Begonia

USE CASE 12:

Smart Ports Operations

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Use case 12: Smart Ports Operations

Use case identification

Table 1. Identification of use case 12.

ID	Name of Use Case	Geographical scope	Cross-sector domains			Interoperability layers
			Electric	Mobility	Data	
BEG.12	Smart Port Operations	☒ Local ☒ Regional ☐ National ☒ Cross-border ☒ Outermost	☐ Customer ☐ DER ☐ Distribution ☐ Transmission ☐ Generation	☐ Customer information ☒ Vehicle ☐ Energy station ☒ Infrastructure ☒ Traffic and logistic	☒ Edge ☒ Fog ☒ Cloud	☒ Component ☒ Communication ☐ Information ☒ Function ☒ Business

The scope and objectives of the use case

Table 2. Scope and objectives of use case 12.

Scope and Objectives of the Use Case	
Scope	The Smart Port Operations Use Case aims to revolutionize port management by integrating advanced monitoring technologies and digital platforms. Utilizing AI cameras and drone systems, the use case focuses on real-time monitoring of port operations, including docks, cranes, and ships, and volumetric measurement of stockpiles. Data from these technologies will be integrated into the Port's FIWARE digital platform, as adopted by the CEF. This integration sets the boundary for the project, emphasizing improved operational efficiency, safety, and sustainability in port activities
Objective	The main objectives of the use case are as follows: • Deploy AI-driven cameras and drone systems to monitor port operations in real-time, ensuring efficient management, improved safety, and security of docks, cranes, ships, and stockpiles. • Ensure seamless integration of data from AI cameras and drones into the port's FIWARE digital platform, enabling comprehensive data analysis, visualization, and informed decision-making. • Use accurate real-time data to optimize resource allocation, scheduling, and inventory management, promoting sustainable practices and reducing environmental impact. • Establish a scalable and replicable model for digital transformation in ports, fostering collaboration among port authorities, technology providers, and stakeholders for continuous improvement of smart port solutions. • Implement advanced technologies to streamline port operations, enhance overall efficiency, and create a framework that can be scaled and adapted to other ports globally.
Reference country(ies)	Spain
Related Business Case	Port management
Possible Stakeholders	Port operators and managers, Shipping companies, Drone service companies

Narrative of the use case

The Smart Port Operations Use Case is designed to revolutionize port management through the integration of advanced technologies and digital platforms. At its core, the initiative aims to enhance monitoring, streamline operations, and elevate safety standards within port environments.

Key components of the use case include the deployment of AI cameras strategically positioned throughout the port. These cameras continuously monitor vessel movements, cargo handling activities, and port infrastructure, providing real-time insights to optimize operations.

In addition to AI cameras, drones equipped with advanced sensors and imaging capabilities are deployed for daily reconnaissance missions over the port. These unmanned aerial vehicles capture detailed imagery of stockpiles and cargo storage areas, enabling accurate volumetric measurements and resource allocation optimization.

The data collected by AI cameras and drones is centralized and processed within the Port's FIWARE digital platform. FIWARE, a standardized and interoperable platform adopted by the CEF, serves as the central hub for data analysis and decision-making. It enables real-time monitoring, analysis, and collaboration among port stakeholders, facilitating swift responses to emerging situations and enhancing overall operational efficiency.

Through the Smart Port Operations Use Case, ports can achieve improved efficiency, safety, and sustainability, ensuring smoother operations and contributing to global trade and commerce.

Figure 1. The framework of the use case 12.

Diagram of the use case

The diagram of the use case 12 is presented in Figure 2. Actors' actions and scenarios' descriptions are presented in Table 3 and Table 4, respectively.

