assan port, meanwhile, sensor-based container localisation has increased the number of operations in one shift by >10%, decreased completion time for one movement by >15% and reduced accidents by >50%. This has increased profitability for the port as 10% more container movements can be made. VTEK, the business scenario leader, is now exploiting this solution in ports in both Europe and Africa.

This is not the only rapid exploitation of I²PANEMA's results, as four new products and four enhancements of existing products have been created. Prodevelop, for example, has extended their Posidonia Port Solution Suite with seamless sensor integration, cloud edge computation and AI analytics. Companies of all sizes can benefit from the project, as SME NautilusLog has shown with the ISO 4891 standard. By completely digitalising logbooks for the first time, they offer savings on both time and paper and have attracted the attention of many ship owners. This has directly led to a growth from five to 15 employees.

Finally, the project has opened future innovation pathways and potential markets, such as the development of Industrial Data Spaces into Port Data Spaces through the combination of findings from I²PANEMA and new developments like Gaia X.

For wider society, the major benefits of I²PANEMA include supply chain resilience, sustainability, and liveability in port cities. For the latter, TriCon CTT and Wesel have developed a method for noise analysis and reduction through the on-site integration of sensors and actuators. Under laboratory conditions, this can reduce noise by >15 decibels and won CNA's 2021 'Intelligence for Transport and Logistics' innovation award. For both sustainability and liveability, the port of Gijón has implemented AI-based algorithms and sensors for environmental particle prediction with an error rate of <30%. This overview of air quality allows port operations to change in real time to reduce pollution in the urban area, with a knock-on benefit for tourism. Such diversity in results helps to cover the wide scope of port operations, maximising the impact of I²PANEMA both now and in the future.

Major project outcomes

Dissemination

- > Several paper publications, among others at ITS Word Congress 2021 Hamburg and at the 8th International Physical Internet Conference IPIC 2021
- > Show-casing of the project business scenario demonstrators at the ITS World Congress 2021
- > Participation to the ITEA booth at the Smart City Expo World Congress 2019 in Barcelona
- > Presentations at various meetings of the ITEA Smart City Advisory Board, SCAB
- > Demonstrations and sales presentation pitches of partner VTEK at the Africa Invest Forum Turkey (AIFT), Istanbul, 2021

Exploitation (so far)

- > Container Localisation module integrated with TOS VPORT to decrease the number of operator's fault and of completion time of stacker movements, of the operator's usage of VMT and of incidents
- > Module for real-time environmental indicators' monitoring enhanced with predictive alarms integrated with Prodevelop's Posidonia Port Solution SW Suite
- > Reference prototype implementation of the Smart Logbook application according to emerging ISO 4891 standard (see below)
- > Follow-up customer projects for Active Noise Control (ANC) Solution for Noise Reduction to decrease noise emissions for allowing longer operating hours in port terminals

Standardisation

- > Significant contribution to and lead of ISO 4891 Smart Logbook Application standardisation (accompanied by NautilusLog's prototype reference implementation)

Award

- > 2021 CNA 'Intelligence for Transport & Logistics' Innovation Award for the project's pioneering work on outdoor Anti-Noise Control (ANC) in port environments

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Partners

Germany

- > Beyarnhafen TriCon Container-Terminal Nürnberg GmbH
- > catkin GmbH
- > DeltaPort GmbH & Co
- > Dortmunder Stadtwerke AG
- > Federation of German Inland Ports
- > Fraunhofer
- > Hamburg Port Authority AöR
- > Materna Information & Communications SE
- > NautilusLog GmbH
- > NXP Semiconductors Germany GmbH
- > University of Rostock

Spain

- > Gijón Port Authority
- > Prodevelop

Turkey

- > ERSTE Software Limited
- > SRDC
- > Turkcell Teknoloji
- > VTEK Information Technologies

Project start

October 2018

Project end

December 2022

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