GREEN INLAND PORTS STUDY: DIGITALISATION EFFORTS IN PORTS

Interactive session 2

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Inventory of Digital Tools Supporting Cooperation and Collaboration

Saša Jovanović, Senior port expert, Pro Danube

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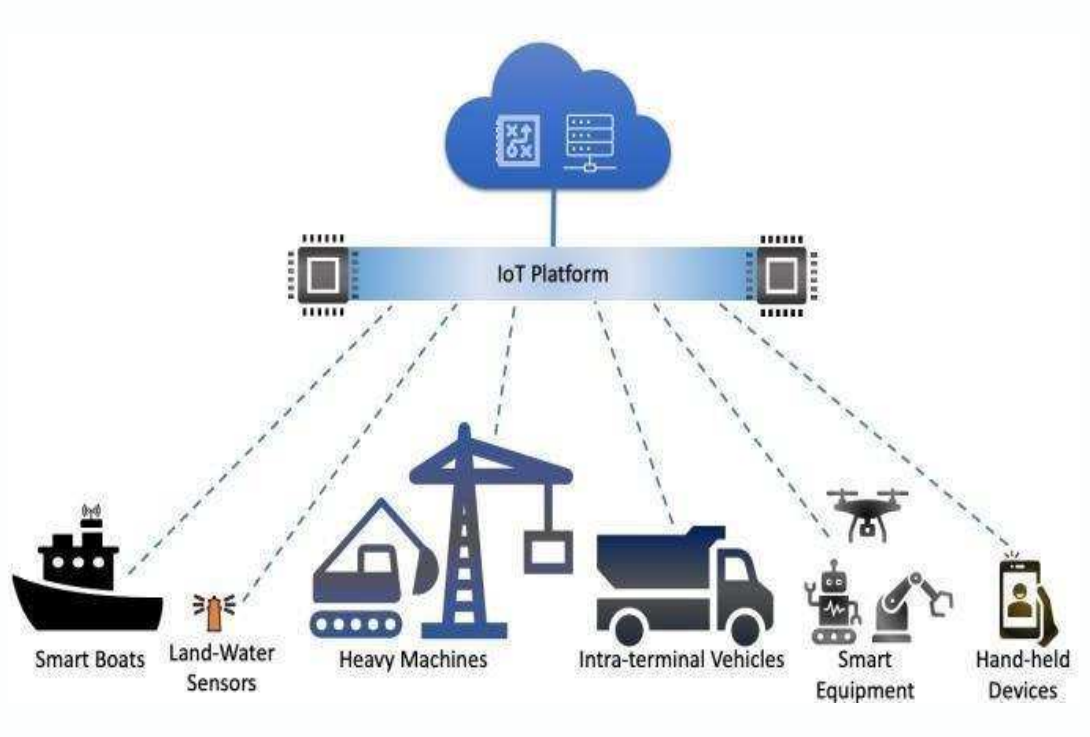
What is digitalisation?

- *Applying and integrating available digital technologies into various port processes and activities to improve port operations and port management.*
- Goal:
  - to improve efficiency and effectiveness,
  - streamline operations,
  - reduce risks, costs, and environmental footprint,
  - and provide better services within the port industry and the entire supply chain.

Main drivers

- Efficiency and productivity enhancement
- Competitive advantage
- Supply chain optimisation
- Regulatory compliance
- Reduction of environmental footprint



Source: https://www.researchgate.net/publication/348269178

Preconditions for digitalisation

- **Robust IT infrastructure**:
  - stable, reliable and high-speed internet connectivity, advanced networking systems, adequate server and data storing capacity, modern hardware and software.
- **Data sharing**:
  - agreements, guidelines and 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 data standards like UNCEFACT XML and UN/EDIFACT.
- **Trained labour**:
  - creation of “cyber-aware“ and “cyber-competent“ workforce.
- **Stakeholder collaboration**:
  - involves governmental organizations (customs, police, sanitary control, etc.), ministries, port authorities, port operators, logistic companies, land transport operators, etc.
- **Clear digitalisation strategy**:
  - definition of goals and scope of digitalisation efforts.

https://sinay.ai/en/what-is-port-digitalization/

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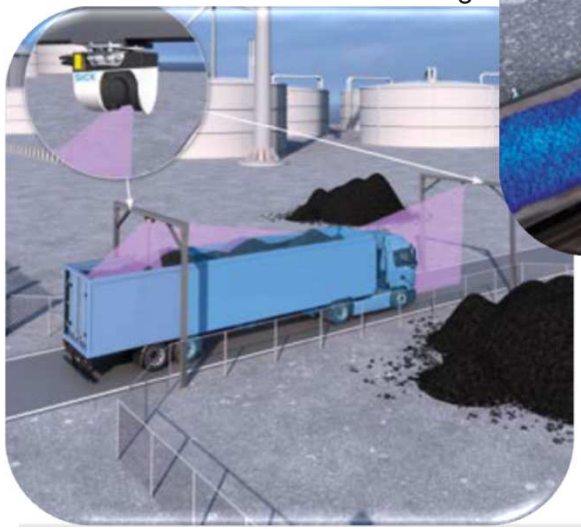
Sensors and devices as building blocks of digitalisation

