



Easing Automation:

Key Guidelines for Data Integration and System Interoperability

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Port Technology
International

The Rise of Intelligent Terminals

Building the Data Backbone to Enable Automation and AI



NEXTPORT

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Context - The New Automation Landscape

Democratizing Smart Ports

Automation is no longer reserved for mega-terminals with multi-hundred-million-dollar budgets. Small to mid-sized terminals can now modernize effectively.

Pragmatic, step-by-step upgrades allow operators to automate without high capital risk or massive operational disruption.

Step-wise Incremental Steps

Focusing on high-impact operational nodes—such as automated gate OCR, CHE tracking, and energy management—unlocks immediate ROI.

By modernizing software layers and system connections, terminals achieve lower OPEX, improved safety, and supported decarbonization targets.

Example: Gate Process Automation

Gate OCR portals and associated process automation software serve as an ideal first step into terminal automation due to their fast payback and clear operational benefits:

- **Automated Capture:** Scans container numbers, ISO codes, license plates, hazard labels...etc automatically.
- **Enhanced Safety:** Moves gate checkers out of hazardous traffic lanes into safe, centralized control rooms.
- **Queue Minimization:** Dramatically increases truck throughput, reducing landside congestion and idle emissions.



Gate Automation - Value Delivery and Efficiency Gains

A light blue rounded rectangular box containing the text '40%' in a large, bold, blue font, with 'Turnaround Time Reduction' in a smaller, bold, blue font below it.

40%

Turnaround Time Reduction

Targeted ROI & High Data Accuracy

Implementing gate automation and integrated data workflows produces immediate, measurable operational metrics:

> 95%+ Read Accuracy: Advanced AI-driven imaging replaces manual keyboard entry, virtually eliminating clerical errors in container tracking.

Lower OPEX & Emissions: Shorter driver dwell times cut truck idle fuel consumption, directly supporting port sustainability targets.

Challenge: IT Landscape and System Interoperability

- *Connecting hardware, operational systems and business platforms effectively*

IT and OT Architecture Layers

IT / Business Layer

Core Platforms: Terminal Operating System (TOS), Crane Maintenance Mng System (CMMS), Enterprise Resource Planning (ERP).

Primary Function: Vessel planning, manages order scheduling, billing, yard allocation planning and high-level business analytics.

OT / Execution Layer

Control Hardware: Gate Operating Systems (GOS), Equipment Control Systems (ECS), Positioning Systems (PDS), OCR camera portals, PLC logic.

Primary Function: Executes physical container handling, sensor data capture, and real-time equipment dispatching.

Core Integration Guidelines



Adopt Event-Driven Architecture:

Shift from legacy batch file exchanges to modern REST APIs, webhooks, and message brokers for instant event delivery.



Maintain Real-Time Data Sync:

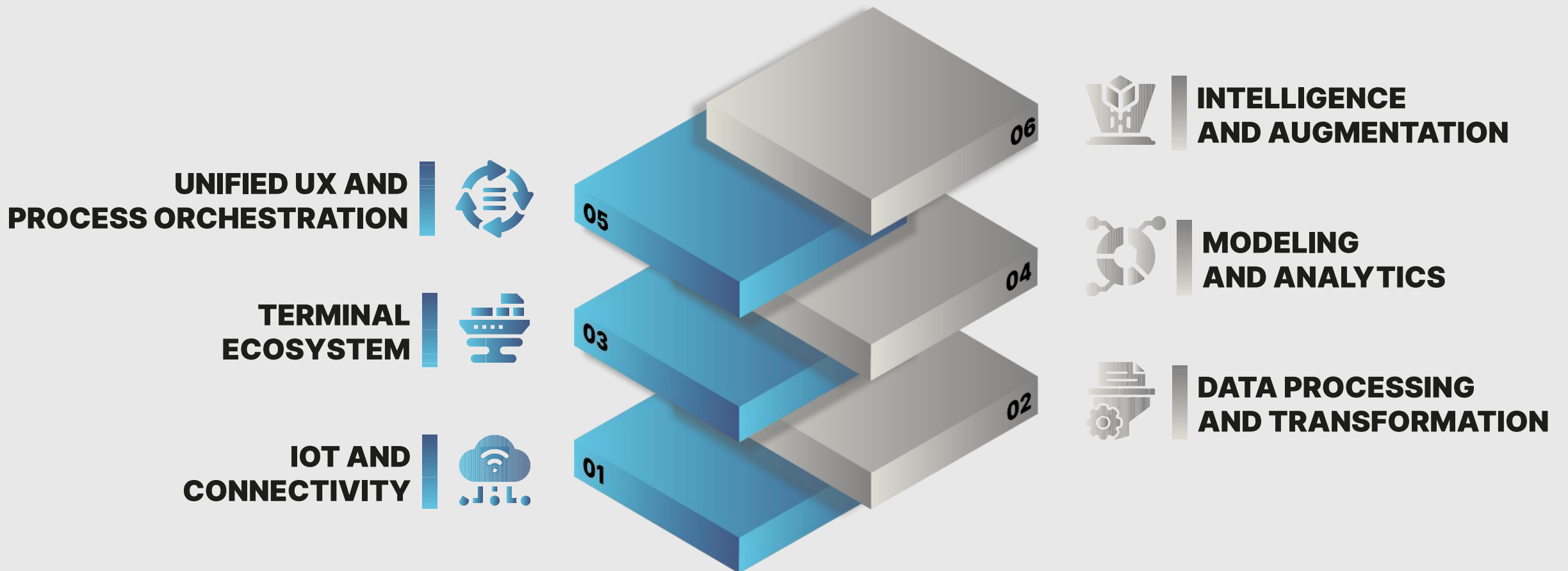
Guarantee sub-second synchronization between physical events & process automation and the core business systems like TOS, ECS or CMMS.



