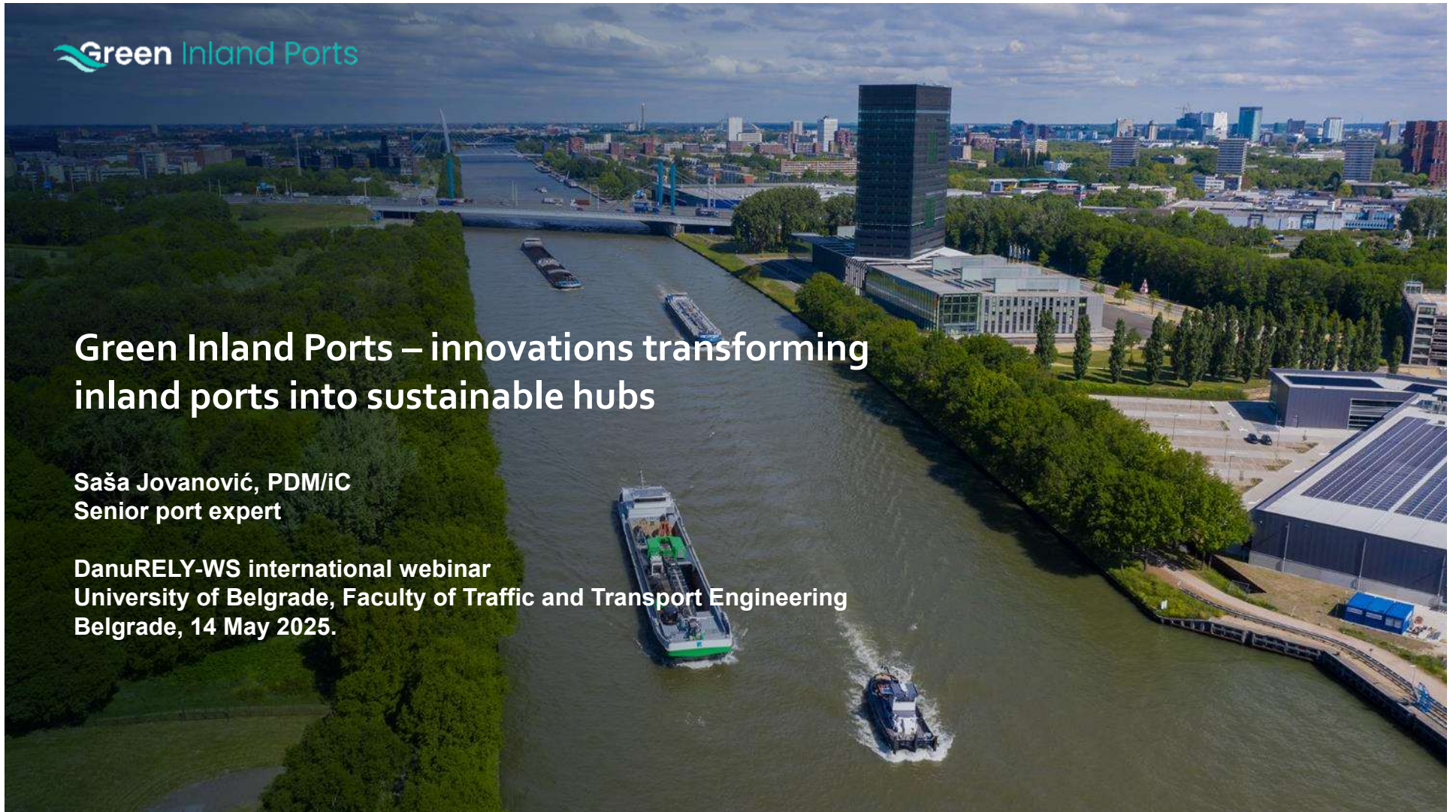**Green Inland Ports**

Green Inland Ports – innovations transforming inland ports into sustainable hubs

Saša Jovanović, PDM/iC
Senior port expert

DanuRELY-WS international webinar
University of Belgrade, Faculty of Traffic and Transport Engineering
Belgrade, 14 May 2025.