Temperature measurement of bulk cargo

Environmental perception on terminal tractors

Volume measurement of bulk cargo



Object detection on ship loaders

All illustrations courtesy of www.sick.com

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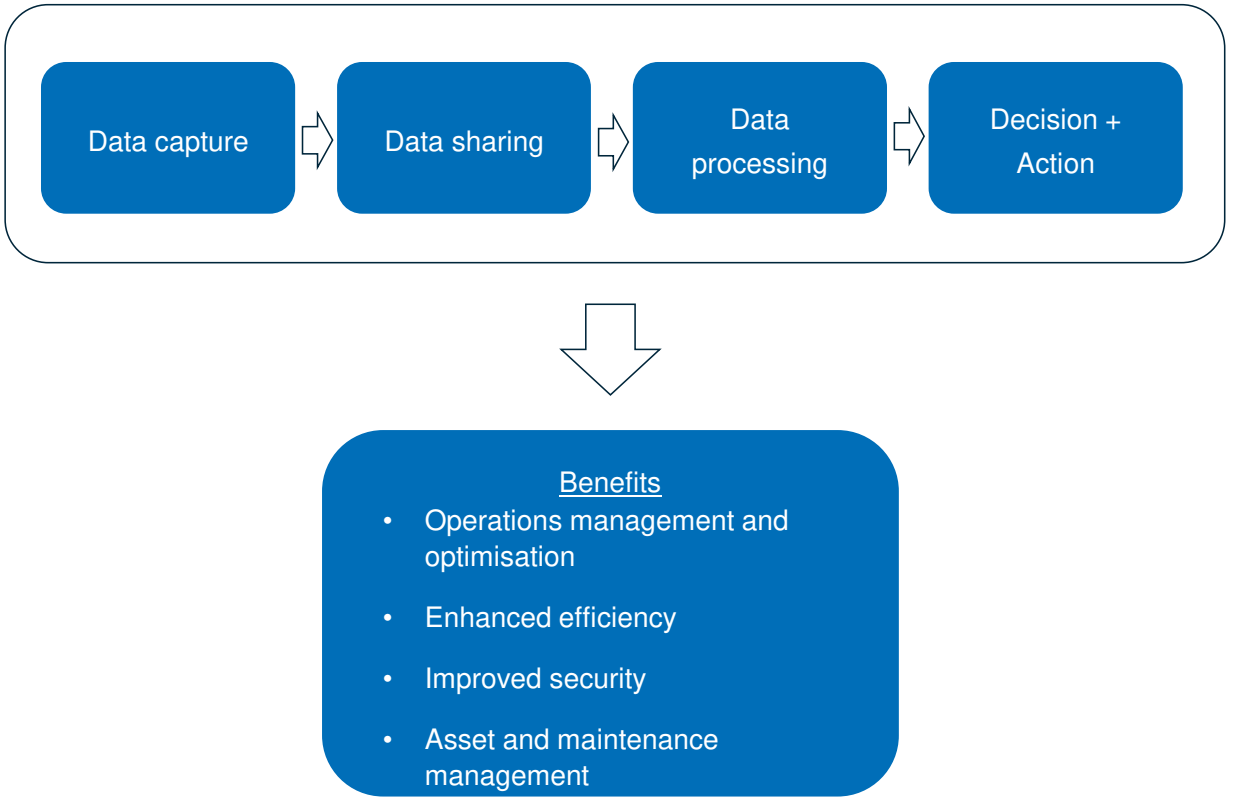
Advanced port digitalisation technologies

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



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Blockchain technology

"Decentralized and transparent digital ledger that securely records and verifies transactions between multiple parties involved in port operations."

- 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, weight and/or volume, 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, providing a decentralized and automated way to facilitate, verify, or enforce the negotiation or performance of a contract.

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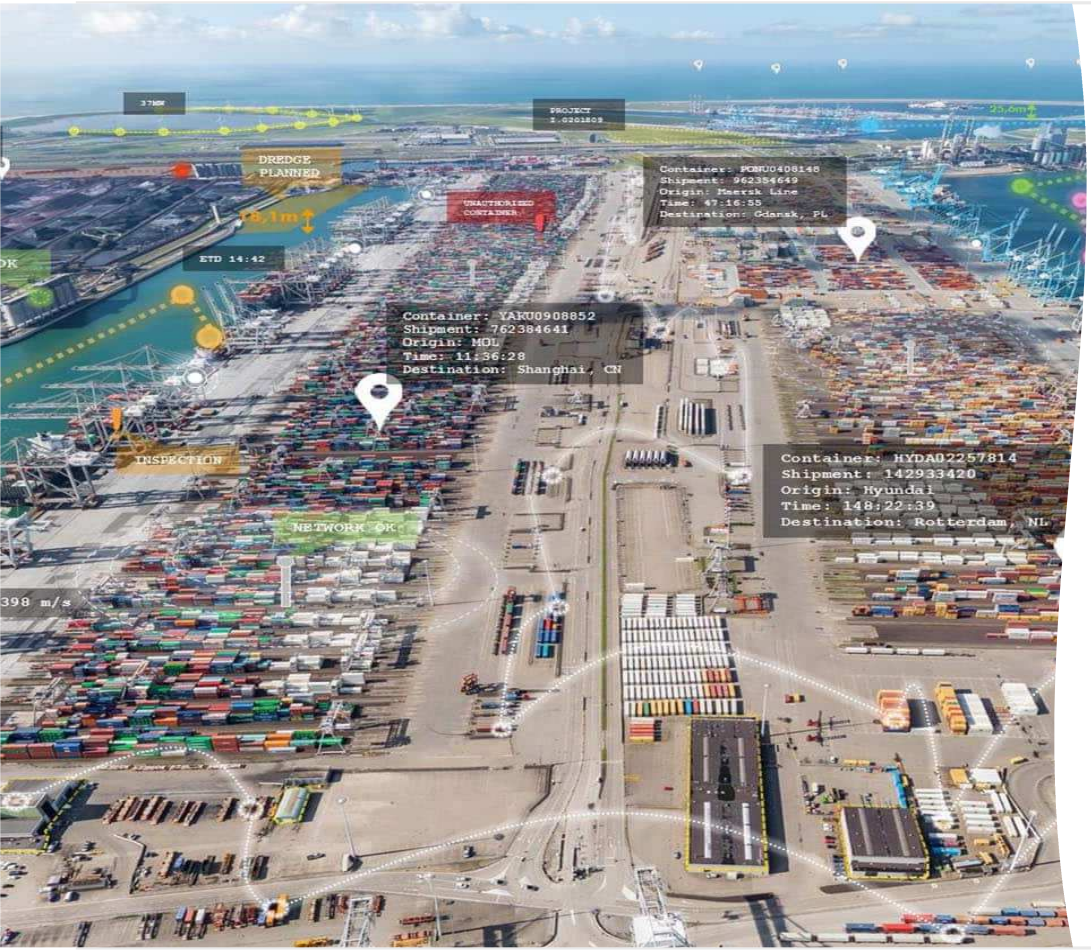

Big data analytics

- **Large volume of data**, both structured and unstructured, generated during day-to-day port operations.
- **Analysed** for insights that lead to better decisions and strategic business moves.
- **Example of data gathered and used**:
  - number and features of vessels in ports,
  - type of cargo handled & stored,
  - productivity of cranes & handling yard equipment,
  - traffic density of land means of transport in ports,
  - ETA, demurrage and laytime,
  - loading/unloading times,
  - structural loads of quay walls or quayside cranes,
  - distances between objects and area dimensions,
  - water depth,
  - environmental data, etc.
- **Data collection done by IoT sensors** and devices, RFID sensors and tags, and GPS systems facilitating real-time data collection, enabling accurate insights into port operations.
- **Used for**:
  - operational efficiency,
  - cargo handling & inventory management,
  - maintenance and safety,
  - port layout planning,
  - environmental performance management, etc.

