

An aerial photograph of a wide river flowing through a city. Several boats are visible on the water, including a large green and white cargo ship in the foreground and a smaller blue boat. The riverbanks are lined with lush green trees. In the background, a city skyline with various buildings and a bridge is visible under a cloudy sky.

Digitalisation Masterplan for inland ports and terminals – Good practices and future-oriented actions

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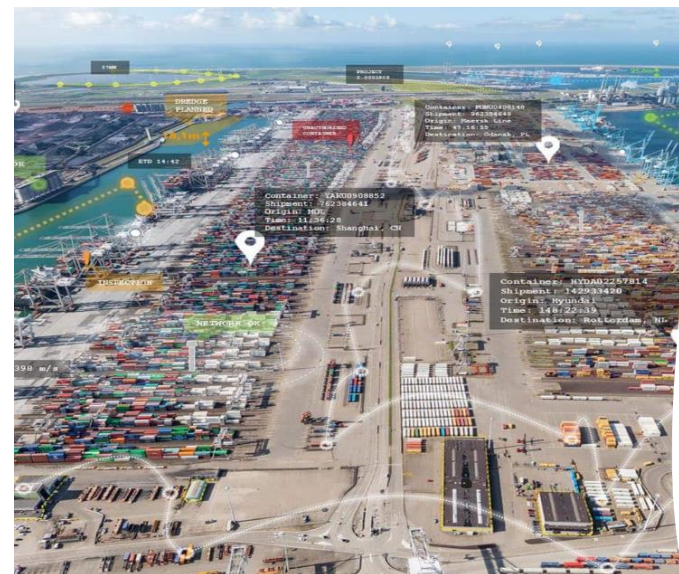


Objective and activities

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 and further interviews/inputs from stakeholders

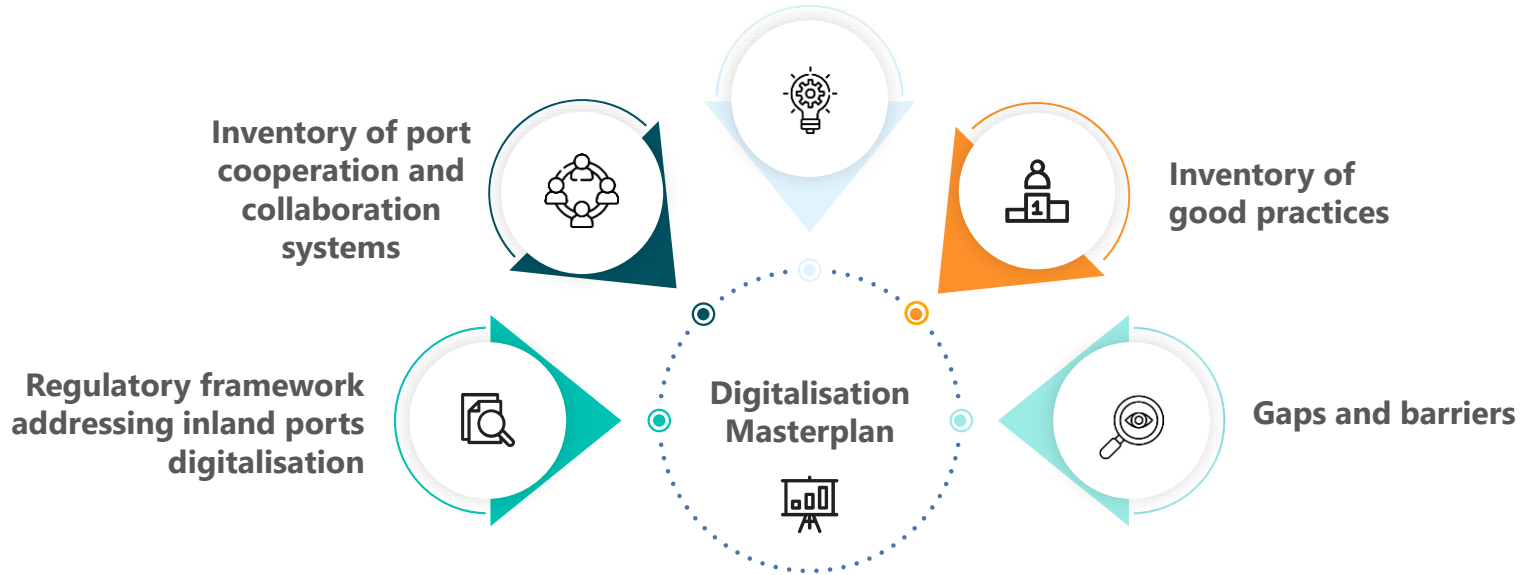


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Digitalisation Masterplan for inland ports and terminals