Policy context, objectives, scope and timeline

Policy context

- Pilot project study proposed by the European Parliament

- **Sustainable & Smart Mobility Strategy: "Flagship 2 Creating zero-emission airports and ports"** and **NAIADES III**

Objectives

- Identify and evaluate the factors affecting the sustainable development of inland ports

- Propose solutions for the implementation of green objectives paired with their economic development

Geographical scope

- All TEN-T inland ports

- Connecting seaports where inland waterway transport is concerned

Timeline

- November 2022 – November 2025

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General methodology and approach

Task 1 – Environmental impacts and Efficiency and Transition

- Document environmental effects, related legislation and which effects are not addressed & the impediments in implementing sustainable management and development

**Task 2 – Urban mobility and Short-Range Inland Waterway Transport**

- Identify possibilities of adopting inland waterway transport for urban mobility and short-distance transport

Task 3 – Digitalisation

- Assess the role of digitalisation and propose solutions

Task 4 – ESMS and pilot implementation of ESMS in selected inland ports

- Pilot projects of several inland ports for implementing the Environmental and Sustainable Management Systems (ESMS) tools and implement coordinated actions for sustainable port management and operation

Task 1
Environmental Impacts and Energy Efficiency and Transition

Task 2
Urban mobility and Short-Range Inland Waterway Transport

Task 3
Digitalisation

Task 4
ESMS and pilot implementation of ESMS in selected inland ports

Task 5
Outreach activities
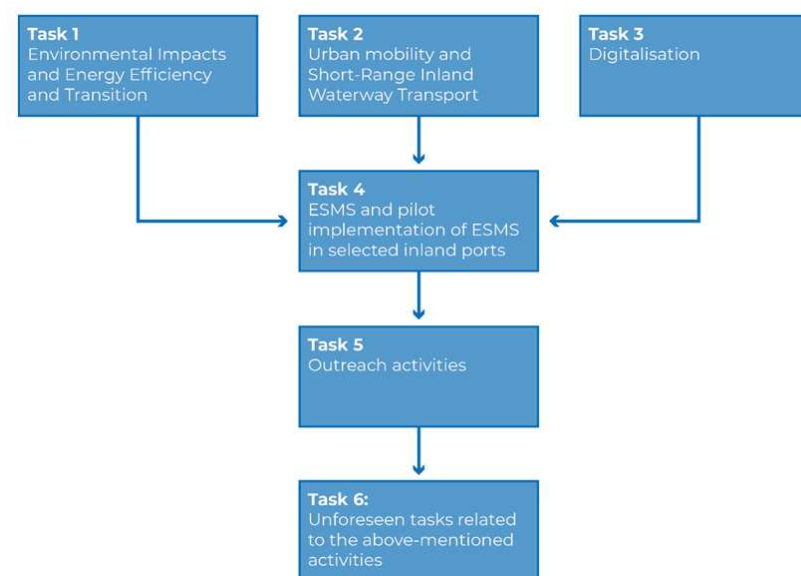
Task 6:
Unforeseen tasks related to the above-mentioned activities

Objective and activities of Task 3 - Digitalisation

Objective: assess the potential of digitalisation for greening port operations, for ensuring multimodality and for facilitating sustainable development of inland ports

Activities:

1. **Regulatory framework** addressing inland ports digitalisation

2. **Inventory** of port cooperation and collaboration systems

3. **Process optimisation** and **interoperability improvement**

4. Inventory of **good practices** at EU and international level

5. **Digitalisation Masterplan** for inland ports and terminals comprising of the lessons learned based on the above results, a gap analysis being rolled out currently and further interviews/inputs from stakeholders

What is digitalisation in inland ports context?

- A process of applying and integrating available digital tech into port processes and activities to improve port management & operations.

- Preconditions:

  - **Robust IT infrastructure**: stable, reliable & fast internet, advanced networking systems, adequate server and data storing capacity, modern hardware & software.

  - **Data sharing**: agreements, guidelines & protocols between various stakeholders as data owners.

  - **Cybersecurity measures**: mitigation of cyberthreats.

  - **Standardised data formats**: formats such as EDI (Electronic Data Interchange), XML (eXtensible Markup Language), JSON and UN/CEFACT XML-based UNCEFACT XML and UN/EDIFACT.

  - **Trained labour**: creation of "cyber-aware" and "cyber-competent" workforce.