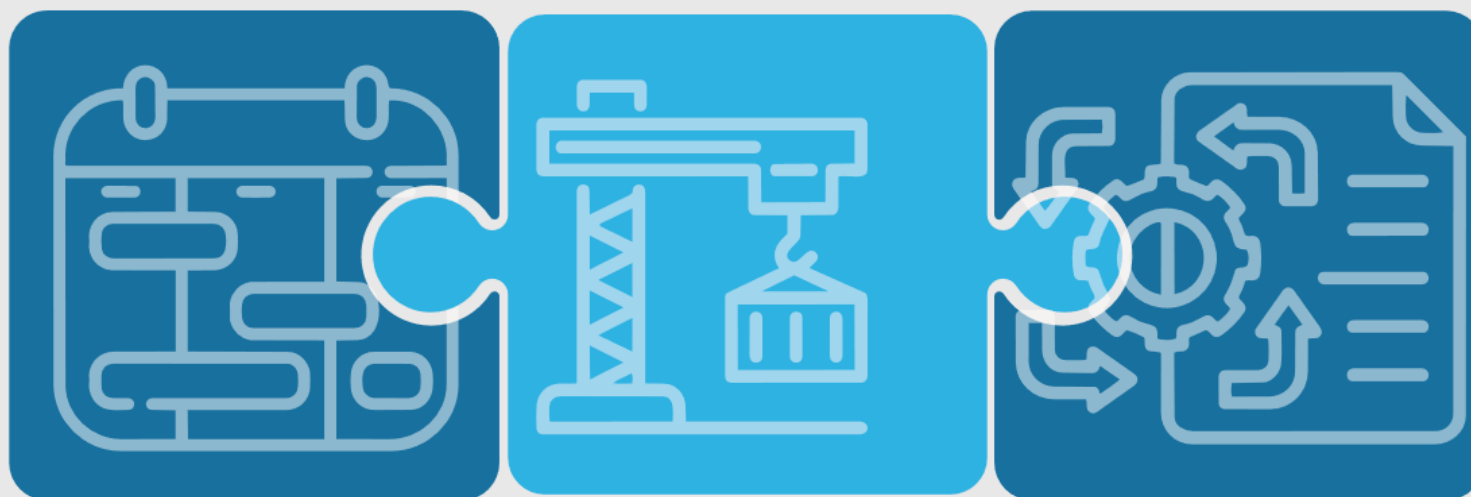
Establish Robust Workflows:

Design automated processes with exceptions handling instrumented and digitized inter-departmental procedures.

Way-forward: Next-Gen Terminal Layers



The need of a Data Backbone



**PLANNED STATES:
DEFINING THE EXPECTATION**

Initial roadmap from TOS detailing what was supposed to happen.

**EXECUTION EVENTS:
CAPTURING OPERATIONAL
REALITY**

Real-time signals from equipment (PLC) and IoT devices, including waypoints, health signals, and timestamps.