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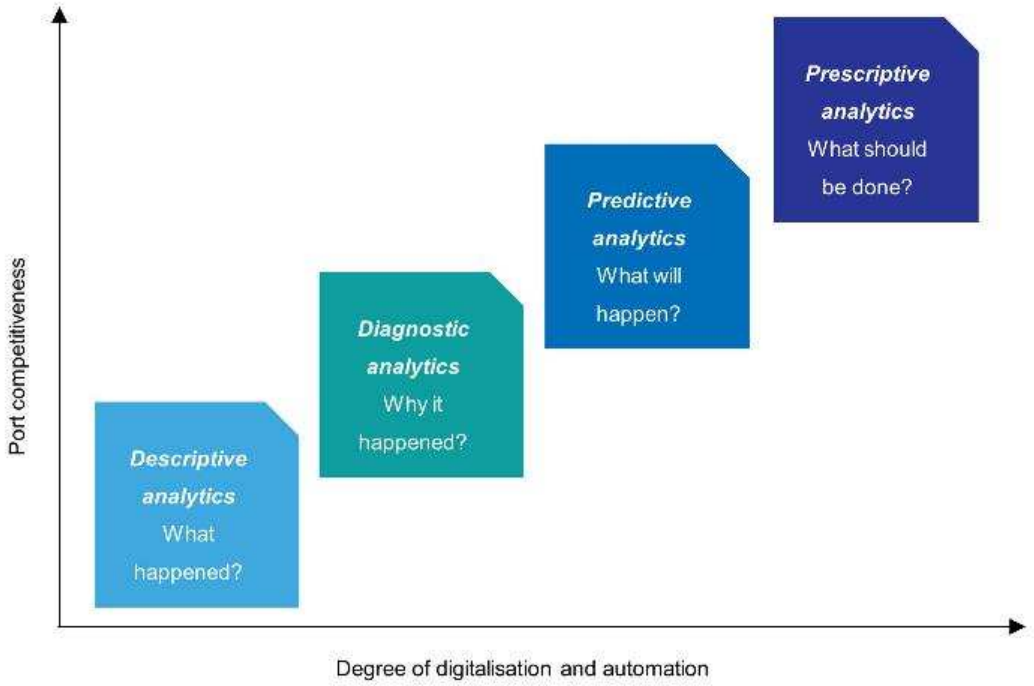
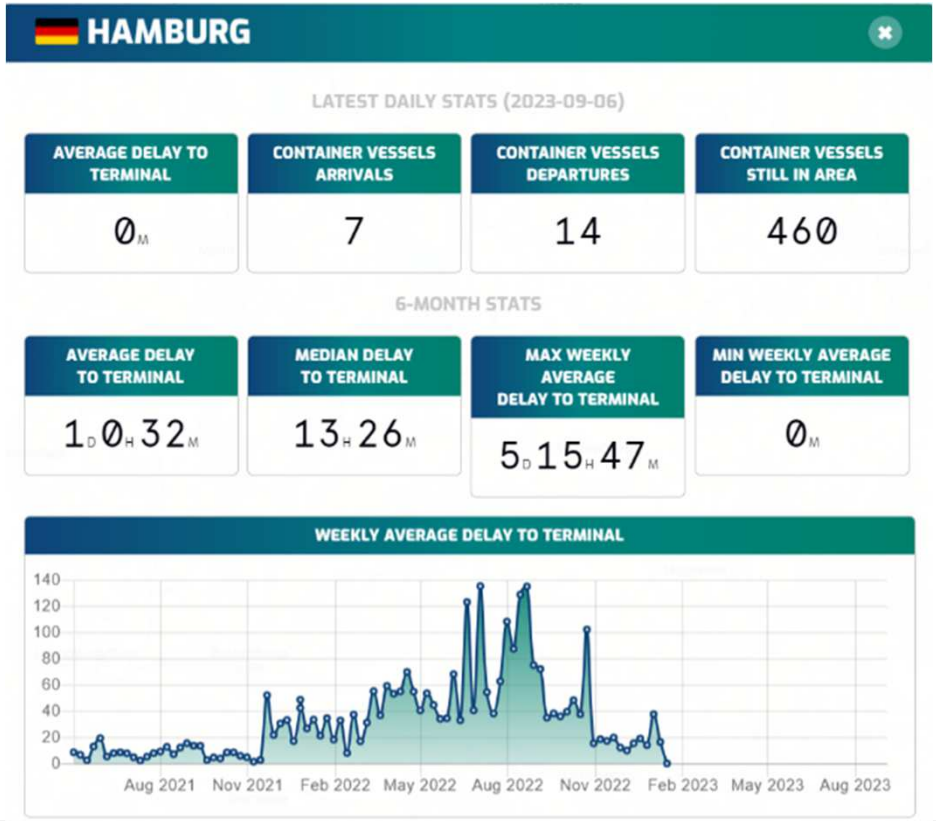
Data analytics and business intelligence