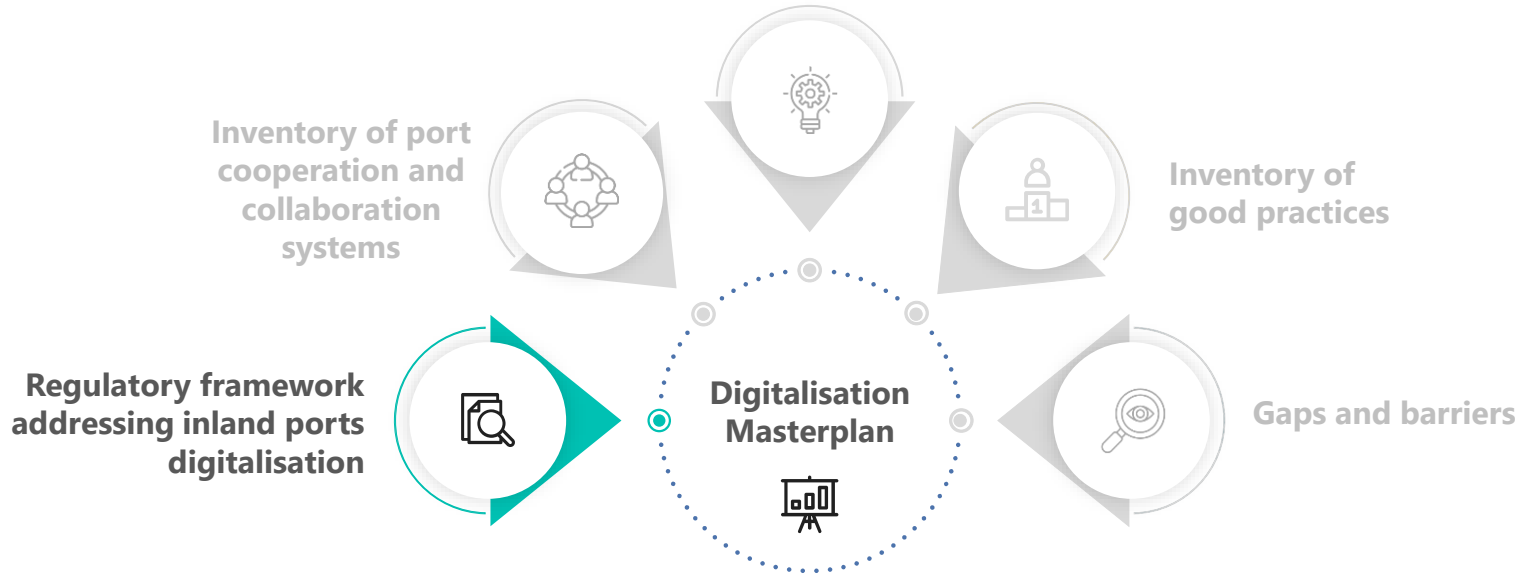
Process optimisation and interoperability improvement



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Digitalisation Masterplan for inland ports and terminals

Process optimisation and interoperability improvement



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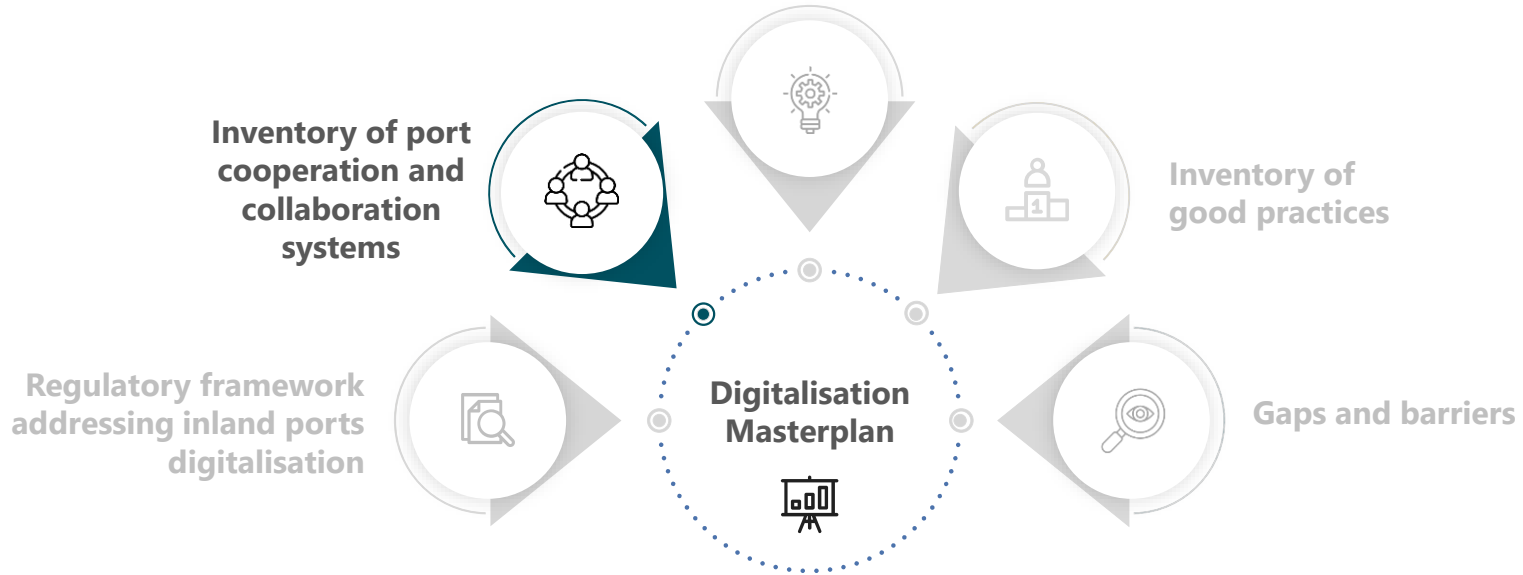
Regulatory framework addressing inland ports digitalisation

- There is (currently) **no European or international legislation** that specifically deals with the digitalisation of ports
- The legal framework consists of **more general acts**, that also apply (or may apply) to digitalisation as it is put into practice in ports. This framework includes:
 - Privacy – GDPR
 - Data ownership
 - Liability for defective software
 - Liability of software users
 - Cybersecurity
- Results so far do not show any binding regulations at the European / Member State level

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Digitalisation Masterplan for inland ports and terminals

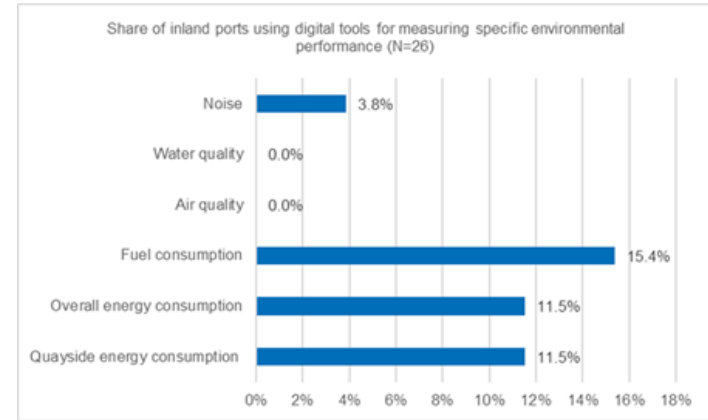
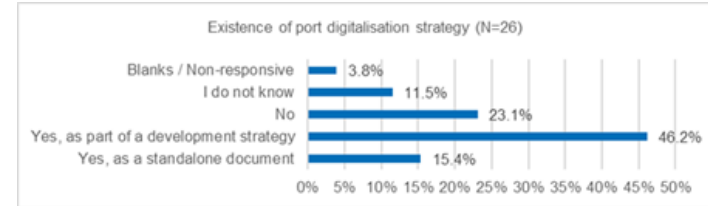
Process optimisation and interoperability improvement



