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The Way to Digitization and the Integration of Intermodal Services in Ports

Summary

- Our global engineering firm SENER is leading the way towards digitization, energy efficiency and decarbonization of ports, as well as improving the management and integration of services related to logistics and inter-modality.
- In this paper, we are going to present two examples of digitization of ports developed by SENER:
  - a digital twin of the port of El Callao in Peru for the digitization of Port Assets Management and
  - a multimodal management port system for the port of Seville (Spain)

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Digital Twin of Port El Callao in Peru

What is a digital twin?

- It is a computer virtual representation that serves as the real-time digital counterpart of a physical object, infrastructure, process or operation
- Digital Twins gather data from multiple sources during the lifecycle stages of the object
- Generate key performance indicators (KPIs)
- Optimize performance of the operation

Digital Twin of Port El Callao in Peru

Award
- The American Association of Port Authorities and the Inter-American Ports Commission of the OAS have awarded APM Terminals Callao (APMTC), concessionaire of the Multipurpose North Terminal of Callao the Award for Excellence in the Port Industry 2022, in the category Technology and Innovation.

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Digital Twin of Port El Callao in Peru

Main advantages:
- Better decisión making
- Optimization of O&M (Operation & Maintenance)
- OPEX reduction
- Security and safety increase
- Reduction of environmental impact
- Operation is more sustainable

Functionalities:
- Centralization and accessibility of information in real time
- dashboards and decision support
- advanced analytics
- process optimization and automation
- predictive maintenance
- cost savings

Digital Twin of Port El Callao in Peru

### Improvements at the APM Terminal El Callao:

- Better operational reliability
- failures were reduced or eliminated
- increased capacity
- better availability and use of the Terminal
- savings in life cycle costs,
- optimization of maintenance activities
- number and magnitude of incidents were reduced

Digital Twin of Port El Callao in Peru

### Scope of Services provided at the APM Terminal El Callao:

- Creation of a digital twin using BIM methodology with a LOD 500 level for the TNM, oriented to O&M
- Proof of concept integrating the digital twin with SCADA Ignition
- Configuration and definition of specific properties associated to hierarchical assets under the operation and maintenance logic
- Generation of a control panel embedded on a web platform for the management and maintenance of the facilities under the domain of the digital twin
- Use of the digital model for in-field data acquisition via mobile devices
- Supporting the topographic survey and LIDAR subcontractor for the generation of the model
- Utilizing point cloud generation services to benefit modeling by means of BIM methodology
- Capturing 360-degree photographs while realizing site visits, and connecting it to the digital twin
- Recording instructional videos for the digital twin categorizing them by intended roles and functions