https://spire.com

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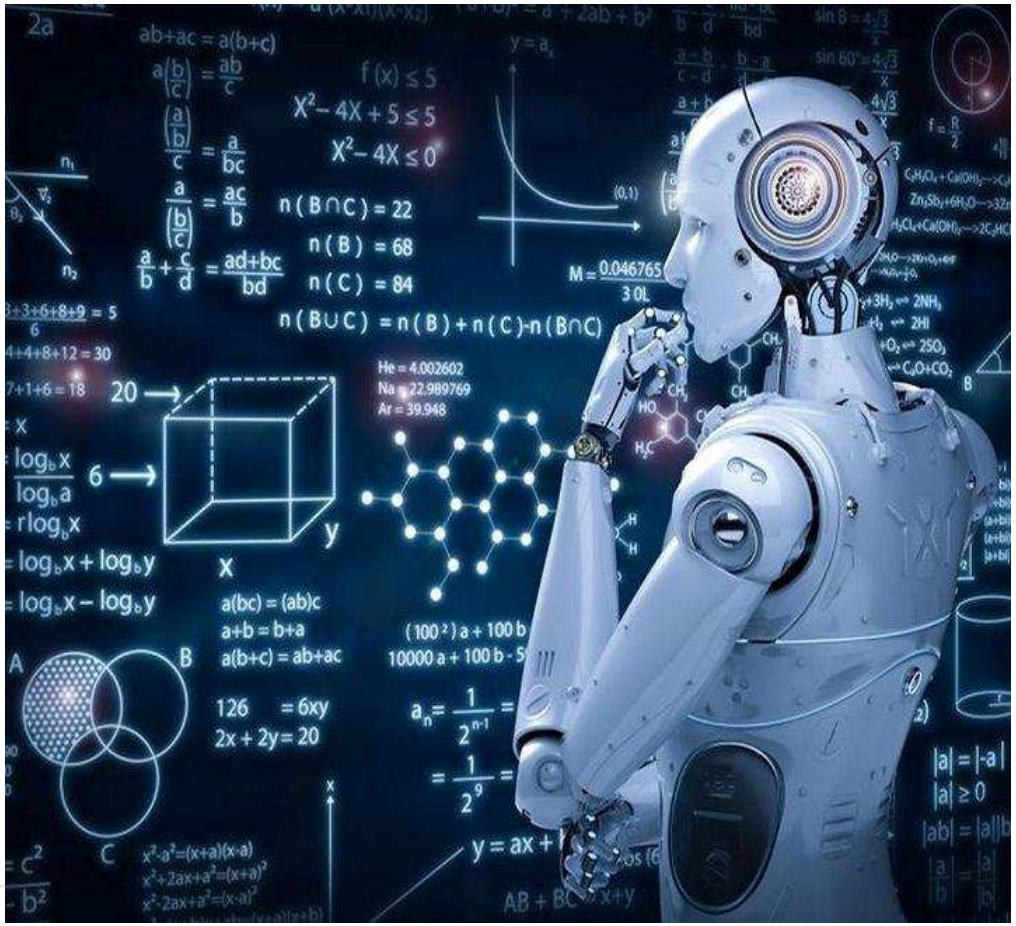
Artificial intelligence

- "*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 & equipment in real-time, prevents 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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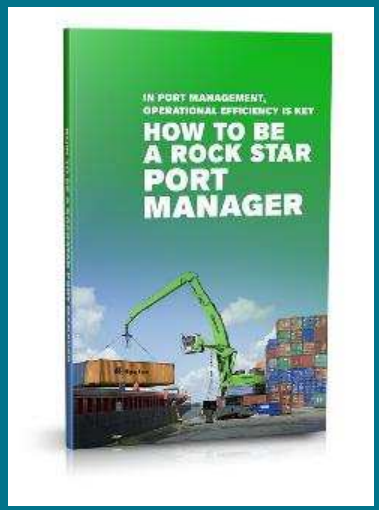
Automated and autonomous ports

Digitalised port	Use of digital technologies and tools, data, and information systems.
Automated port	Mechanisation and robotics of physical tasks, activities and processes in the port, to assist human labour.
Autonomous port	Higher degree of independence for machines & systems in decision-making and operations, human involvement reduced/excluded.

Goal:



improve the overall port management and operations

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- Digitalisation is a founding pillar for both automation and autonomation of ports.
- Automated and autonomated ports are highly digitalised, but digitalised ports do not have to be automated/autonomous at all.

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Automated port equipment and their benefits

Automated guided vehicles (AGV)

Autonomous grab ship loader

Remotely operated STS cranes

- **Efficiency and speed enhancement**: significantly reduces loading/unloading time & enables faster turnaround time for vessels and trucks. Reduces congestion and dwell time.
- **Cost reductions**: long-term cost-savings. Reduces the cost of labour, fuel and energy, errors-caused costs. Results in improved financial sustainability.
- **Environmental sustainability**: reduces energy consumption by optimising the use of equipment → lower emissions.
- **Improved safety**: manual labour significantly reduced, especially in potentially hazardous tasks → labour safety increased, risk of accidents reduced.
- **Resilience**: automated systems can operate continuously, in adverse conditions, increasing resilience to disruptions caused by weather or unforeseen events.

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Digital Twins for ports

- Digital Twin - a virtual representation of a physical facility.
- It can make 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.
- Revolutionising the entire process of data capture, analysis and interpretation.
- In the European inland ports, only the Port of Trier on the Moselle in Germany reported using the Digital Twin technology for its operations and management.

Advanced Port Information & Control Assistant (APICA)
https://www.youtube.com/watch?v=kLLTNRPgLe8

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

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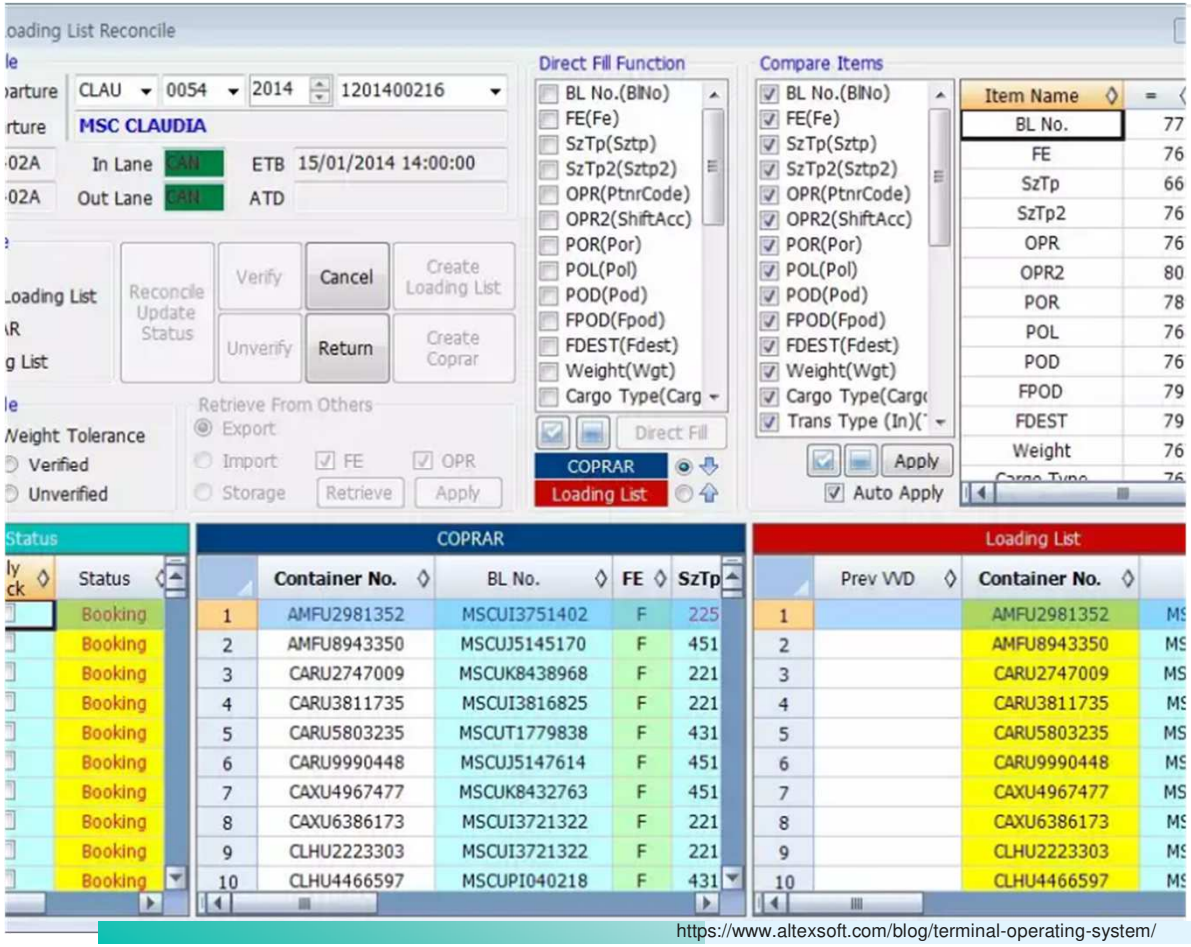

