



WATERBORNE

DIGITALIZATION FOR THE EUROPEAN WATERBORNE SECTOR



CONTENT

Working group participation from across the waterborne sector:

Shipyards

- Emmanuel Brochard, NAVAL Group
- Hermann-Josef Mammes - Meyer Werft
- Andrea Melegari - Fincantieri Group

Equipment manufacturers

- Hildegunn McLernon - Kongsberg Maritime

Classification society

- Duncan Duffy - Lloyd's Register

PREAMBLE

DEFINITIONS USED IN THE REPORT

Digitalization

Waterborne Sector

CONTEXT AND PROBLEM DEFINITION

Challenges related to increased labour shortage combined with increased demand for the waterborne sector

Challenges related to international competition and geopolitical developments

Challenges related to the transition to zero-emission waterborne transport

Challenges related to the modal shift

Challenges related to fragmentation

Challenges related to urgency

OBJECTIVES AND EXPECTED IMPACTS

1. Near term - Operationalize digitalization for the waterborne sector

2. Medium term - Strategic growth of the European waterborne sector

3. Long term - Transform the waterborne sector with disruptive technologies

NECESSITY TEST: RATIONALE FOR A EUROPEAN COORDINATED INITIATIVE

Digital transformation

APPENDIX

Technologies and Research Needs

Some usecase examples

02

02

02

02

04

04

05

05

05

06

06

08

08

10

10

12

12

14

14

14



PREAMBLE

Digitalization has been flagged as one of the key priorities by the members of the Waterborne Technology Platform. Following up on the work done by the previous task force and a working group, and building upon these results, a new working group was established to prepare the grounds for further RD&I activities. The exercise conducted by the working group initially prepares the contents for a larger initiative, to be finalised when discussions on further detailing the content of FP 10 kick-off.

This final report has been based on broad consultations, both with the members of the Waterborne TP, as well as with the broader group of European associations representing the waterborne sector.

It is the recommendation from this working group that further work should be undertaken looking at a combined European Partnership for the waterborne sector, where this digitalization input and the Zero-Emission Waterborne Transport cPP is merged in one holistic Partnership for a resilient, competitive, secure and sustainable European waterborne sector.

The proposed initiative is critical to ensure a resilient, competitive and prosperous future for European citizens through an accelerated digital transformation of the waterborne sector. Digitalization is the key enabler for human centric innovation and sustainable solutions, enhancing sovereignty, efficiency, security, safety and reliability. This will create a foundation for the demonstration of digital technologies by 2035.

DEFINITIONS USED IN THE REPORT

Digitalization

Digitalization is the broad transformation of societal and business models through the adoption and strategic integration of digital technologies. Research, development and implementation will focus on programs to improve efficiencies, enhance customer experience, provide new opportunities, enable automation, drive innovation and results in a more agile and competitive organization.

Waterborne Sector

The European waterborne sector includes all relevant actors of the sector, including, inter alia, shipyards and equipment manufacturers, shipowners (both maritime and inland navigation), ports, classification societies, blue economy, infrastructure and service providers and the academic and research communities. It includes, inter alia, all main ship types, included in the cPP Zero-emission waterborne transport, and has been extended with underwater vehicles: inland waterway transport vessels, ferries, short sea shipping, offshore, cruise ships, long-distance shipping, underwater and unmanned vehicles.



CONTEXT AND PROBLEM DEFINITION

The waterborne sector is fundamental to Europe's sovereignty, economic and strategic autonomy. It also provides the most sustainable way to achieve the EU Green Deal ambitions. However, the European waterborne sector is very different to other sectors due to its huge scale, unique technologies and fuels, endurance, special operating environment and regulation.

to 9.7 billion in 2050 and 10.4 billion by 2100². This increase will result in an increased need for waterborne transport due to increasing worldwide trade. This is clearly shown in the fourth IMO GHG study, indicating that emissions from maritime transport are projected to increase from about 90% of 2008 emissions in 2018 to 90-130% of 2008 emissions by 2050 for a range of plausible long-term economic and energy scenarios³.

The European shipping fleet represents around 40% of the global fleet, making the sector a geopolitical asset for the continent⁴. Europe has 300 shipyards, the largest of which build the most complex, innovative and technologically advanced civilian and naval ships and platforms in the world⁵. Others maintain, convert, repair or retrofit existing (merchant) ship types. A third category builds, repairs or maintains smaller vessel types or boats. Almost half of marine equipment is produced by European companies, including over 70% of the world's large marine engines. The majority of the European marine equipment sector are SMEs.

Europe's maritime technology companies are the leading providers of solutions to combat climate change, to minimise marine pollution and to make shipping better connected, more digital, automated or even autonomous.