  - **Stakeholder collaboration**: governmental organizations (customs, police, etc.), port authorities & operators, forwarders &, land carriers, etc.

  - **Clear digitalisation strategy**: definition of goals & scope of digitalisation

Source: https://www.researchgate.net/publication/348269178
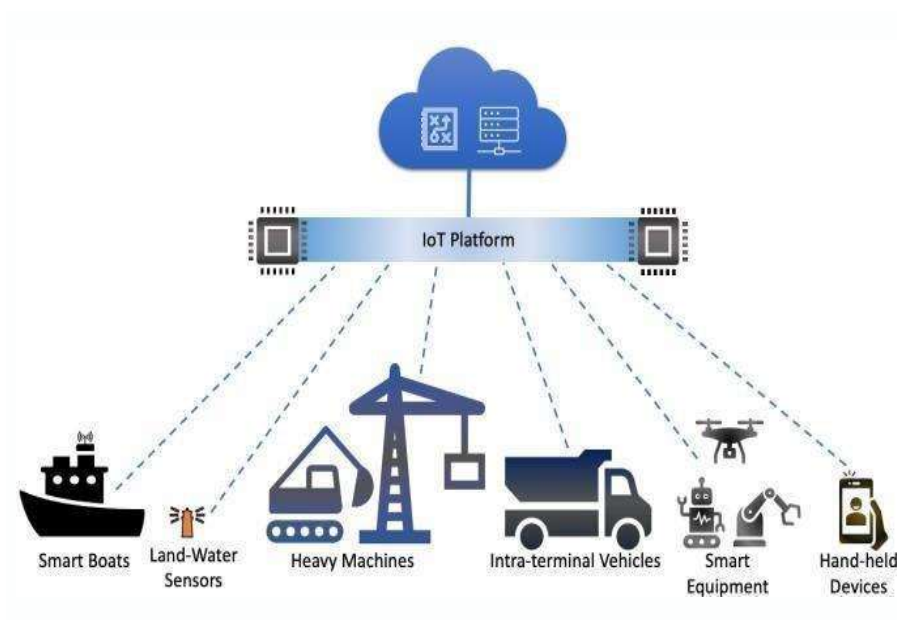
Sensors and devices as building blocks of digitalisation
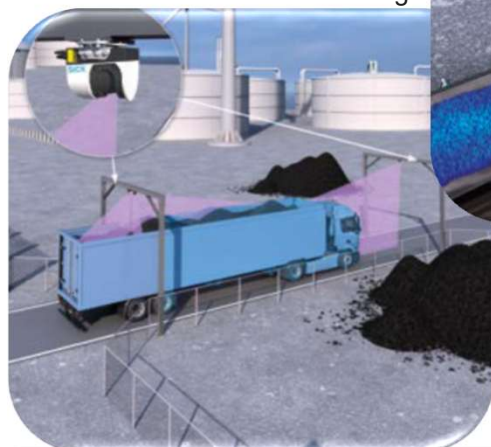
Temperature measurement of bulk cargo

Environmental perception on terminal tractors

Object detection on ship loaders

Volume measurement of bulk cargo

All illustrations courtesy of www.sick.com

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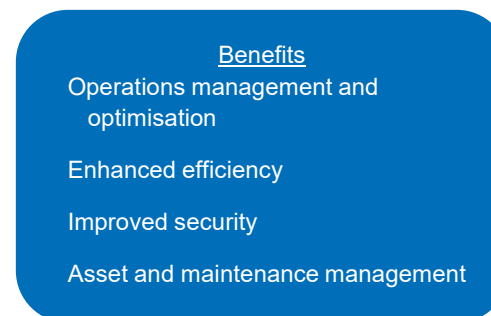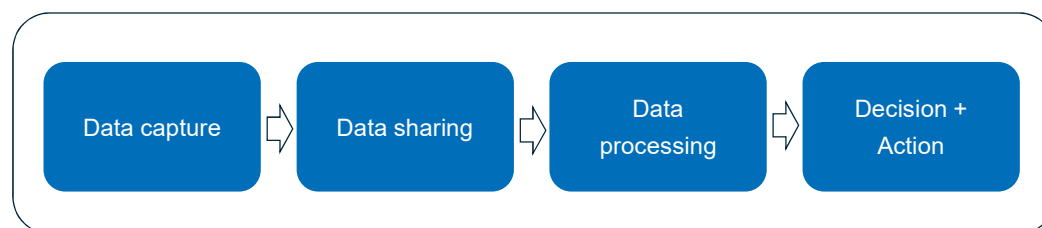ECORYS   CE Delft   Panteia Research to Progress   pro DANUBE   Erasmus Universiteit Rotterdam   EICB