https://www.altexsoft.com/blog/terminal-operating-system/

Terminal Operating Systems

- Software solutions designed to manage and optimize the operations of port terminals.
- Planning components (examples):
  - Resource allocation (berths, quay cranes, yard space, equipment, etc.)
  - Vessel scheduling
  - Equipment control & monitoring
- Operational components
  - Real-time monitoring of operations
  - Documentation and reporting
  - Billing and invoicing
  - Integration with other platforms and PCS
  - User access control
  - Environmental monitoring

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Digitalisation of environmental performance measurement

- Environmental Management Tools (EMT) - a set of instruments, methodologies, and systems used by ports to manage and monitor their environmental performance.
- Digitalizing Environmental Management Tools (EMT) in inland ports – advantages:
- Efficiency and automation: Digital EMT systems automate data collection, analysis, and reporting processes, saving time and reducing the risk of errors.
- Real-time monitoring of environmental parameters through various sensors for the measurements of air/water quality, noise, etc.
- Regulatory compliance: digital EMT systems can assist in ensuring compliance by providing a structured approach to data management, reporting, and documentation.
- Transparency and stakeholder communication
- Integration with other port operating systems creating a holistic approach to operations.

Source: Oizom

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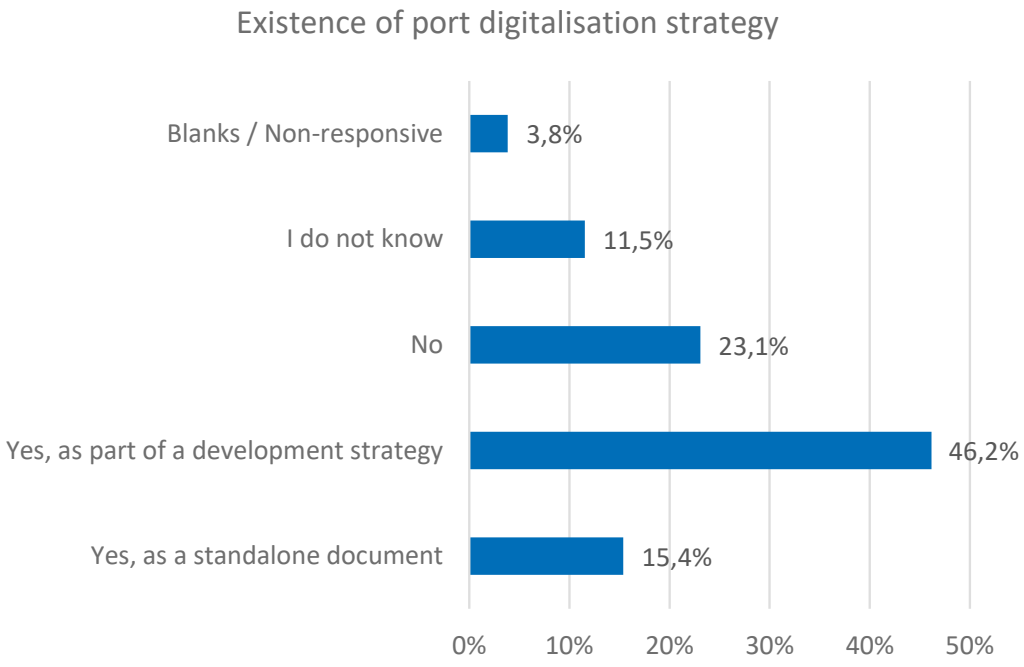
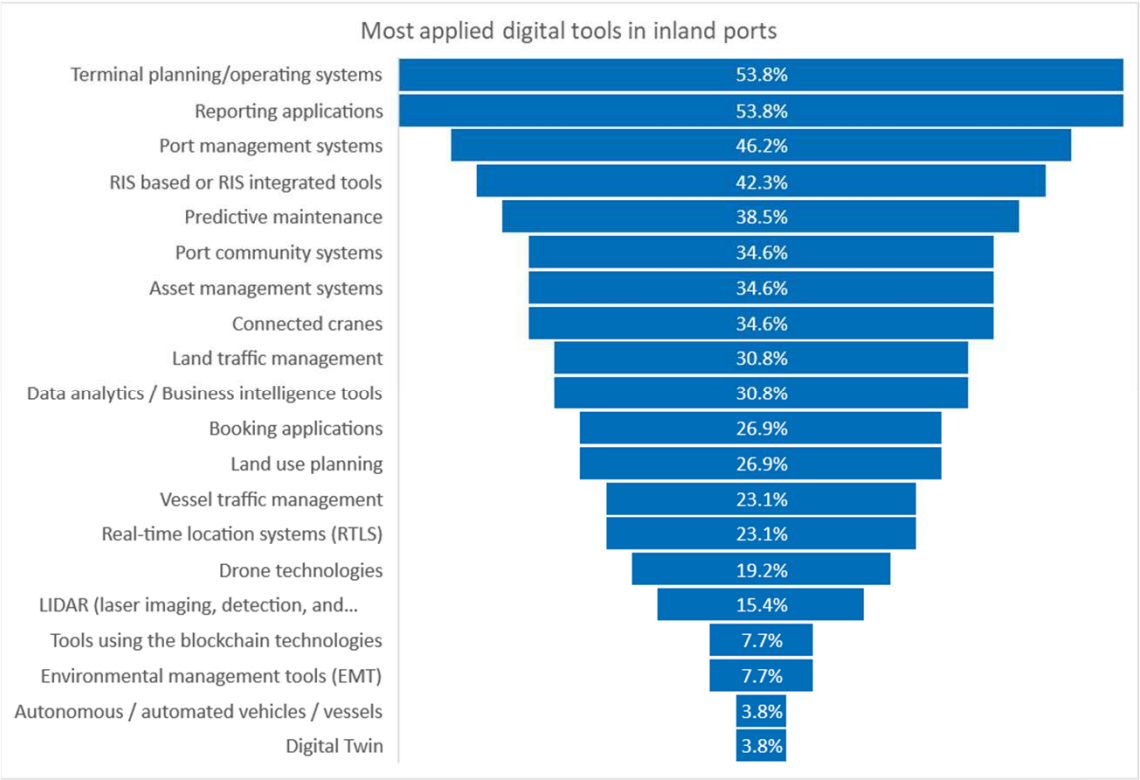
Port digitalisation in practice – survey results