There will be a further need for an increased workforce with different skills set for all segments of the waterborne sector to keep ships sailing, and to be able to build and equip these ships. Digitalisation will be critical to improve efficiency and automate tasks in a safe and secure manner. In addition, adopting new technologies and digitalization will attract a new generation of workers.

This sets it apart from other activities and raises specific challenges:

Challenges related to increased labour shortage combined with increased demand for the waterborne sector

Demographic change poses challenges for the future of the European Union and the waterborne sector. In Europe, the declining and ageing population will have an impact on the labour market (labour shortages) and on the position of Europe in the world¹. On the other hand, the world population is projected to reach 8.5 billion in 2030, and to increase further

¹https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/new-push-european-democracy/impact-demographic-change-europe_en

²<https://www.un.org/en/global-issues/population>

³<https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Fourth%20IMO%20GHG%20Study%202020%20Executive-Summary.pdf>

⁴<https://ecsa.eu/competitive-european-shipping-key-for-europes-security-and-for-strong-maritime-cluster/>

⁵https://www.waterborne.eu/images/documents/200527_Zero-Emission_Waterborne_Transport_Proposal_Final_Version_Spread.pdf



Challenges related to international competition and geopolitical developments

The EU Waterborne sector is critical for trade and economy, handling 90% of international trade, with 81% of the EU's external trade and 40% of its internal trade. In addition, the sector plays a significant role towards reinforcing the EU's resilience in terms of trade, security, defence, energy supply and sustainability and thus being an enabler of the transition towards sustainable energy while safeguarding strategic resilience and a robust supply chain. The entire waterborne sector (ranging from shipyards, equipment manufacturers, to shipowners and ports) is essential to keep this position.

However, Europe's competitiveness is eroding due to aggressive investments and protectionist policies. The EU's ownership share of the global maritime fleet is declining⁶. In addition, EU manufacturing of transport equipment is not on a level playing field with production in other world regions, impacting some segments in particular. In the shipbuilding sector, the distortive impact has been particularly acute⁷.

Utilizing new technologies for efficient engineering and construction, and optimizing integrated operations through

connected ships, fleets, offshore installations, underwater facilities and vessels, unmanned vehicles, shipyards, equipment manufacturers and ports are essential for Europe to remain as a global waterborne leader.

In addition, digitalization will address risks related to supply chain and energy security, risks related to physical and cyber security of critical maritime infrastructure, risks related to technology security and risks related to economic dependencies.

Furthermore, digitalization is required to optimize the design, engineering, production, maintenance and operation of waterborne assets. This will ensure competitiveness of the waterborne sector. Digital infrastructure will enhance adoption and implementation of disruptive technologies to maintain a competitive edge.

Finally, new regulations and standards require monitoring, reporting and verification of environmental performance across the sector. Digitalization and structured data will ensure efficiency and provide insights to monitor progress and adjust so that targets, like sustainability and growth targets are met.

Challenges related to the transition to zero-emission waterborne transport

In the Political Guidelines for the next European Commission⁸, it is envisaged that the proposed 90% emission-reduction target for 2040 will be enshrined in the European Climate Law. Besides the transition to the use of sustainable alternative fuels, energy-efficiency will become even more important, considering the average lifetime of a vessel and the current lack of sustainable alternative fuels available. The transition and speed towards zero-emission waterborne transport will be accelerated with the support of digital technologies, as the green and digital transition reinforce each other. Furthermore, the integration of a comprehensive digital lifecycle approach transforms not only ship design and production but also optimizes the supply chain's efficiency and cost-effectiveness and supports a circular lifecycle approach.

Challenges related to the modal shift

The sustainable and smart mobility strategy, lays down the objective of shifting a substantial amount of freight onto rail, inland waterways and short sea shipping⁹. The milestone set is transport by inland waterways and short sea shipping will increase by 25% by 2030 and by 50% by 2050. Digitalization will be key for the integration and the creation of new synergies of waterborne transport in the logistics chain and with other transport sectors.

Challenges related to fragmentation

The sector is fragmented because of its complex international structures, diverse regulatory frameworks (international, national, regional and European laws) and authorities (ports, rivers, waterways, national maritime and inland authorities). There are also many actors, e.g. some 300 shipyards and 22.000 maritime equipment manufacturers, as well as ports and shipping companies in the EU.

Fragmented developments are slow and costly. Digitalization requires a holistic approach and strategy across the entire sector, public and private stakeholders included. Digital solutions must be scalable and allow interconnectivity whereas regulations and standards are necessary to support so that new technologies can be implemented.