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Inventory of port cooperation and collaboration systems

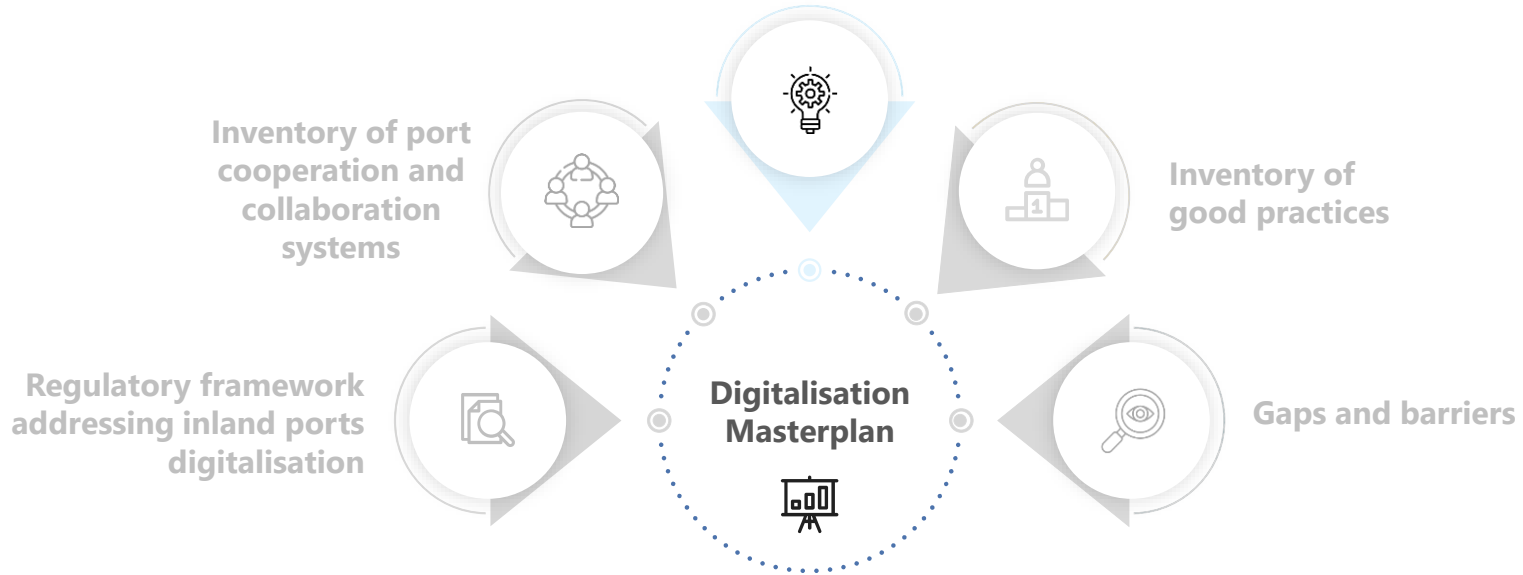
- Content of the inventory report:
 - Introduction
 - Port digitalisation technologies and platforms and their potential use in greening
 - Cybersecurity aspects
 - Digitalisation of environmental management tools in ports
 - Selected digitalised Environmental Management Tools
 - Port digitalisation in practice – results of the 1st survey
 - Further digitalisation needs and potentials
 - Conclusions



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Digitalisation Masterplan for inland ports and terminals

Process optimisation and interoperability improvement



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Process optimisation and interoperability improvement

Key considerations and challenges related to **process optimisation** in port digitalisation:

- Integration of systems
- Data security and privacy
- Interoperability
- Legacy infrastructure
- Employee training
- Real-time data processing
- Scalability
- Regulatory compliance
- Cost-Benefit Analysis
- Sustainability