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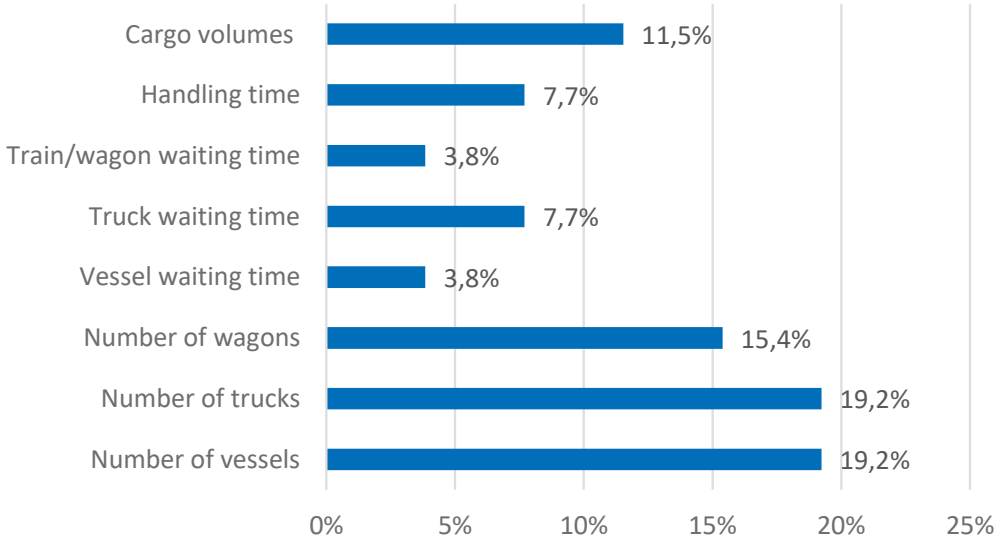
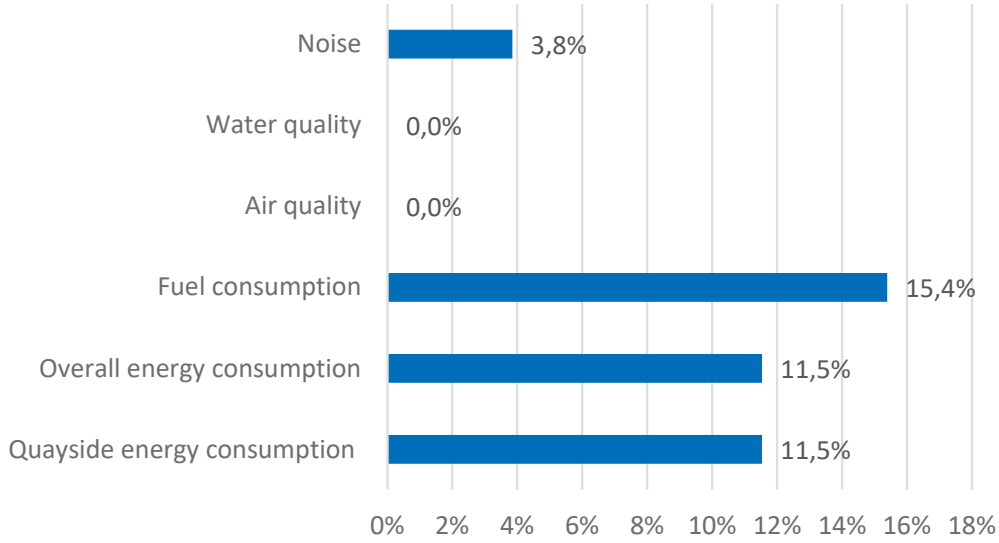
Port digitalisation in practice – survey results

Share of inland ports applying **digital** tools in operational KPI measurements



Share of inland ports using **digital** tools for measuring specific environmental performance indicators