Challenges related to urgency

To meet the different policy objectives set, to be able to deal with the negative impacts of the demographic developments in Europe, to remain international competitive, and to ensure Europe's resilience, radical change will be required, which will not be possible through operational changes and incremental improvements alone. New technologies need to be developed and deployed. Considering the typical 30-year life of a ship, radically changed ships need to be deployed as soon as possible, with technology developed during the period of FP10. In this sense, different associations have communicated the objective of their specific segments^{10 11 12}.

Digitalization will be key to supporting the blue economy in achieving the policy objectives set and will stimulate growth with innovative solutions. Digitalization will help collaboration, knowledge and insights to ensure sustainable developments are meeting their full potential.



⁶ https://commission.europa.eu/document/download/ec1409c1-d4b4-4882-8bdd-3519f86bbb92_en?filename=The%20future%20of%20European%20competitiveness_%20In-depth%20analysis%20and%20recommendations_0.pdf

⁷ https://commission.europa.eu/document/download/ec1409c1-d4b4-4882-8bdd-3519f86bbb92_en?filename=The%20future%20of%20European%20competitiveness_%20In-depth%20analysis%20and%20recommendations_0.pdf

⁸ https://commission.europa.eu/document/download/e6cd4328-673c-4e7a-8683-f63ffb2cf648_en?filename=Political%20Guidelines%202024-2029_EN.pdf

⁹ https://transport.ec.europa.eu/document/download/be22d311-4a07-4c29-8b72-d6d255846069_en?filename=2021-mobility-strategy-and-action-plan.pdf

¹⁰ https://www.seaeurope.eu/images/Setting_sail_to_build_in_Europe_10000_sustainable_and_digitalised_vessels_by_2035_SEA_Europes_call_for_a_European_maritime_industrial_strategy_April_2024.pdf

¹¹ <https://ecsa.eu/strategic-priorities/>

¹² https://www.espo.be/media/ESPO%20memorandum%20-%20%20priorities%20-%20Elections%202024_3.pdf



OBJECTIVES AND EXPECTED IMPACTS

A new plan for Europe's sustainable prosperity and competitiveness is one of the cornerstones in the Political Guidelines for the next European Commission. The importance of the digital and green transition is emphasized throughout these Guidelines.

Digitalization will be key to overcome the challenges identified, and the expected impacts of a coordinated initiative on digitalization over time are three-fold and described below:

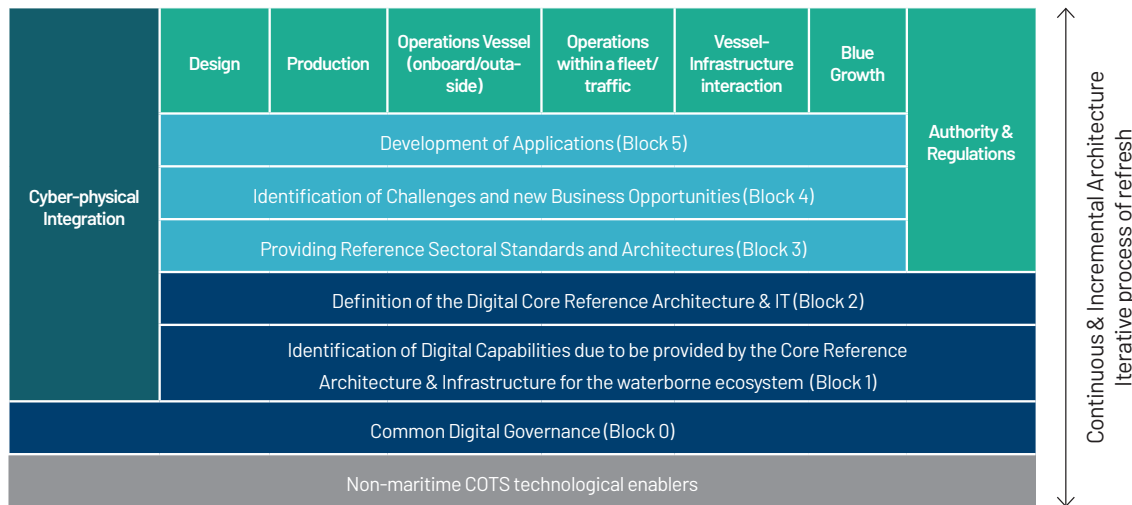
1. **Near term** - Operationalize digitalization for the waterborne sector
2. **Medium term** - Strategic growth of the European waterborne sector
3. **Long term** - Transform the waterborne sector with disruptive technologies

1. NEAR TERM - OPERATIONALIZE DIGITALIZATION FOR THE WATERBORNE SECTOR

The near-term objective is to accelerate the development and use of digital technologies to tackle current challenges and unlock opportunities within each specific area of the waterborne sector (ships, fleets, offshore installations, underwater facilities and vessels, unmanned vehicles, shipyards, equipment manufacturers and ports). Focus will be placed on rapidly developing and deploying innovative solutions leveraging digital technologies. The short-term objectives aim to research, develop, test and refine these digital solutions through both research actions and pilot projects in real-world scenarios with various waterborne stakeholders.