Advanced port digitalisation technologies

Internet of Things (IoT)

- *"Network of devices such as sensors and embedded systems connected to the Internet, thus enabling physical objects to collect, transmit and exchange data."*

- IoT sensors can be literally placed anywhere.

- Movable and unmovable objects

- Cranes, quay walls, cargo handling equipment

- Tracking vehicle accumulation

- Congestion management

- Gate management

- Environmental monitoring

| Data capture | Data sharing | Data processing | Decision + Action |

Benefits
Operations management and optimisation

Enhanced efficiency

Improved security

Asset and maintenance management

Blockchain technology

...a digital system that securely records and shares information about cargo, shipments, and port activities in a way that everyone involved can see, trust, verify and use to make port operations faster, safer, and more transparent.

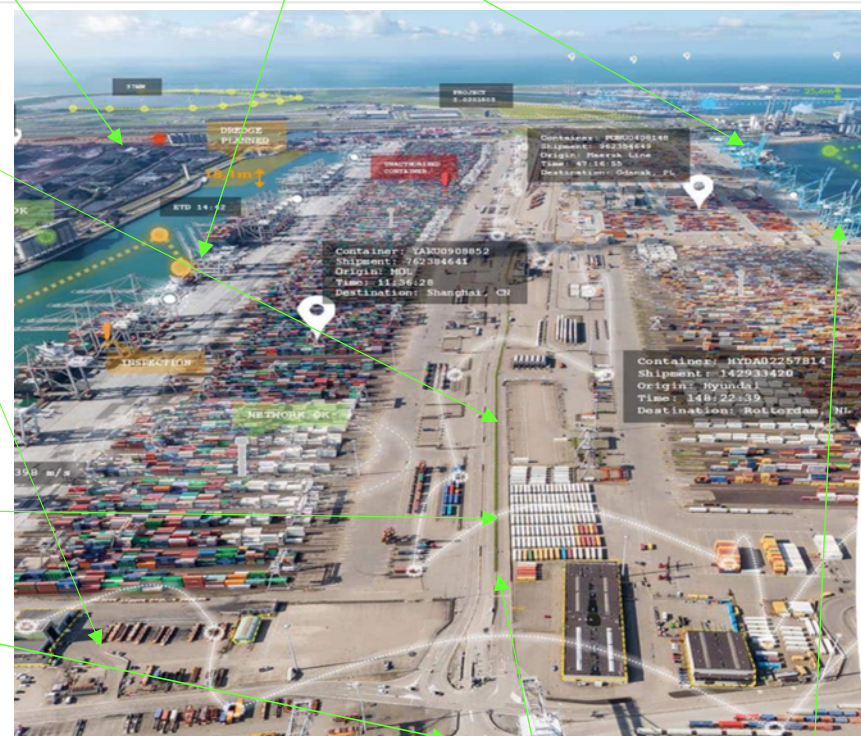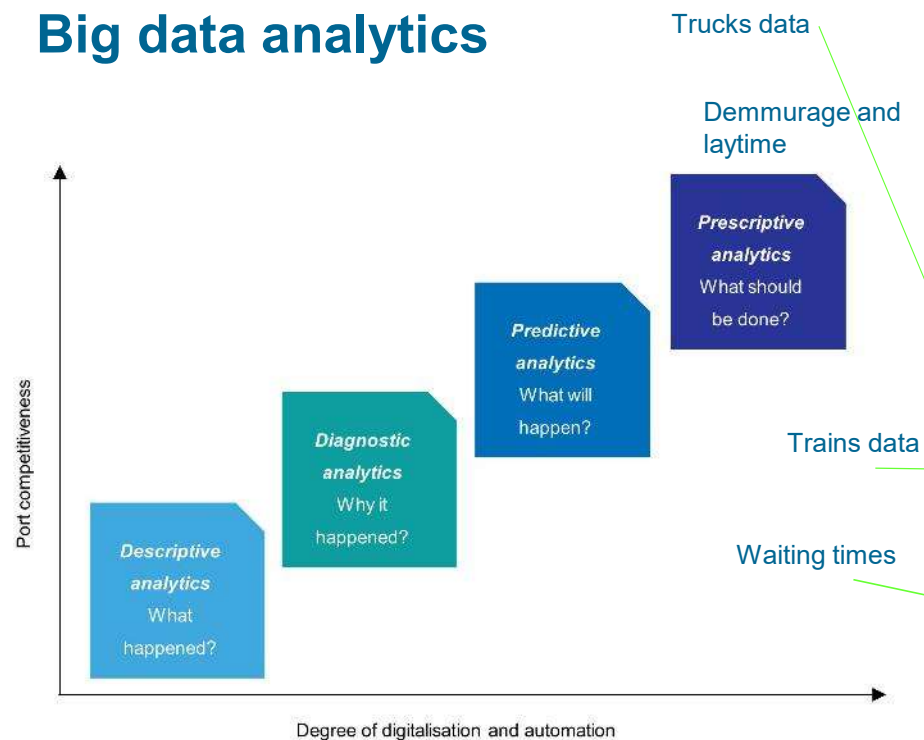|						
• Shipment prepared, ID created. • Info on shipment and involved parties entered into the blockchain (app or platform). • All parties validate the info. • **Block 1 created**.	• Carrier (freight forwarder) initiates the next step in supply chain. • Relevant info entered into the blockchain. • All parties validate the info. • **Block 2 created**.	• Loading port takes over the shipment, initiates the next step. • Relevant info entered into the blockchain. • All parties validate the info. • Smart contract initiated and shipment released. • **Block 3 created**.	• Cargo taken over and carrier by shipping line. • Relevant info entered into the blockchain. • Progress info added – ETA, delays, etc. • All parties validate the info. • **Block 4 created**.	• Unloading port unloads the cargo. • Relevant info entered into the blockchain. • All parties validate the info. • Smart contract triggers the next step, shipment cleared & released to land carrier. • **Block 5 created**.	• Land carrier (freight forwarder) performs its step. • Relevant info entered into the blockchain. • All parties validate the info. • Smart contract triggers the next step and shipment released to receiver. • **Block 6 created**.	• Retailer/receiver, receives the cargo. • Relevant info entered into the blockchain. • All parties validate the info. • Smart contract fulfilled. • **Block 7 created**.