Digital Twin of Port El Callao in Peru
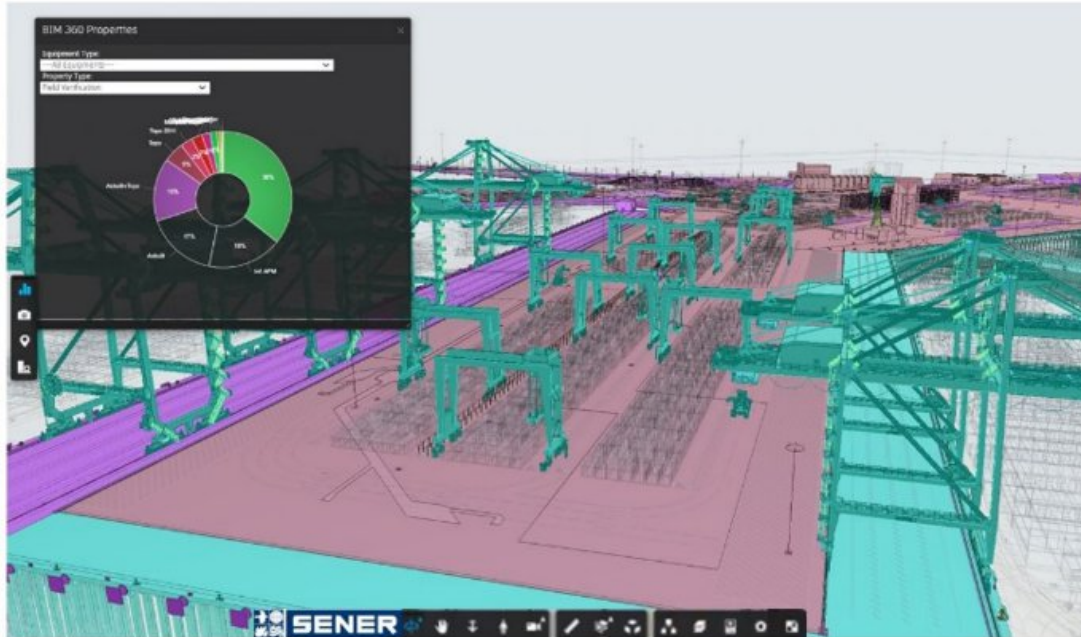
Digital Twin of Port El Callao in Peru
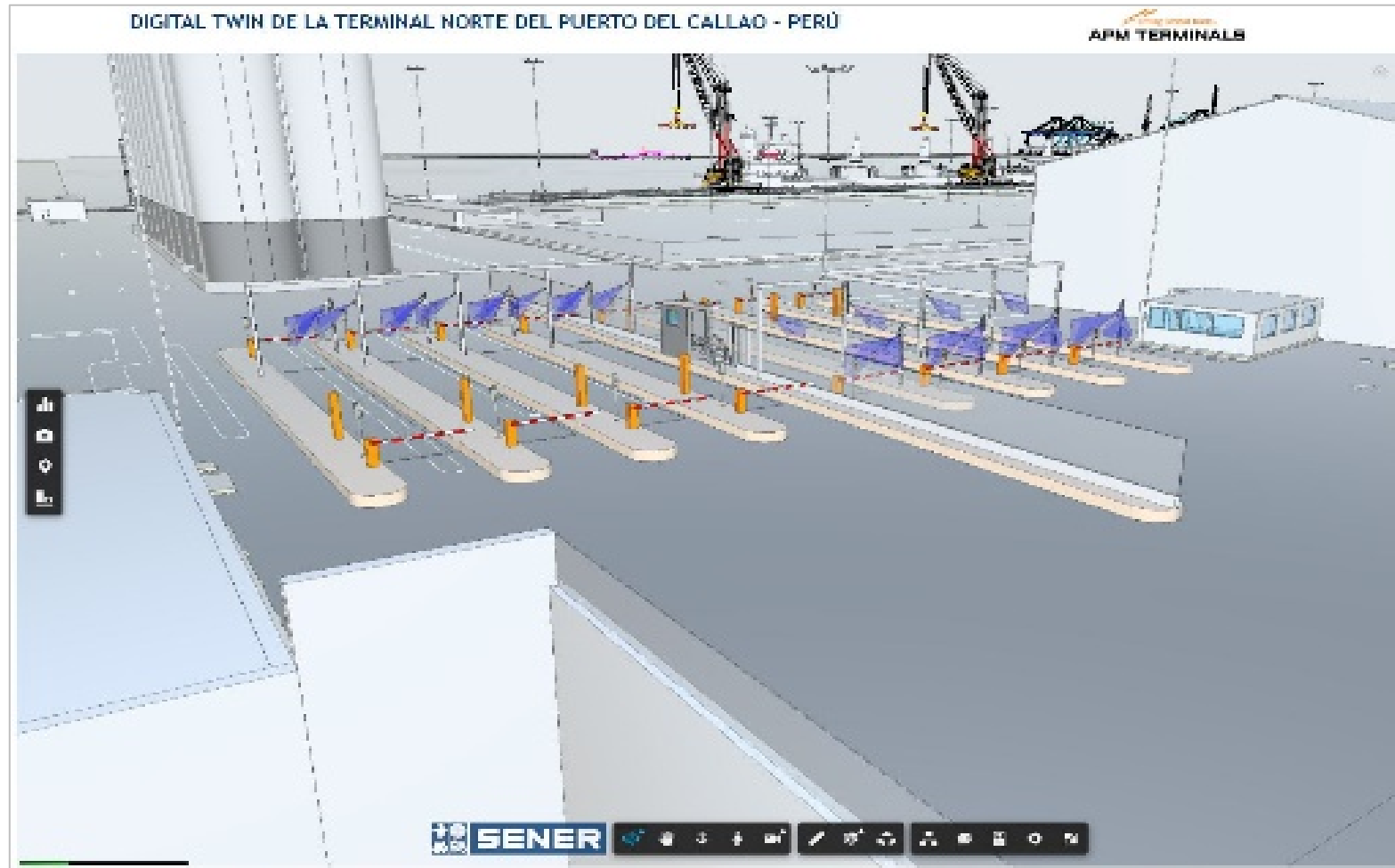
Digital Twin of Port El Callao in Peru