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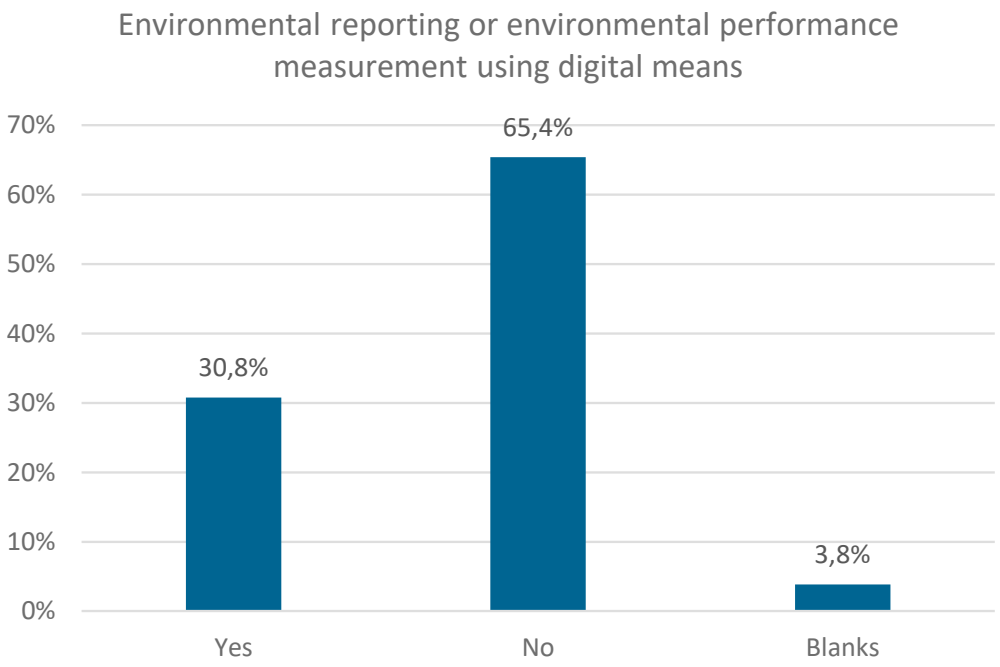

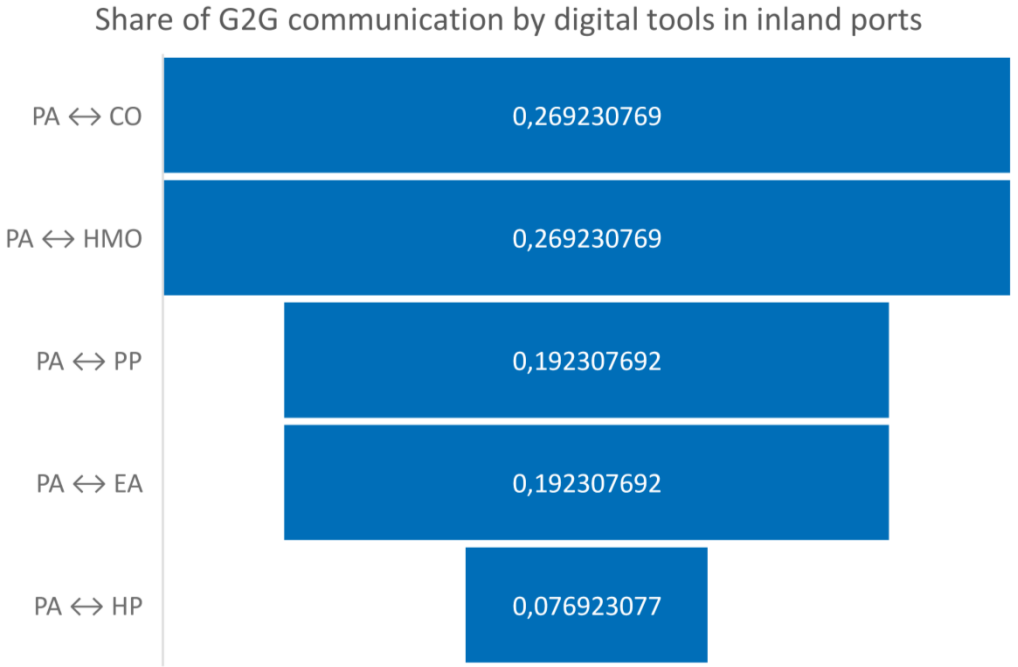

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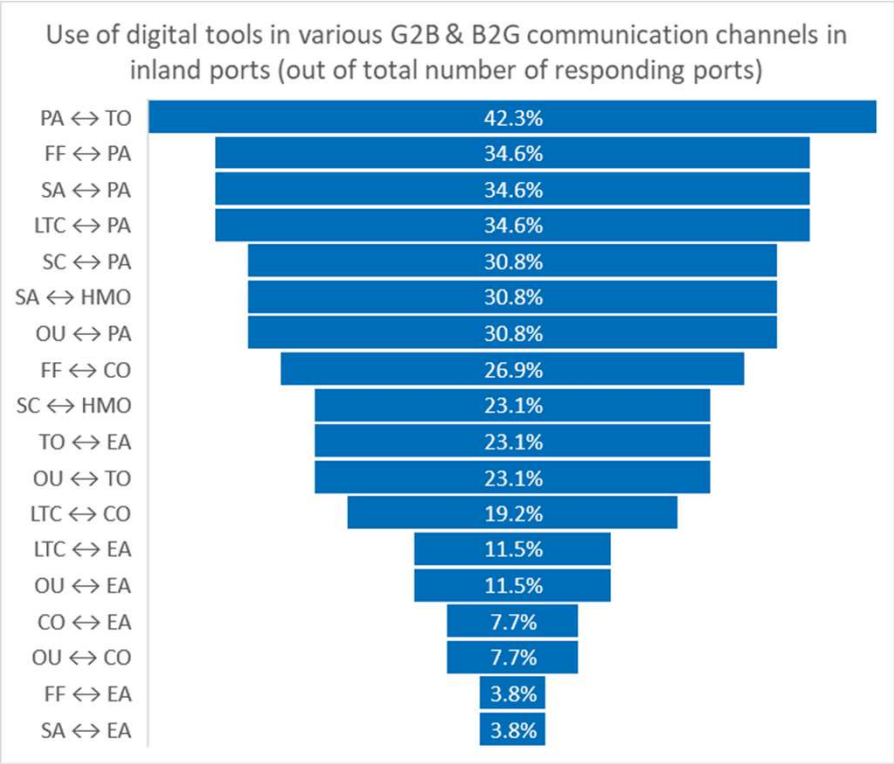
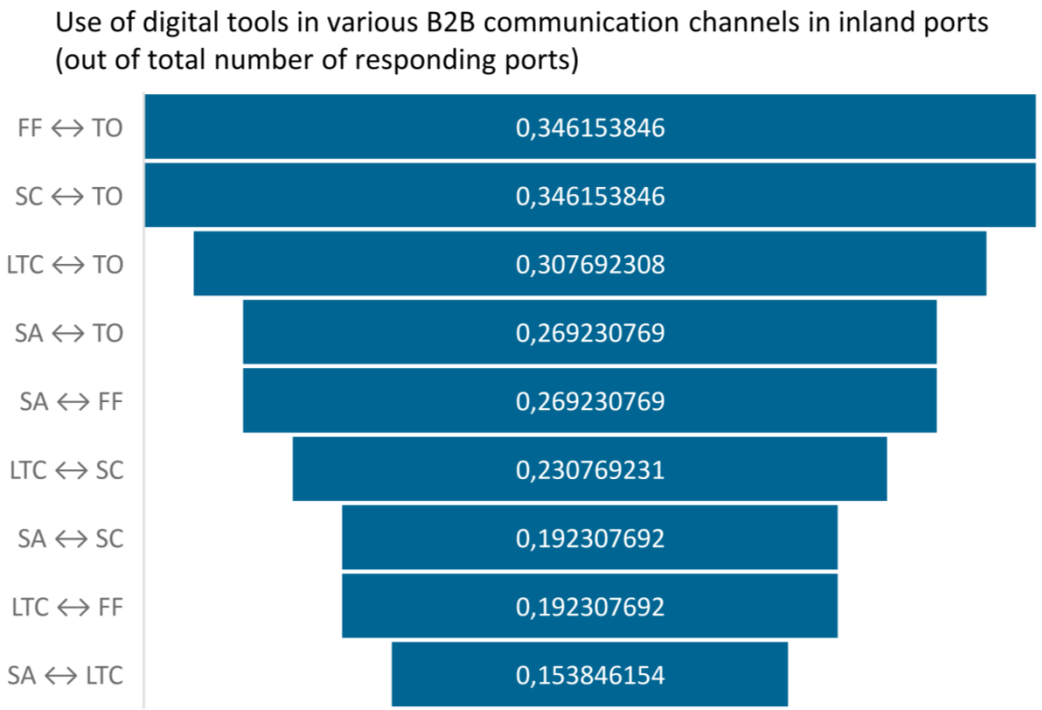
G2G = Government to Government (communication between various public authorities)
PA = Port Authority, CO = Customs Office, HMO = Harbour Master Office,
PP = Port Police, HP = Harbour Pilot,
EA = Environmental Authorities, CO = Customs Office