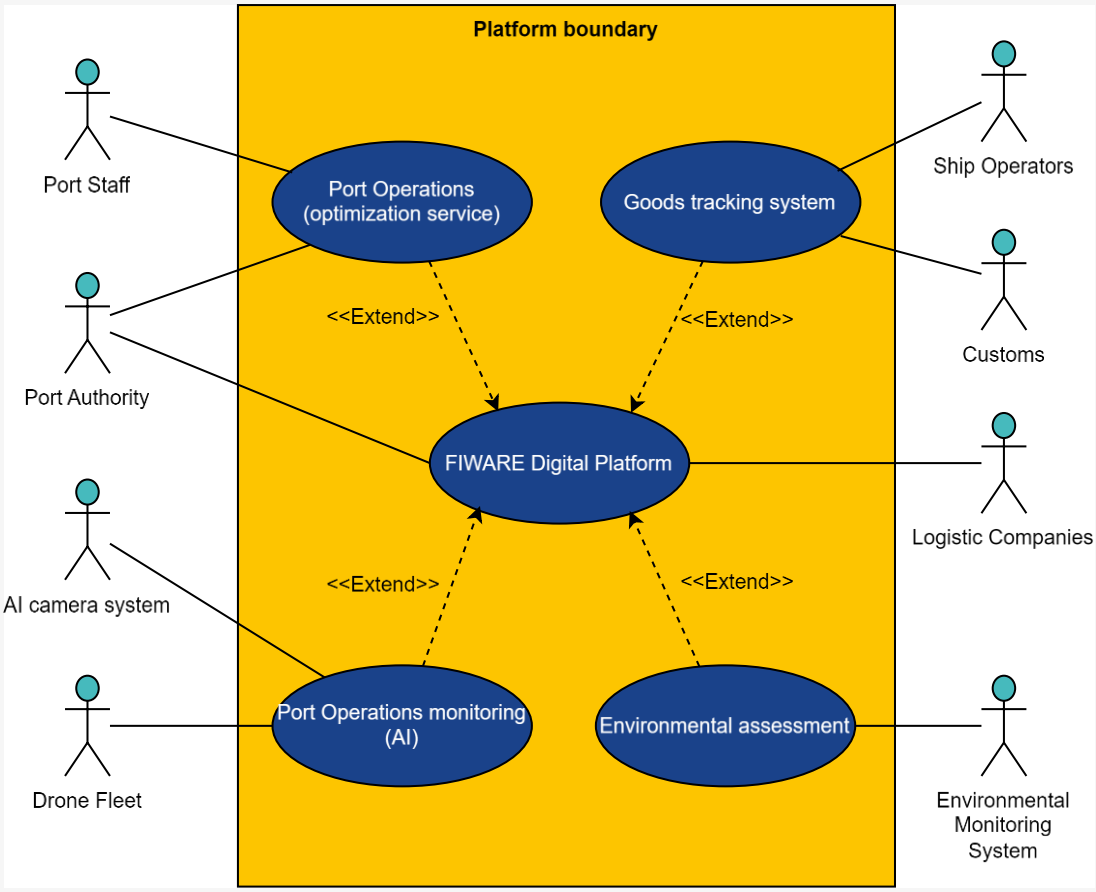

Figure 2. The diagram of the use case 12.

Actors of the use case

Table 3. Description of the actions of use case 12 actors.

Actor Name	Actor Type	Actor description	Actions	Standards
Port Authority	Role	The governing body responsible for the overall management, regulation, and administration of the port.	-Supplies input information about port regulations, schedules, and safety protocols. -Receives real-time operational data from AI cameras and drones. -Both supplies and receives information to ensure smooth and efficient port operations, overseeing all activities.	No
AI Camera System	System	An intelligent camera network installed throughout the port to monitor operations and detect anomalies.	-Supplies real-time video and analytical data to the central digital platform. -Receives configuration updates and operational commands from the digital platform.	ISO 27001
Drone Fleet	System	A fleet of drones programmed to conduct volumetric measurements and surveillance of the port.	-Supplies aerial data, including volumetric measurements of stockpiles, to the central platform. -Receives flight plans, operational commands, and data processing instructions from the digital platform.	EASA (EU) 2019/947.

Logistics Companies	Role	Companies responsible for transporting goods to and from the port, managing supply chains, and coordinating with port authorities.	-Supplies input information about shipment schedules and logistics requirements. -Receives real-time updates on port operations, traffic conditions, and potential delays.	No
Ship Operators	Role	Entities responsible for managing ships docking at the port, including cargo handling and scheduling.	-Supplies input information regarding ship arrival and departure times, cargo details, and operational needs. -Receives real-time updates on docking schedules, available resources, and any potential operational issues.	No
Customs Authorities		Government officials responsible for regulating and inspecting goods entering and leaving the port to ensure compliance with national laws.	-Supplies input information about customs regulations and requirements. -Receives real-time data on incoming and outgoing shipments to facilitate inspections and compliance checks.	National Regulations
Environmental Monitoring Systems	System	Systems installed to monitor environmental conditions, such as air and water quality, within the port.	-Supplies real-time environmental data to the digital platform. -Receives alerts and commands for data collection and reporting from the digital platform.	ISO 14001
Port Staff	Role	Employees working within the port, including dockworkers, crane operators, and administrative staff.	-Supplies input information on operational status, equipment conditions, and work schedules. -Receives real-time updates on operational tasks, safety protocols, and workflow changes.	No

Scenarios

Table 4. Description of use case 12 scenarios.