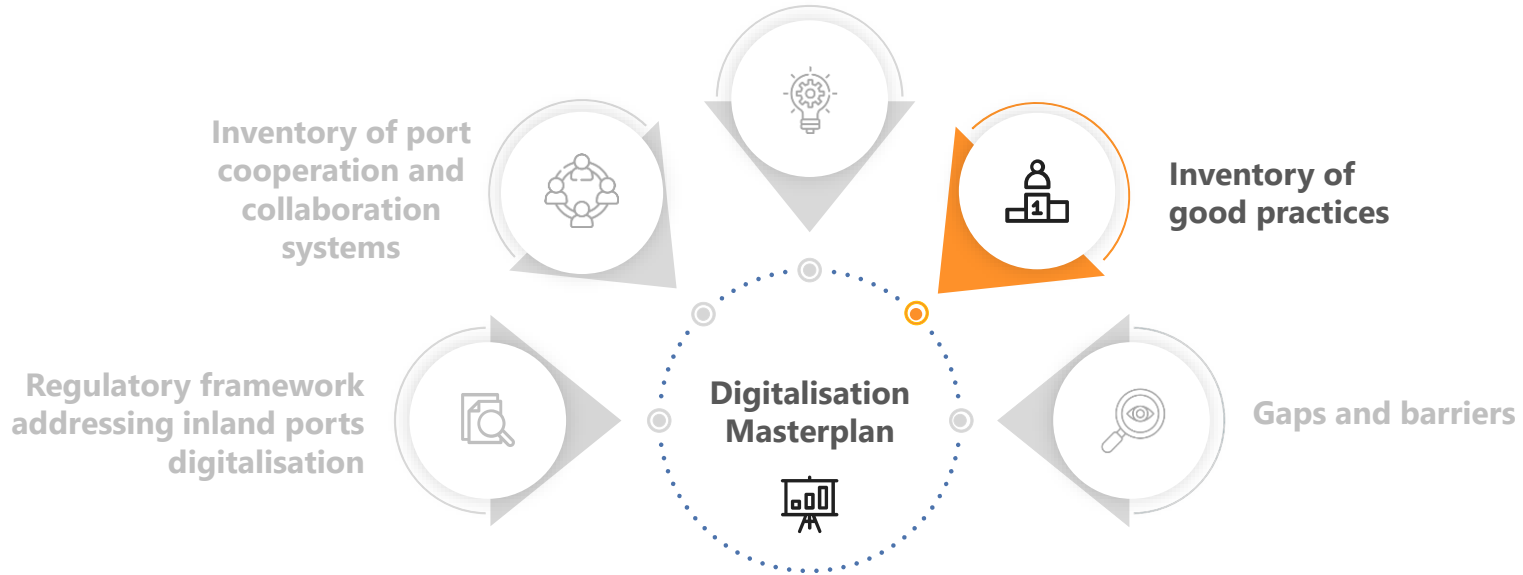
Problems, needs, issues, and challenges related to **interoperability of various digital tools** for ports:

- Diverse ecosystem
- Legacy systems
- Data silos
- Lack of standards
- Complex integration
- Data security and privacy
- Real-time communication
- Regulatory compliance
- Scalability
- Stakeholder collaboration
- Change management
- Budget constraints

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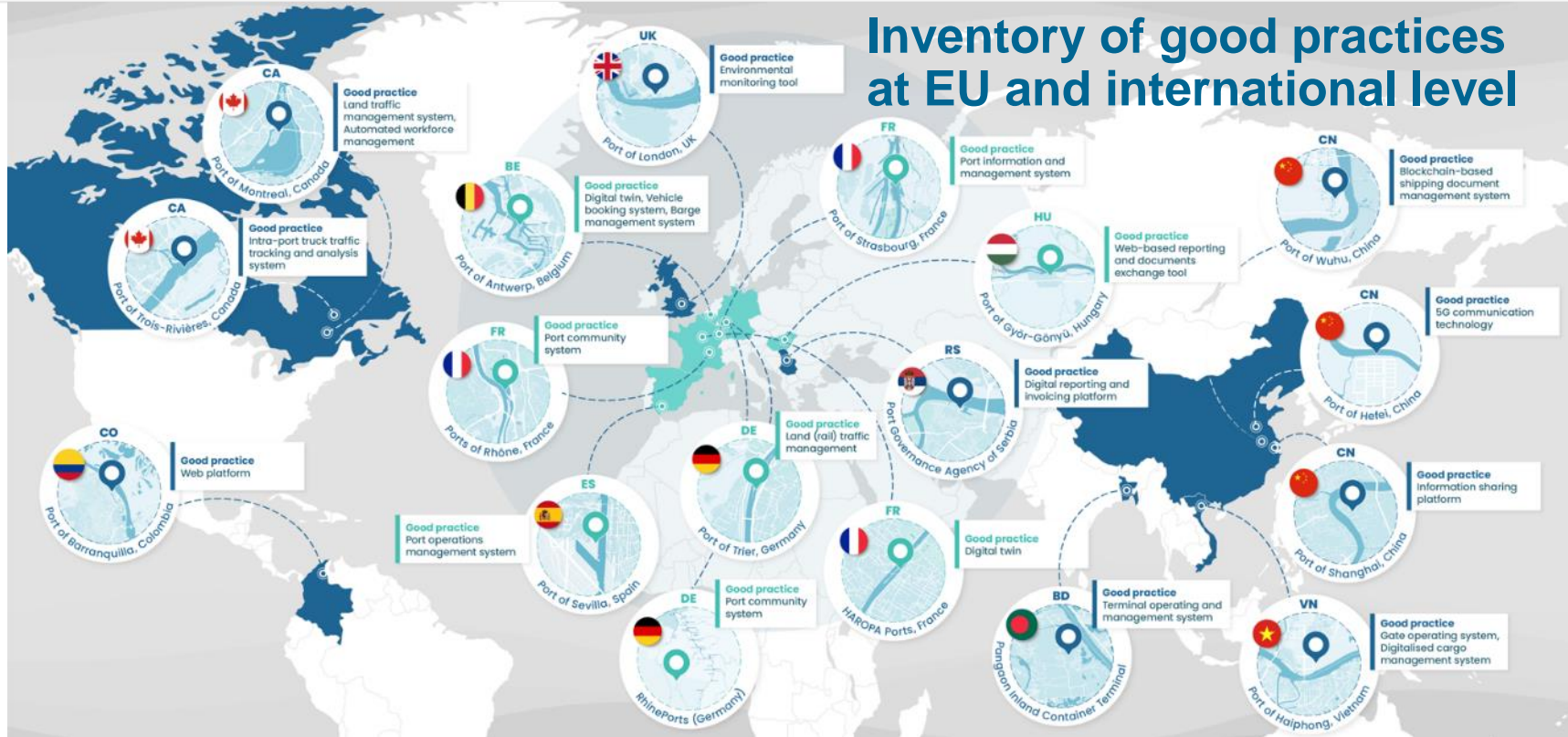
Digitalisation Masterplan for inland ports and terminals