• **Parties in the supply chain**: manufacturer, shipper, freight forwarder, land carriers, shipping line, port, customs, sanitary authorities, bank, retailer, receiver, etc. All-time access to info in blocks.
• **Relevant info**: shipment ready at the factory, quantity, pre-haulage completed, delivered at port, loaded, in transit, vessel ETA, position, insurance paid, freight paid, customs cleared, etc.
• **Smart contract**: Self-executing contracts with the terms of the agreement directly written into code. They automatically enforce and execute the terms of the contract when predefined conditions are met.

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Big data analytics

Green Inland Ports

Funded by the European Union

Port competitiveness

Descriptive analytics
What happened?

Diagnostic analytics
Why it happened?

Predictive analytics
What will happen?

Prescriptive analytics
What should be done?

Degree of digitalisation and automation

Cargo data

Vessels data

Structural loads

Trucks data

Demmurage and laytime

Trains data

Waiting times

Environmental parameters

CHE productivity

Traffic density

https://spire.com

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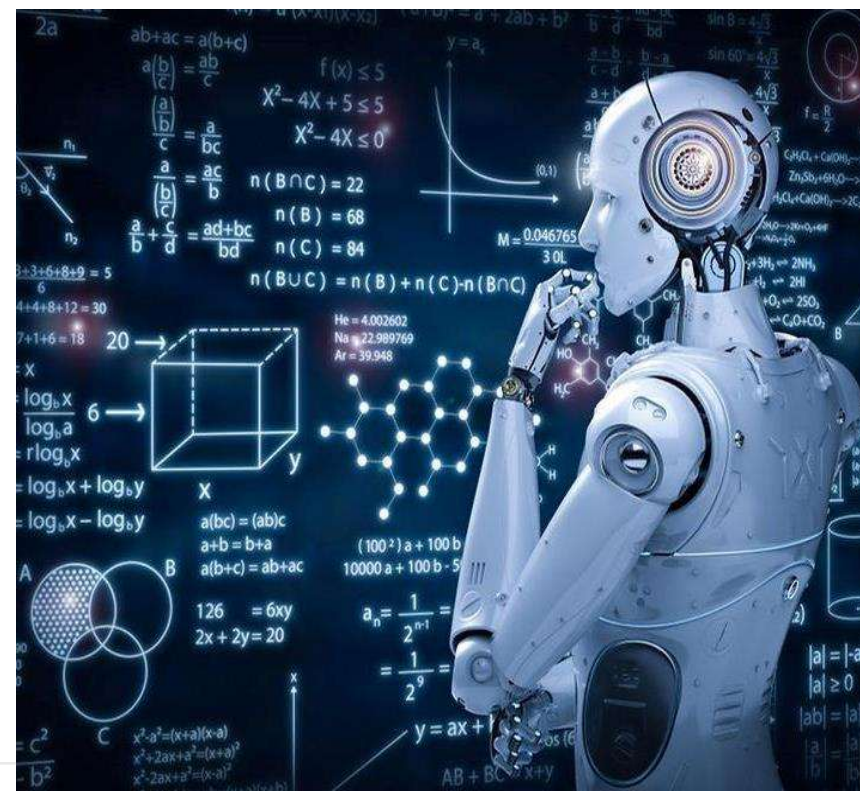
Artificial intelligence

- "*Simulation of human intelligence in machines (hardware and software), allowing them to execute tasks that would otherwise require human intelligence.*"

- **Tasks**: problem-solving, learning, reasoning, recognising patterns, understanding human language, and making, suggesting and explaining decisions.

- Uses IoT devices, big data, blockchain and other technologies to perform tasks it is programmed to do.

- **Cargo management**: cargo handling optimisation, predicting or managing arrival times, identifying priority shipments and suggesting optimal storage and loading strategies → reduced congestion, faster turnaround times.

- **Predictive maintenance**: monitors conditions of port infrastructure and equipment in real-time, enabling predictive maintenance to prevent breakdowns and accidents, thus reducing costs and increasing efficiency.

- **Traffic management**: AI algorithms analyse vessel & vehicle movements to optimise traffic flows within port areas, minimising congestion and emissions, maximising efficiency.

- **Environmental monitoring**: suggesting environmentally friendly practices and strategies, thus directly assisting in environmental footprint reduction.

https://www.kio.tech/en-us/blog/do-humans-and-ai-think-alike

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Digital Twins for ports

- Digital Twin - a virtual representation of a physical facility.

- A digital copy of virtually everything in the port: buildings, light poles, fences, quay walls, bollards, cranes, mobile equipment, winds, tides, currents, water levels, cargoes, etc.

- Created using the data & input from sensors, IoT devices, cameras, physical plans and drawings, and other sources.

- Uses technologies like Big Data, Data Analytics, 5G Networks, Machine Learning, Blockchain, airborne & waterborne drones, etc.

- Analysing real-time data and simulating the behaviour of the physical port.

Port Community Systems (PCS)

- Port Community System - an *electronic platform* which connects the multiple systems operated by a variety of organisations forming a seaport or inland port community.

- Neutral and open electronic platform enabling intelligent and secure exchange of information between public and private stakeholders.

- Creates a network of shipping agents, shippers, freight forwarders, transporters, terminals, logistics platforms, and public entities.