S.No	Scenario Name	Triggering Event	Scenario Description	Primary Actor
BEG.12.S1	Real-Time Monitoring of Port Operation	Detection of unusual activity or operational anomalies by AI cameras.	AI cameras installed throughout the port continuously monitor activities such as docking, loading, and unloading of ships. If the AI system detects unusual activity, such as unauthorized access to restricted areas or operational inefficiencies, it immediately sends an alert to the Port Authority through the FIWARE digital platform. The Port Authority reviews the alert, verifies the issue using the camera feed, and coordinates with the Security Personnel to address the anomaly. The security team takes necessary actions to resolve the issue and updates the Port	AI Camera System

			Authority. The incident is logged in the digital platform for future reference and analysis.	
BEG.12.S2	Volumetric Measurement of Stockpiles	Scheduled drone flight for daily volumetric measurement.	At a scheduled time, drones programmed to measure stockpile volumes take off and follow pre-defined routes around the port. They capture detailed aerial images and use software to calculate the volume of materials stored in the port. This data is transmitted to the FIWARE digital platform, where it is processed and analyzed. The Port Authority receives a detailed report on stockpile volumes, which is also accessible to Logistics Companies and Environmental Monitoring Systems for inventory management and environmental impact assessments. Any discrepancies or unusual findings are flagged for further investigation.	Drone Fleet
BEG.12.S3	Coordination of Ship Docking	Arrival notification of an incoming ship.	When a ship is approaching the port, the Ship Operators notify the Port Authority of its estimated time of arrival and docking requirements. The Port Authority uses real-time data from AI cameras and the digital platform to assess the availability of docking spaces and allocate a suitable dock for the incoming ship. The information is relayed back to the Ship Operators and the port workforce. Dockworkers prepare the allocated dock, and the ship docks smoothly. The process is monitored in real-time to ensure efficiency and safety. Any issues are immediately addressed by coordinating with the relevant actors.	Ship Operators
BEG.12.S4	Environmental Monitoring and Response	Detection of environmental threshold breaches by monitoring systems.	Environmental Monitoring Systems continuously collect data on air and water quality within the port. If any environmental parameter breaches the pre-set safety thresholds, the system sends an alert to the FIWARE digital platform. The Port Authority receives the alert and coordinates with Environmental Monitoring Systems and the port workforce to investigate the source of the pollution. Corrective actions are taken, such as adjusting operations or implementing mitigation measures. The response and actions taken are logged in the digital platform for regulatory reporting and future reference.	Environmental Monitoring Systems

Policy and digitalisation needs

Table 5. Description of use case 12 policy and digitalisation needs.

Policy needs	**Minimum regulatory requirements** • AI camera deployments and drone inspection involves collectiong and processing massive amounts of data, including potentially sensitive information. In this regard, the compliance with GDPR is essential. • Aviation and Drone Operation Laws: The use of drones for monitoring and volumetric measurements requires adherence to aviation regulations governing drone operations. This includes obtaining necessary permits, ensuring drones are operated by certified pilots, and complying with flight restrictions in and around port areas. • Port operations are subject to environmental regulations aimed at minimizing pollution and protecting marine ecosystems. This includes adhering to noise pollution standards and avoiding interference with wildlife. • Ports must ensure that their infrastructure can support the deployment of advanced technologies. This includes having adequate network bandwidth, reliable power supply, and robust IT infrastructure. **Legal and Social Factors** • The introduction of advanced technologies may necessitate reskilling and upskilling of the port workforce. Ensuring that workers are adequately trained to operate and interact with new technologies is essential for implementation • Determining legal liability in the event of technology failures or incidents involving AI cameras and drones requires clear legal frameworks.
Digitalisation needs	**Interoperability** • The FIWARE digital platform serves as a central hub for data integration. However, other ports may use different digital platforms. Ensuring compatibility and interoperability between FIWARE and other platforms • Ensuring seamless data integration between AI cameras, drones, and existing port management systems is crucial. This requires standardized data formats and protocols. **Technical infrastructure** • Reliable and high-speed network connectivity is key for the real-time transmission of data from AI cameras and drones to the digital platform. • Ports must have adequate data storage and processing capabilities to handle the amount of information. **Cybersecurity** • Implementing robust cybersecurity measures, such as encryption, secure access controls, and regular security audits is necessary. **Scalabilty** • Implementing a modular architecture allows for incremental upgrades and integration of new technologies • Flexible AI and drone systems that can be easily expanded or adapted to meet the specific needs of each port are needed.