Process optimisation and interoperability improvement



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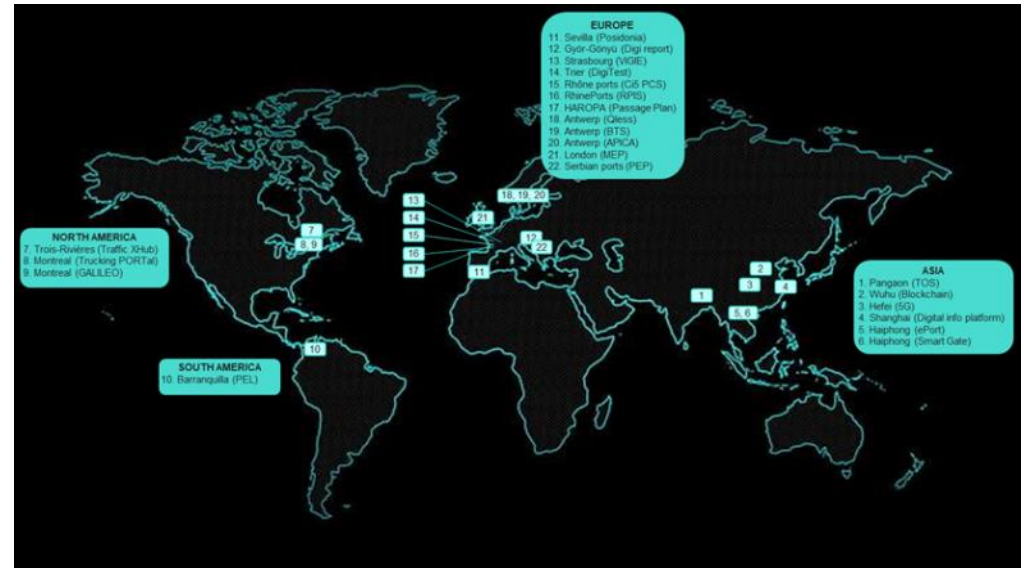
Inventory of good practices at EU and international level



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Inventory of good practices at EU and international level

- Large numbers of ports **in and outside of the EU** have been approached
- **Factsheet** for each good practice:
 - Location of the port: (geographical location – city/town, country)
 - Inland waterway (on which the port is located)
 - Category of digital tools (port community system, digital twin, automation, port information system, IoT applications)
 - Stakeholders involved (port authority, port operators, shipping companies, forwarders, cargo owners)
 - Description of the good practice
 - Realised/potential impact

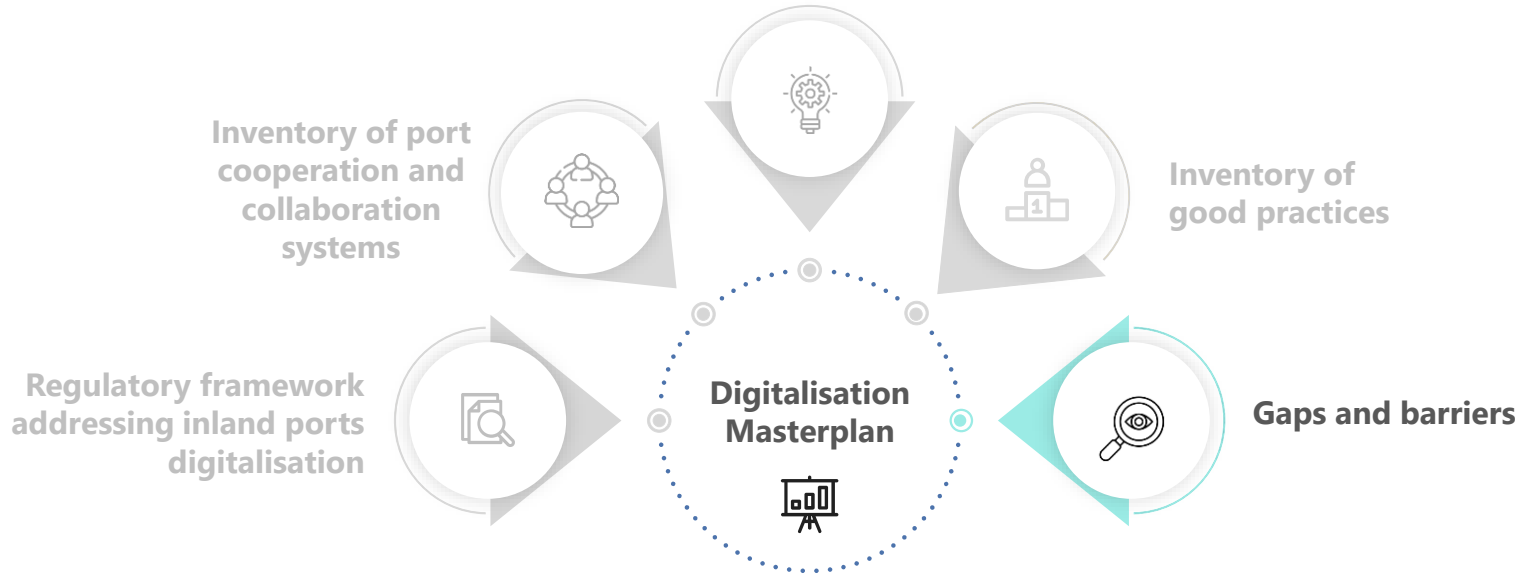


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Digitalisation Masterplan for inland ports and terminals

Process optimisation and interoperability improvement



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Gaps and barriers

- Objective: identify gaps and barriers in the implementation of digital tools across inland ports.
- The study utilised a combination of qualitative and quantitative research methods including:
 - Desk Research
 - Surveys with over 30 participants
 - Interviews with key experts from multiple inland ports
- **Legal Gaps and Barriers:**
 - Fragmented legal framework difficult to navigate
 - Absence of standardised (cyber security) solutions
 - Gaps in coverage (liability and data security) regulations
- **Financial Gaps and Barriers:**
 - Limited budget for digital transformation
 - Complexity (and inaccessibility of) subsidy frameworks
 - Financial constraints (affecting smaller ports disproportionately)



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Gaps and barriers

- Technical Gaps and Barriers:**

- Lack of standardisation across systems (reducing interoperability)
- Outdated technology that is incompatible with modern systems
- Challenges in data quality and consistency

- Human Resources / Workforce Gaps:**







- Shortage of skilled personnel (for digital tool implementation)
- Need for training and development programs
- Resistance to change and adaptation (within the workforce)

Considering the digital tools and applications currently in use at the port, do you believe they are being utilised to their full potential?