Application example:

An interactive logistics traffic simulation for the APM Callao Terminal is presented:
- Integration of the 3 tools already developed to feed each other dynamically to work together for a common goal in a common interactive 3D VR platform:
  - Digital Twin (Navis, BIM360)
  - Traffic Micro Simulation (Infraworks Traffic Analyst)
  - Queue Simulation Model (Python)

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Multimodal Management System: Airis II Synchro in the Port of Seville (Spain)

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Multimodal Management System: Airis II Synchro in the Port of Seville (Spain)

Objectives:
- Improvement of the navigability of the river Guadalquivir estuary
- Improvement of rail, maritime and road intermodal operations

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Multimodal Management System: Airis II Synchro in the Port of Seville (Spain)

Improvement of the navigability of the river Guadalquivir estuary

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Multimodal Management System: Airis II Synchro in the Port of Seville (Spain)

**Improvement of the navigability of the river estuary**
- **Requirements:**
  - Run a hydrodynamic Model of the Guadalquivir Estuary (tides, currents, winds, bathymetry...)
  - Development of timing and risk analysis tools to make it possible to identify the "operational windows" and maximize the draft of vessels in transit through the river.
  - Estimation of the risk of stranding by applying the Monte Carlo method
  - Specifications of type and characteristics of the vessels, navigation speed, tides and squat

Multimodal Management System: Airis II Synchro in the Port of Seville (Spain)

Improvement of the navigability of the river Guadalquivir estuary:

- Model output of the width and draft (UKC) available for navigation in the river
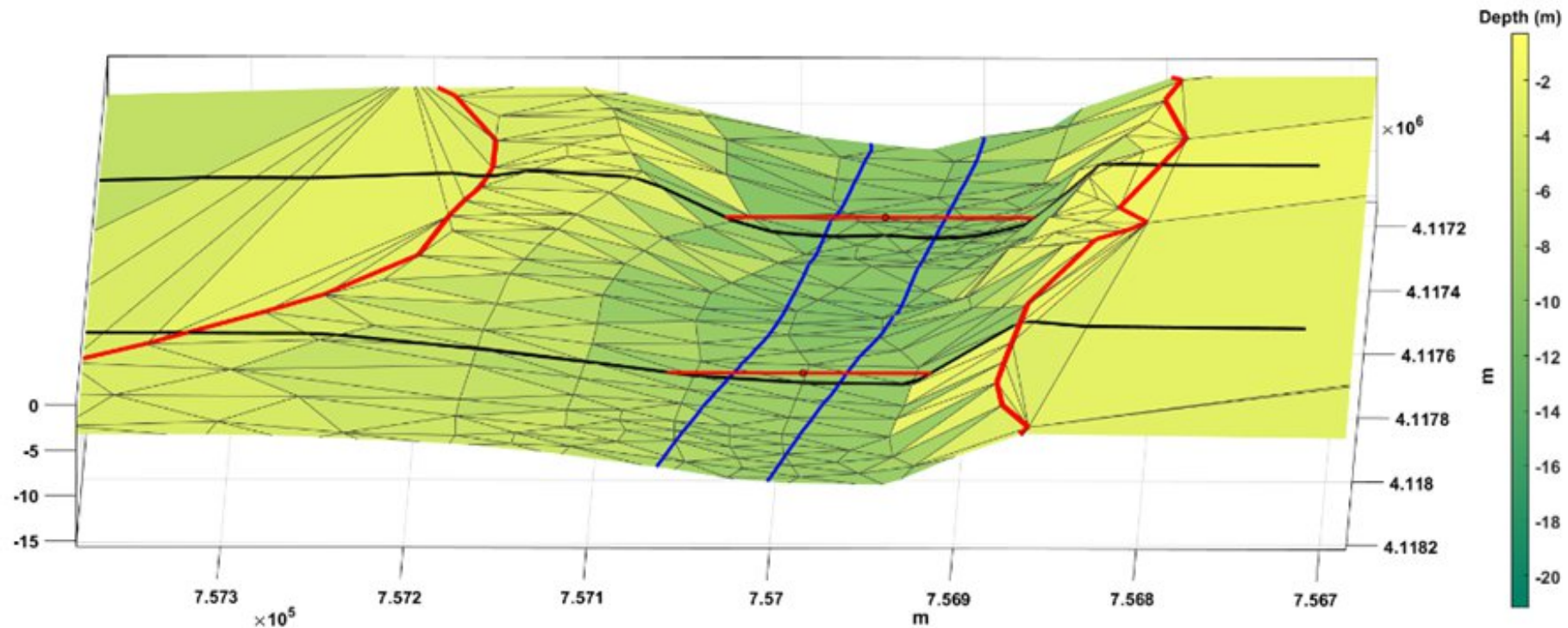
Multimodal Management System: Airis II Synchro in the Port of Seville (Spain)