Port digitalisation in practice – survey results





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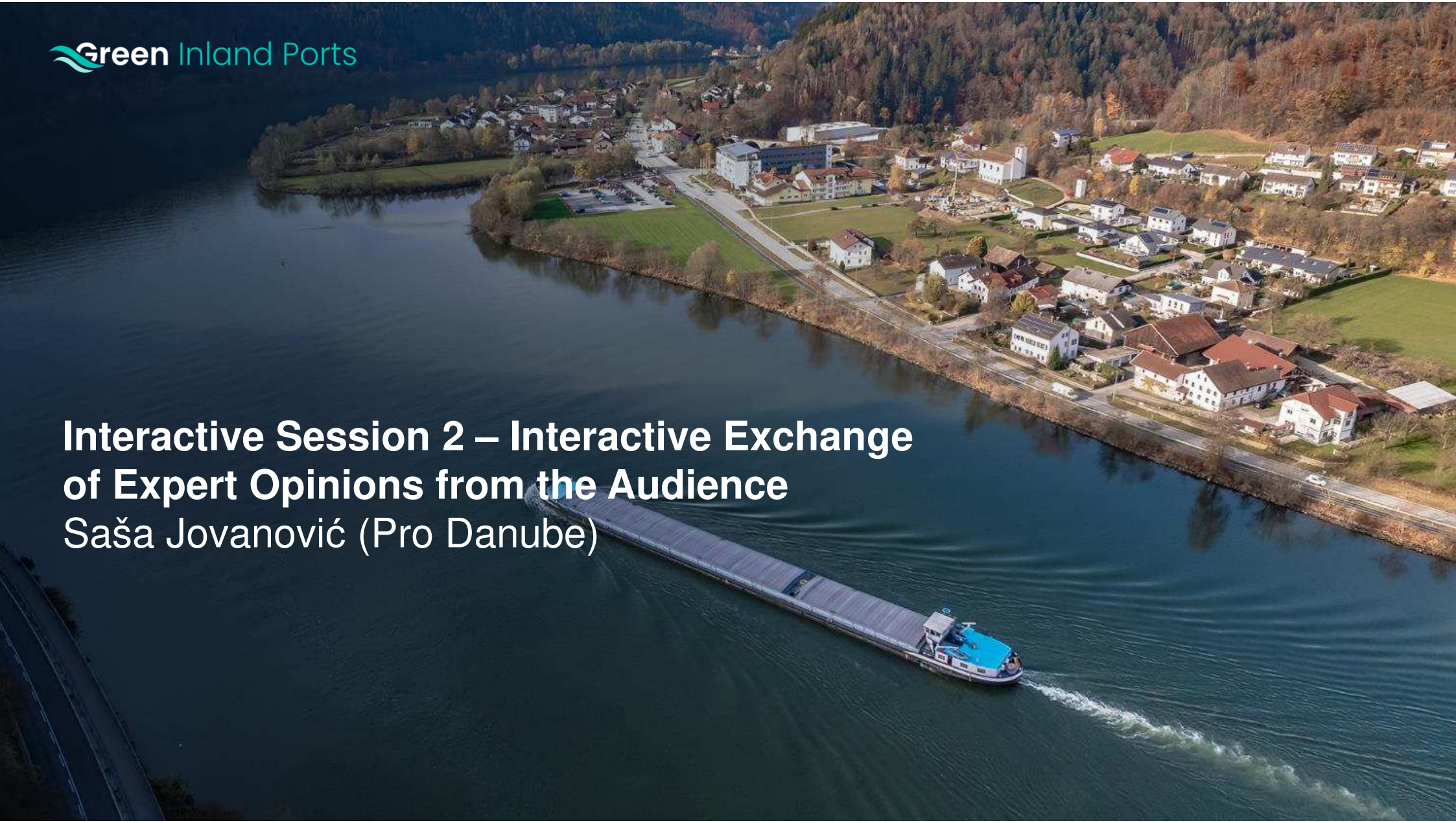
G2B = Government to Business (and vice-versa; B2G) communication between public/private independent companies and public authorities (and vice-versa)
TO = Terminal Operator, SC = Shipping Company (acting as ship owner/operator/manager…)
FF = Freight Forwarder (acting on its own or on behalf of the cargo owner
SA = Ship (or port) Agent, LTC = Land Transport Companies (rail and road transport operators)
OU = Other port users



Interactive Session 2 – Interactive Exchange of Expert Opinions from the Audience

Saša Jovanović (Pro Danube)