	Count	% of responses	%
Additional benefits could be gained with increased or broader usage	16		64%
They are used sufficiently	6		24%
Other comments	4		16%

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What are the major obstacles or challenges you face when trying to achieve interoperability between your inland port's digital tools and those of connected inland ports, seaports, and external stakeholders?

	Count	% of responses	%
Resistance from stakeholders	15		58%
Lack of standardised data formats	10		38%
No significant challenges	8		31%
Technological incompatibility	7		27%
Cybersecurity concerns	5		19%
Other (please specify)	3		12%

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Digitalisation Masterplan for inland ports and terminals

- Executive summary
- Introduction
- Digitalisation vision
 - Strategy
 - Roadmap
 - Action plan
- Digitalisation guidelines
- Digital ports landscape mapping the B2B, B2G and G2G processes in ports and terminal operations
- Toolbox for self-assessment tools for digital readiness and environmental conformity
 - Tool for digital readiness self-assessment of inland ports
 - Tool for assessing the environmental conformity of ports
- Conclusions

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Digitalisation vision for inland ports

Vision statement

*Inland ports in Europe are transformed into **smart, interconnected, and sustainable logistics hubs** that are digitally integrated in the broader logistics network.*

Inland ports use advanced digital technologies, including, but not limited to, digital twins, artificial intelligence, blockchain, and advanced data analytics, with the purposes of optimisation of freight and passenger flows, facilitating the performing of efficient, transparent, and sustainable operations that are aligned with the goals of the European Green Deal, Sustainable and Smart Mobility Strategy, and Inland Waterway Transport Digitalisation Vision.

*Inland ports are also fully **compatible nodes** in the concept of Physical Internet. **Collaboration with all relevant stakeholders and related data-sharing facilitates** the contribution of inland ports to end-to-end visibility and control over supply chains.*

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Digitalisation vision for inland ports

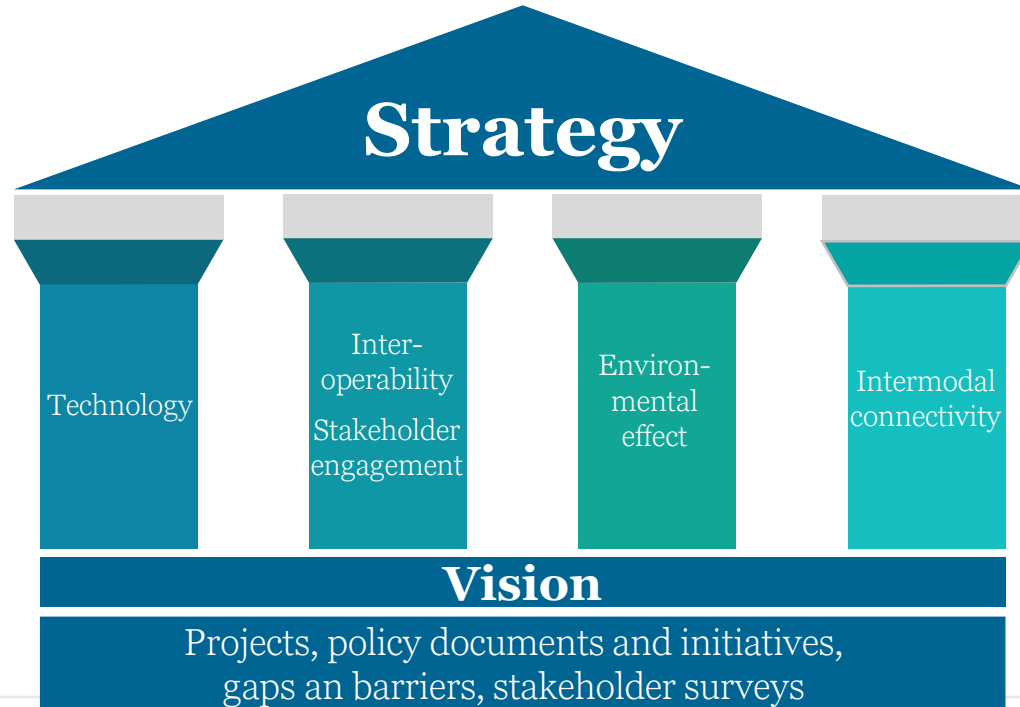
Strategy

- Foundation for the development of the roadmap and action plan
- The Strategy will consider the lessons learnt in the previous projects, policy documents and initiatives (DIWA Masterplan, PLATINA III IWT Policy Platform, IWT digitalisation vision, etc.), gaps and barriers identified during the project, as well as the findings from the two stakeholder surveys conducted during the Study