The digital transformation of the waterborne sector shall include the following topics:

- Digital governance and data sovereignty (including cloud)
- Cyber physical integration and cyber-resilient digital infrastructures and platforms (including onboard ship), with ability to adapt to evolving threats
- Digital Core Reference architecture and infrastructure, also including vessel and fleet connectivity and data management (including with drones)
- Communication for mobility and IoT, communications systems, standardization of communications
- Applications, business opportunities and sectorial standards for e.g. ship operating systems and ship navigation systems, platform autonomy, damage control and resilience of digital systems



- Prerequisites to Digital Transformation
- Preconditions to Sectoral implementation of the Digital Transformation

The figure above shows a holistic approach to digitalization through the 7 areas (verticals) related to the industrial stages and businesses sharing common interests, and the 6 blocks (horizontals) of prerequisites and preconditions for the digital transformation of the waterborne sector.

This ensures that digitalization occurs at every step of the value chain from design, production, operations and decommissioning with interconnectivities from single vessel, fleet and infrastructure, through industrialization and blue growth, for example (but not limited to):

- Digital twins for design and industrialization facilitating collaborative and efficient interaction along the product lifecycle from design to maintenance
- Factory of the future with data driven activities, cognitive assistance, robotics, additive manufacturing and new materials
- Simulation and training, including human factors and AI trust and acceptability
- Remote and autonomous supported operations of vessels and fleets
- Digital twins and augmented reality for industrialization, predictive maintenance and operational support
- Data and insights to support blue growth

Any relevant regulatory gap related to digitalization must be identified and addressed. Authorities and regulations must proactively be involved to help remove barriers to digitalization of the waterborne sector. Feedback to and compliance with new regulations must be harmonized with technology development and the digital transformation.

2. MEDIUM TERM - STRATEGIC GROWTH OF THE EUROPEAN WATERBORNE SECTOR

The medium-term objectives are to create value through research, development and testing of new technologies with interoperability across the waterborne sector. Strategic growth will be ensured by integrating key digital technologies across the whole waterborne sector to create a highly integrated overwater & underwater ecosystem where all actors in the waterborne sector seamlessly connect and share data.

Expected benefits aims to improve efficiency, safety, and sustainability across the waterborne sector, fostering:

- **Optimized Operations:** Real-time data sharing can enable ships and ports to better predict arrival times, optimize cargo handling, and reduce congestion
- **Enhanced Safety:** Increased awareness of weather conditions, vessel positions, and potential hazards can be achieved through data sharing
- **Sustainability Improvements:** Data analysis, innovative propulsions and smart energy management systems can contribute to optimizing fuel consumption and implementing practices compliant with long term net-zero goals
- **Full interoperability** between all partners and vessels
- **Improve crew wellbeing:** Optimize information flow and improve crew efficiency. Trust and acceptability of new technologies like e.g. AI

Strategic growth through digitalization also includes blue growth opportunities - like blue growth applications, digital-based knowledge input for multiple use purposes and digital management of blue growth infrastructure.

Digital transformation and new technologies will enable new business and operating models.



3. LONG TERM - TRANSFORM THE WATERBORNE SECTOR WITH DISRUPTIVE TECHNOLOGIES

The long-term objectives is to identify and explore disruptive technologies with the potential to revolutionize the waterborne landscape and the economic and social benefits of the ocean space.

The long-term activates includes:

- Screen, explore and research new technologies at low TRL
- Stay ahead of the curve by anticipating and analyzing emerging trends with transformative potential
- Assess the potential impact of these disruptive technologies (like humanoid, metamaterials, quantum computing and sensor evolutions, etc.) considering economic, environmental, and social implications

The long-term research, developments and tests will have the potential to transform the waterborne sector and its interoperability and interaction with other industries.



NECESSITY TEST: RATIONALE FOR A EUROPEAN COORDINATED INITIATIVE

Whilst there is a consensus concerning the need to digitalize the waterborne sector, a European coordinated initiative is needed to mobilise a critical mass that is committed to the urgent development of the necessary knowledge, technology and business models, and to ensure its deployment. The initiative is expected to enhance Europe's technological leadership over competitors in other geographical areas, who are stepping up their R&I investments, in particular in the transport sector with advanced technology.

