

State of the Port Technology

"Digital Twin and Artificial Intelligence transforming decision-making at Ports & Terminals"

- Dr. Oscar Pernia, November 2023



Moffatt & Nichol today

Strategic investment in Technology & Innovation in Spain





Our SmartPort 'vision'

Digital Transformation as catalyst towards Supply Chain visibility, flexibility and sustainability



Evolving Simulation to Digital Twin

Market segments, Product and Applications





WITHOUT DATA, IN QUANTITY & QUALITY, A.I. WILL HAVE A MINOR IMPACT – DIGITAL TWIN WILL ENABLE CONNECTING PROCESSES, SYSTEMS AND DATA: EASING A.I. TO BE PRACTICAL AND INCLUSIVE

Focus Areas for Ports

Just-In-Time Operations and Synchromodality as catalysts for efficiency and sustainability



Case Study Ro-Pax Operations

Problem Statement

Complexity of Operations during OPE time:

- Up to 8500 vessel calls
- 3,3M pax and 750K vehicles in 2 months
- Peaks of up to 11 rotations/berth/day

Any change at planning causes a spillover effect in the whole Port Operation, impacting **Control Room Users** with uncertainty and stress:

• Stakeholders sharing data and prognosis 'adhoc', with multiple manual calculations.





Case Study Ro-Pax Operations

Concept Solution

The combination of **multiple data sources** and enough historical baseline to generate a background learning ML process.

A 360 Digital Twin solution providing:

- Live Mirroring Waterside Operation,
- ML Prediction to alert Berth conflicts,
- Prescription of potential Solutions,
- 'What If' analysis of prescribed actions with Simulation for landside traffic.



Case Study Ro-Pax Operations

Value Brought

Enhance control and collaboration across waterside and landside decisions, enabling **datadriven decision making**.

Continuous improvements and processoriented focus at Control Center, generating significant benefits at efficiency and sustainability.





Case Study JiT Bunkering Operations

Problem Statement

EU R&D project to bring planning to a **A.I. usercentered framework**, which among others:

- Make AI planning relevant to different sectors
- Facilitates research and lower access barriers

As a particular use case, **bunkering process** can be subject to optimization:

 Maritime dynamics create uncertainty on the planning of services such as bunkering, tugging, pilotage, ...

"First come, first served" as common bunkering practice due to **lack of "look ahead" visibility**.







Case Study JiT Bunkering Operations

Concept Solution

Leverage EU approach and framework to develop A.I. algorithms to optimize the bunkering process at Ports:

- ML Model for **bunkering lead time** prediction, based on historical data
- Calculation of **vessel waiting time** using an algorithm to detect drifting

And feed resulting predictions to AIPLAN4EU Planning Optimization Engine for knowledge generation and collaboration.





Case Study JiT Bunkering Operations

Value Brought

R&D effort to complement our solution to enable the **Just-In-Time paradigm**:

 Providing stakeholders with updated information, and improving efficiency and sustainability

EU promotes a common framework where different sectors, universities and companies can collaborate for **A.I. adoption**.





PORTS WILL LEVERAGE A.I. TO BETTER UTILIZE ASSETS AND TO ENABLE SUSTAINABLE OPERATION: DIGITAL TWINS WILL 'LEARN-FROM-PAST' AND 'LOOK-AHEAD' MORE PRECISELY IN INFRASTRUCTURE AND OPERATION

Focus Areas for Terminals

Combining multiple sources to improve decisions and minimizing risk for system integration



Case Study Assets Performance

Problem Statement

Productivity drops without a clear understanding about root-causes:

 e.g. TTs very low productivity, when Yard gets above 60% occupancy. Increasing #TTs per QC maintains the productivity but impacts traffic & OPEX.

Difficult to take **data-driven decisions** and to influence staff **behavior & mindset for performance**.

• Several applications but difficult for analytics and not persistent data for A.I.



Case Study Assets Performance

Concept Solution

Generate a **digital process replica** with data from telemetry (PLC, IOT) and TOS operational data and split the data to **analyze Assets Performance**.





Case Study Assets Performance

Value Brought

Generate a standard and centralized system agnostic capability to **get value from Data**, and open opportunities for Digital Twin and AI applications.



Digital Twin provides more precise and actionable information from Assets: (A) **Monitor Operations** in real time, triggering & managing **Alarms**; and (B) **Predicting bottlenecks**, by Data continuous analysis.

Case Study System Integration

Problem Statement

PSA develop their own TOS & ECS, going through important **Automation Deployments**: testing & integration environment help implementation, improve efficiencies and simpler operations.

Size and complexity of systems implementation and their integration is key for new automated terminals:

- Pasir Panjang project (32M TEUs).
- TUAS project (65M TEUs).





Case Study System Integration

Concept Solution

Create detailed digital replicas of PSA equipment that connect to TOS and ECS.



Full testing and validation environment, processing and acting on more than 600 different message types: interfaces validation, whole system integration testing, database models accuracy, stress / scale testing and exceptions handling testing.

Case Study System Integration

Value Brought

Provide low-risk **development environment** for TOS-ECS development, speeding up test cycle and integration.

FlexTerm[™] Emulator utilized for:

- Safer **Testing** with emulation before rolling SW into a production,
- Support **Bug fixing**, limiting unexpected performance bottlenecks,
- Comprehensive 'System parameters tuning' to reduce risk and train staff,
- Continuous optimization improving operations systematically.







TERMINALS EFFICIENCY AND INNOVATION BY ADDED VALUE FROM DATA, AND APPLYING A.I. - AUTOMATION NEEDS TO MINIMIZE RISK OF INTEGRATION, USING DIGITAL TWIN ALSO WITH TRAINING AND OPTIMIZATION

Thanks

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