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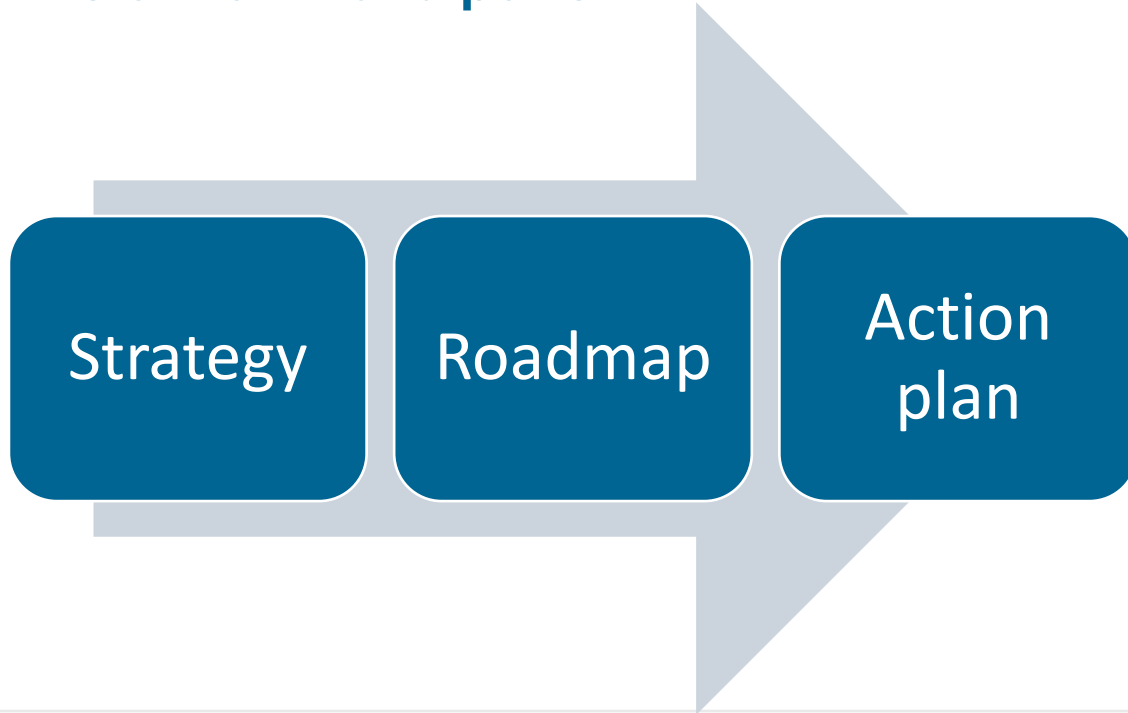


Digitalisation vision for inland ports



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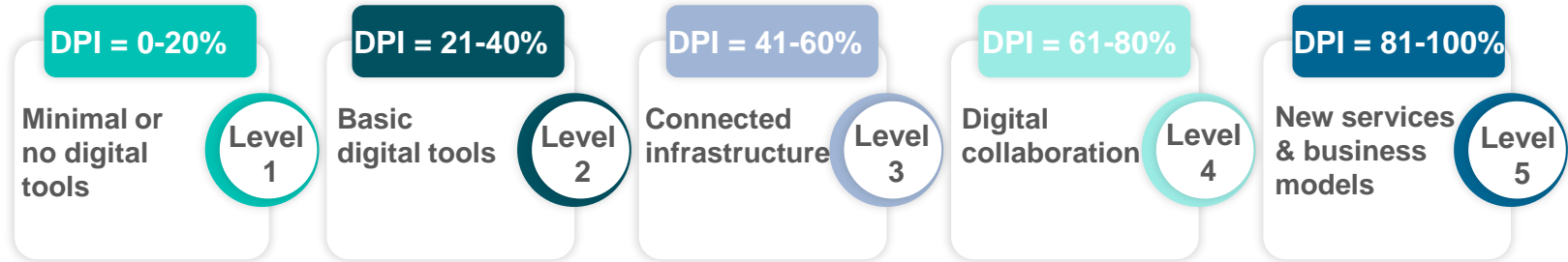
Digitalisation vision for inland ports



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Tool for the self-assessment of digital readiness

- The toolbox will be used to assist ports to **self-assess the level of digital readiness and digital maturity**
- It can help inland ports identify areas for improvement and track their progress over time.
- Basic key performance indicator of the digital readiness/maturity of inland ports is defined as the **Digital Performance Index (DPI)**, which is designed to quantify the level of digital maturity of ports
- The DPI can determine the average level of digital maturity

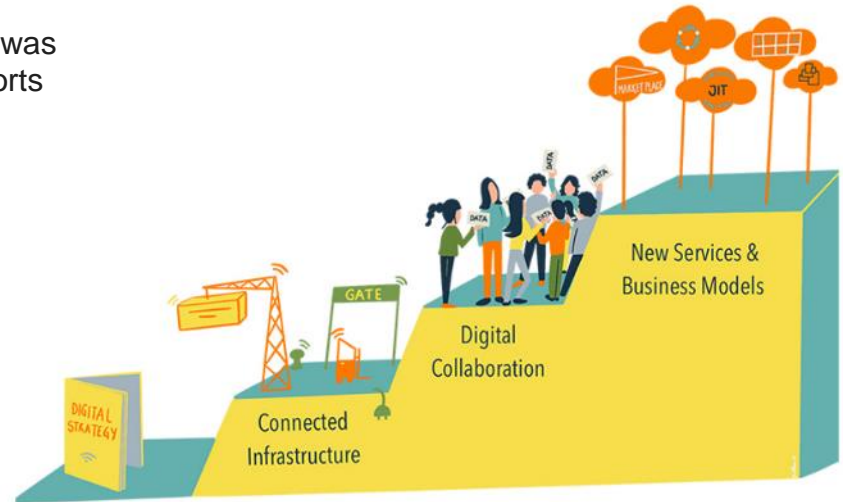


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Tool for the self-assessment of digital readiness

“Trafikverket model” of digital maturity in ports

- The Trafikverket model was the basis for our model, which was developed as an extended and adapted model for inland ports
- Levels of maturity proposed by Lind, et.al. on the basis of experience of Swedish sea and inland ports



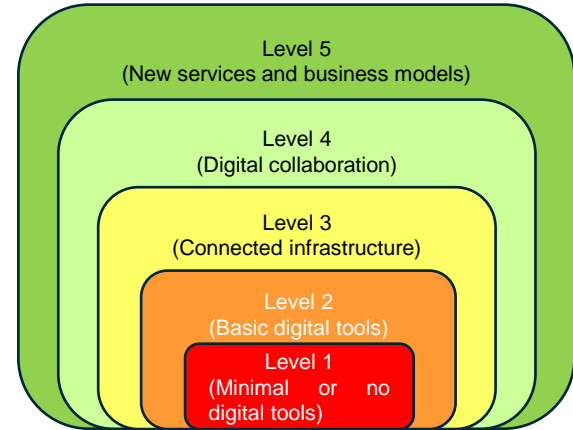
Source: Lind, M., Haraldson, S., Lind, K., Lundman, J., Karlsson, M., Olsson, E., Bach, A. (2021). *Hamnen som digital nod* (in Swedish), Report 2021-9-30, Trafikverket