- Information sharing

- Cargo tracking

- Booking and reservations

- Document management

- Customs integration

- Real-time notifications

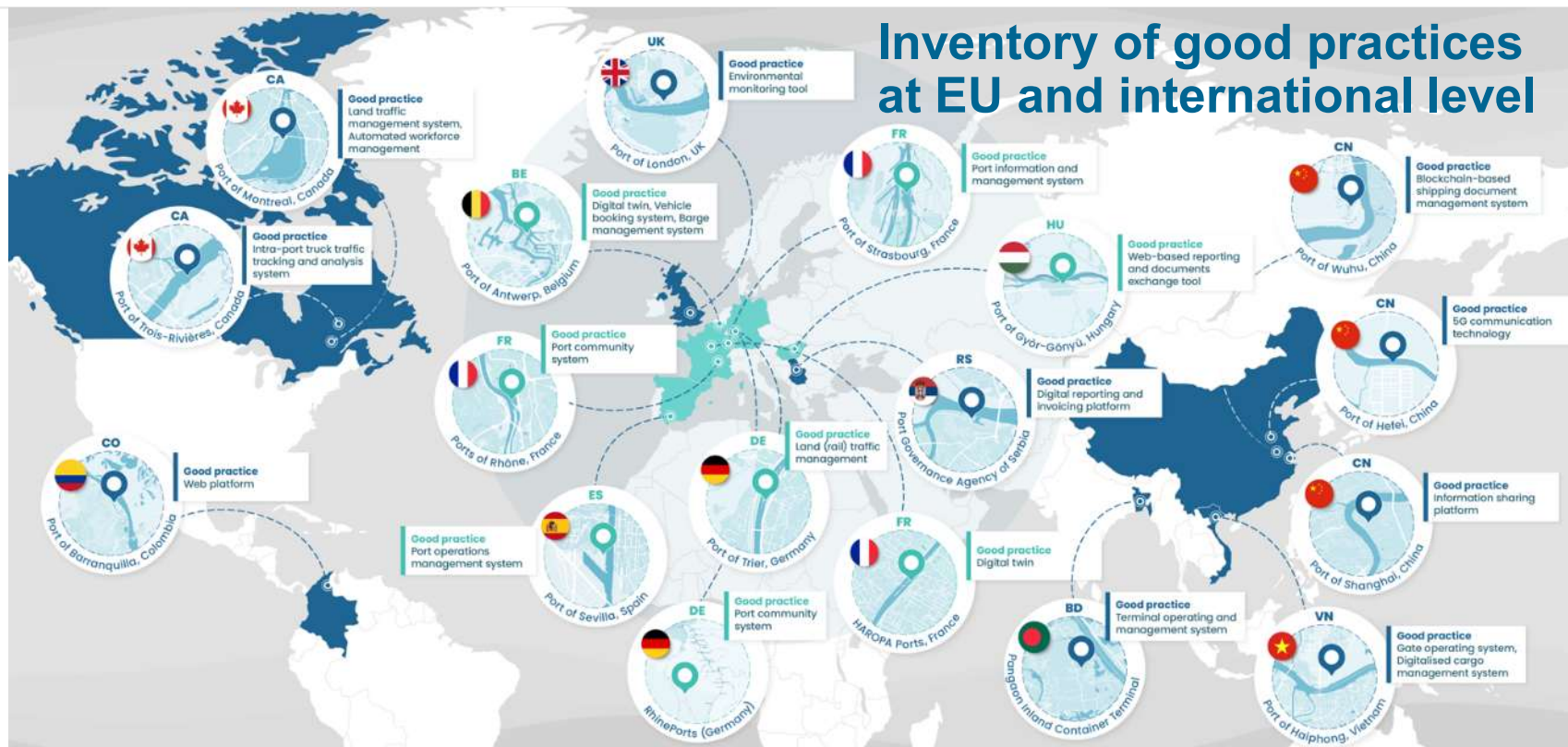- Billing and invoicing

- Performance analytics, etc.
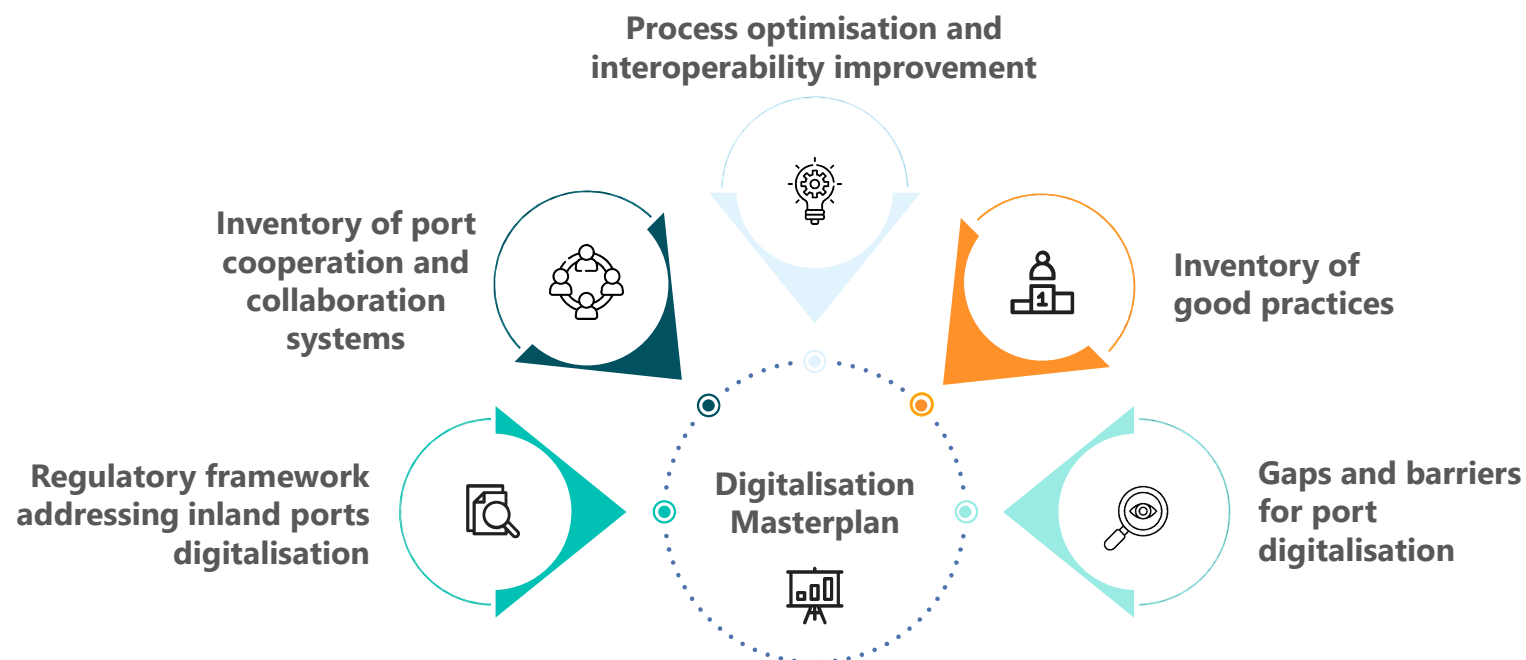

Source: Port Economics, Management and Policy

Inventory of good practices at EU and international level

Elements of the Digitalisation Masterplan for Inland Ports

**Digitalisation
guidelines**

Establishing
guidelines for digital
transformation of
ports

**Digitalisation
vision**

Envisioning the
sustainability of
inland ports through
digital innovation

**Digitalisation
strategy**

Developing a
strategic approach
to integrate digital
technologies

DMAT

Assessing the digital
readiness of ports

**Digitalisation
Masterplan**

Action plan

Implementing
concrete steps to
achieve digital goals

Roadmap

Charting a clear path
for digital
transformation

DAT

Green Inland Ports

How we can attract more young people to pursue careers in inland waterborne transport?

Question	Your Reflection
1. What are we doing right?	We are modernising the sector through digitalisation and sustainability efforts, which align well with interests values that matter to younger generations.
2. What are we doing wrong?	The sector still suffers from an outdated image and lacks visibility in education and career guidance systems. Communication often fails to demonstrate the innovative and impactful aspects of working in IWT.
3. What are we not using effectively?	Educational institutions that offer IWT-related programmes, especially at the secondary and university level, have low visibility and limited outreach, and are less than a handful. We are also not making enough use of social media, digital storytelling, and opportunities to involve young professionals as ambassadors of the sector.
4. What is missing?	There are not enough IWT-focused educational programmes, and stronger cooperation is needed between universities, "middle" schools and the shipping and port industries to offer real-world needs and job opportunities.
5. What is your idea?	Launch a Europe-wide "IWT Talent Lab" - a programme combining summer or online schools, hackathons, and real-life challenges from ports and shipping companies, where students co-create solutions and get mentorship. Creating a joint (industry and educational institutions) dedicated web and social media presence can be a powerful, modern way to open IWT to young professionals and/or future students.

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For more info about the project, please visit: https://green-inland-ports.eu

Thank you!

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