Improvement of rail, maritime and road intermodal operations

Objectives and functions:

- Development of a synchromodal railway planning and management web tool in order to:
    - Plan the route of the railway convoys, optimizing their intermodal operations
    - Facilitate compliance with the planned schedules for trains in nodes before and after the Port of Seville in the logistics networks.
    - Monitor the key elements that affect circulation: state of level crossings (interrelation with the road mode) and presence of ships in the surroundings of the Port of Seville
    - Integrate the solution into the technological infrastructure of the Port of Seville through its Advanced Service Integration Platform
    - Manage and supervise the port's transportation modes (road, sea and rail)
    - Plan the road traffic to the port using an access management tool and entry requests by trucks
    - Integrate all the previous tools so that they are accessible from a single platform

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Multimodal Management System: Airis II Synchro in the Port of Seville (Spain)

Improvement of rail, maritime and road intermodal operations
Advantages:

- The web application allows real-time visualization of the port's three modes of transport (road, sea and rail) based on the information shared by each of the modes
- It also allows the user to plan operations, in which arrival and departure estimated time data (ETA and ETD), freight, dock and other relevant information to improve the operation of the port of Seville
- A Gate Appointment System has also been developed for trucks entering the port in such a way that they are synchronized as much as possible with the rest of the modes of transport
- This makes it possible to synchronize the arrival of the ship and/or train with that of the truck. This results in savings in waiting times with the consequent reduction of emissions into the atmosphere.

Conclusions

Digital Twin for APM Terminals at Port El Callao (Peru)

- The digital twin developed by SENER in Port El Callao (Peru) for the digitization of the port assets resulted in many advantages in decision making, in optimization of O&M and in OPEX reduction
- It also allowed an operational reliability, since failures were reduced or eliminated, allowed an increased capacity through a better availability and use of the Terminal, allowed savings in life cycle costs through the optimization of maintenance activities, and also increased security.

Conclusions

Modeling Hydrodynamic Tools and Syncromodality for Port of Seville (Spain)

- The numerical modeling tools developed to improve the navigability and hydrodynamic behavior of the Guadalquivir River made it possible to establish the maximum entry and exit drafts depending on the tide level, as well as the operational slots for the vessels.
- Also, precise and updated knowledge of the bathymetry of the navigation channel made it possible to optimize the access and exit UKCs.
- Moreover, within the framework of the AIRIS II – SYNCHRO project for the Port of Seville, a port transport management and planning web tool has been developed
- This web application allows real-time visualization of the port's three modes of transport (road, sea and rail) based on the information shared by each of the modes
- This tool allows the user to plan operations, in which arrival and departure data, what freight, what dock and other relevant information for the programming of resources to improve port operations

Perspectives

- The perspectives of the implementation of these digitization tools are promising in terms of optimizing cost and time savings in the port asset management and the efficiency of intermodal transport services
- Finally, the next arrival of new AI tools will surely boost the improvements of these innovation techniques for smart ports applications

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THANK YOU

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