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Tool for the self-assessment of digital readiness

- **Five proposed levels of digital maturity** for inland ports
 - Level 1: Minimal or no digital tools
 - Level 2: Basic digital tools
 - Level 3: Connected infrastructure
 - Level 4: Digital collaboration
 - Level 5: New services and business models



- Each of these five levels has its own five “dimensions”, or aspects of digital maturity, that are used for the assessment of a port’s digital maturity level, on the basis of criteria developed for each dimension

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Preview of the calculation tool

Level	Dimension	Criteria	Obtained score*	Maximum score
Level 1	Basic IT infrastructure	Availability of basic IT hardware, simple networking, use of basic office software.		
	Digital awareness and strategy consideration	Initial discussion or plan about digitalisation, management commitment.		
	Manual processes with minimal digital support	Reliance on manual processes, use of basic digital tools like spreadsheets.		
	Basic communication tools	Use of email, mobile phone, radio for communication.		
	Minimal data collection and reporting	Basic data collection using simple tools (e.g. Word, Excel, Access, etc.) and absence of automated systems.		
Level 1 intermediate score:			0	20
Level 2	Digital invoicing and billing systems	Use of digital invoicing systems for managing payments and billing.		
	Digital calculation of port fees and tariffs	Implementation of software for digital calculation of tariffs, fees, and service charges.		
	Digital customs declaration	Electronic submission and processing of customs documentation.		
	Digital cargo documentation	Use of digital systems for managing cargo-related paperwork (e.g., waybills, manifests, etc.).		
	Basic administrative automation	Partial digital automation of administrative tasks without digitalisation of port infrastructure.		
Level 2 intermediate score:			0	20
Level 3	Infrastructure connectivity	Secure physical objects - connectivity of quays, gates, bridges, storage areas, etc.		
	Operational monitoring	Real-time monitoring of port activities (cargo, vehicles), basic automation.		
	Data collection and storage	Centralised data collection, basic data storage systems.		
	Digital infrastructure interoperability	Different digital tools (e.g., IoT sensors, monitoring systems, data bases) within the port fully integrated and capable of seamless data exchange.		
	Initial data-driven decision-making	Use of collected data for basic operational decisions.		
Level 3 intermediate score:			0	20
Level 4	Data sharing with internal & external port stakeholders	Secure data sharing within the port and with external partners.		
	Collaborative planning	Joint planning tools for coordinating operations with stakeholders.		
	Supply chain visibility	Real-time tracking and visibility of goods throughout the supply chain.		
	Digital communication platform	Degree of use of advanced communication tools (partially, collaborative software) that provide broader and more advanced digital support for all types of interactions.		
	Advanced data analytics	Implementation of data analytic tools for improving decision-making.		
Level 4 intermediate score:			0	20
Level 5	Development of new digital services	Creation of new services using digital tools, e.g., digital marketplace, predictive maintenance or services, digital cargo management (tracking via IoT and RFID).		
	Innovation in business models	Introduction of new business models using digital capabilities (subscription-based services, digital platforms as a service principle, outcome-based pricing models).		
	Use of emerging technologies	Implementation of AI, blockchain, IoT for advanced solutions.		
	Integration with global digital ecosystems	Participation in global digital platforms and networks, such as Global Shipping Business Network (GSBN), RiverPort Planning and Information System (RPIS), etc.		
	Continuous improvement and innovation	Ongoing refinement of digital services, fostering innovation.		
Level 5 intermediate score:			0	20
Total scores:			0	100
Digital Performance Index (DPI) -			0%	

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Preview of the calculation tool

Level	Dimensions	Obtained score	Maximum score
Level 1	Basic IT infrastructure	3	4
	Digital awareness and strategy consideration	2	4
	Manual processes with minimal digital support	4	4
	Basic communication tools	3	4
	Minimal data collection and reporting	2	4
		$\Sigma=14$	$\Sigma=20$
Level 2	Digital invoicing and billing systems	3	4
	Digital calculation of port fees and tariffs	4	4
	Digital customs declaration	2	4
	Digital cargo documentation	3	4
	Basic administrative automation	3	4
		$\Sigma=15$	$\Sigma=20$
Level 3	Infrastructure connectivity	4	4
	Operational monitoring	3	4
	Data collection and storage	4	4
	Digital infrastructure interoperability	3	4
	Initial data-driven decision-making	2	4
		$\Sigma=16$	$\Sigma=20$

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Preview of the calculation tool

Level	Dimensions	Obtained score	Maximum score
Level 4	Data sharing with internal and external port stakeholders	3	4
	Collaborative planning	2	4
	Supply chain visibility	2	4
	Digital communication platforms	3	4
	Advanced data analytics	1	4
		$\Sigma=11$	$\Sigma=20$
Level 5	Development of new digital services	2	4
	Innovation in business models	1	4
	Use of emerging technologies	2	4
	Integration with global digital ecosystems	2	4
	Continuous improvement and innovation	1	4
		$\Sigma=8$	$\Sigma=20$
Total score:		$\Sigma\Sigma=64$	$\Sigma\Sigma=100$
$DPI = (64/100) \times 100\% = 64\%$			

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Digitalisation guidelines and outlook

- Digitalisation guidelines will be developed for each of the four higher levels (level 2 and higher) of digital maturity of inland ports
 - **Level 1: Minimal or no digital tools**
 - **Level 2: Basic digital tools**
 - **Level 3: Connected infrastructure**
 - **Level 4: Digital collaboration**
 - **Level 5: New services and business models**
- The ports will be able to consult the guidelines according to their self-assessed digital maturity level and move up the ladder in terms of digital maturity, according to their needs

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