**PLANNING CHANGES:
TRACKING THE EVOLUTION**

Documentation of how and why the plan shifted or evolved, bridging the gap between original intent and final outcome.



TOS
(TERMINAL OPERATING
SYSTEM)
Initial Roadmap,
Estimated Times,
Assignments

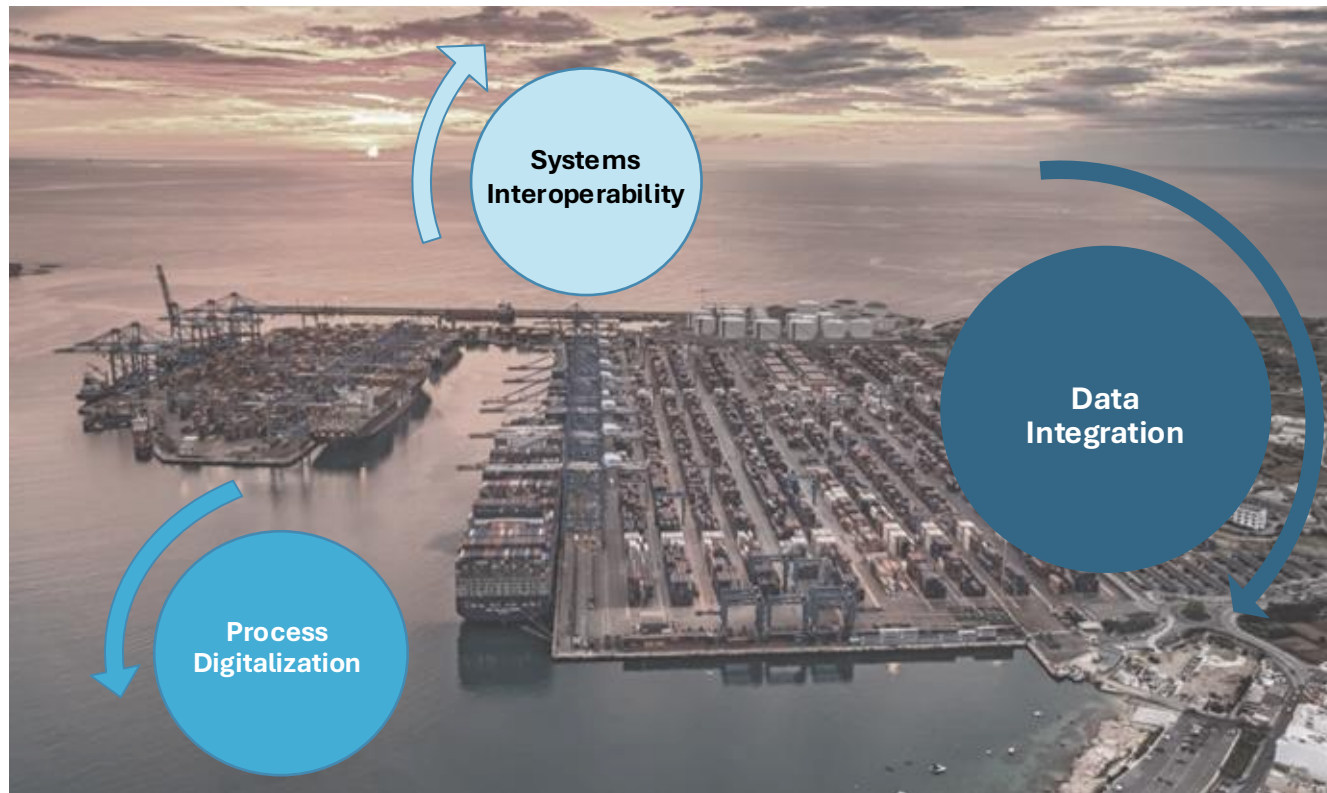


EQUIPMENT (PLC)
Real-time Signals,
Health, Timestamps



IOT DEVICES
Waypoints, Precise
Data

Industry Standards – Enabling a Data Backbone



Key Takeaways

Start Small • Architect Ecosystem • Scale Smart

Data Integration and System Interoperability make automation accessible to terminals of all sizes without massive capital risk and optimizing time-to-value.

Our Industry cannot expect intelligent automation, neither practical impact of AI, if we cannot first achieve harmonized Data Integration.



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Thanks!