Digital transformation is a major **game-changer** for the **waterborne sector** that cannot be addressed through the traditional sectorial in-silo approaches. It requires to be tackled with focused effort and by the entire waterborne sector through a **horizontal and collaborate approach**:

- European initiatives are specifically designed to address complex societal challenges aligned with the EU's strategic priorities. By focusing resources and expertise on these shared goals, these initiatives are better positioned to deliver impactful solutions with tangible benefits for Europe
 - Sustainable Implementation: European initiatives encourage the development of additional, non-funded activities alongside the core research projects. This can encompass activities like market deployment, skill development, and regulatory considerations.
 - This proposal advocates for the implementation of a European initiative to achieve the ambitious objectives as it provides a more comprehensive and effective approach. The collaborative environment, long-term vision, strategic alignment, and focus on sustainable implementation will significantly increase the initiative's impact and contribution to the EU's overall research and innovation landscape.
 - A European initiative fosters collaboration between public authorities, research institutions, and the private sector. This broader coalition allows for the pooling of expertise, resources, and funding that surpasses the capabilities of individual entities responding to traditional calls.
- Long-Term Strategic Vision: European initiatives enable the development of a long-term Strategic Research and Innovation Agenda (SRIA) setting a clear roadmap, guiding research efforts towards a unified goal and ensuring continuity beyond the initial funding period.
 - A European initiative will empower the continued growth, competitiveness and resilience of the waterborne sector through digital transformation, by focusing on immediate needs, strategic integration, and futureproofing through disruptive technologies.
 - The initiative will ensure that the waterborne sector fully exploits the opportunities for existing and disruptive digital technologies to enhance competitiveness in collaboration with other sectors and industries. The initiative is an important tool to mobilise the firm commitment of all stakeholders (public and private) necessary to meet the ambitions and ensure alignment of policies, regulations and research activities to achieve digital transformation. In doing so, the initiative would overcome duplication, improve efficiency of efforts and increase the EU's influence in the Waterborne sector.

APPENDIX

TECHNOLOGIES AND RESEARCH NEEDS

Many different technologies have been identified as key to develop at European level and monitor, research and develop for the future of the waterborne sector. The list is not complete, and it must be reviewed if technologies are to be researched and developed at lower technology readiness levels or implemented in products and solutions at higher technology readiness levels. Both are applicable, and will depend on safety, security, resilience, technology maturity and applications assessment.

Typical technologies to be researched and developed include (but are not limited to):

0-15yr

1. Artificial Intelligence (AI) and Machine Learning (ML)
2. Connectivity, Internet of Things (IoT) and Sensor Technologies
3. Big Data Analytics
4. Edge & Cloud Computing
5. Digital Twin Technology
6. Augmented Reality (AR) and Virtual Reality (VR)
7. Robotics and Autonomous Systems
8. Cybersecurity Platforms and Tool
9. Predictive Analytics
10. Energy Management Systems
11. Swarm Robotics / Multiagent teaming
12. Autonomous Drones

0-30yr

1. 5G and Advanced Wireless Communications
2. Neuromorphic Computing
3. Advanced Materials and Nano technologies
4. Brain-Computer Interfaces
5. Federated Learning
6. Generative AI, Explainable AI
7. Quantum
8. Synthetic Data Generation
9. Conversational AI





SOME USECASE EXAMPLES

Operationalise digitalization:

- Common digital governance and data sovereignty
- Core reference architecture and infrastructure standards (ensuring cybersecurity, digital resilience, safety and security)
- Onboard computing (computing, storage, network)
- Edge and cloud infrastructure
- Applications
- Services offered by onboard digital infrastructures for crew specialties, connectivity, data management and technical resources

Solutions:

- Factory of the future - smart design and manufacturing at shipyards and equipment manufacturer
- Digital twins for design, manufacturing, maintenance and operational performance
- Virtual Reality and Augmented reality
- Smart Energy Management Systems
- Maritime Autonomous Systems, including Uncrewed surface and underwater Vehicles
- Navigation solutions and Control
- Cyber security systems
- Damage control integrating assistance to operational capabilities
- Communications systems (including networks, wireless, intra-crew)

Services and Compliance:

- Maintenance and Asset Management
- Safety and Emergency Management
- Environmental Management
- Sustainable Shipping
- Data Analysis and Decision Support
- Compliance and Documentation

Interoperability:

- Fleet Management
- Port Integration and Management
- Vessel to Port Integration
- Optimized human-machine interfaces

Ship and Interoperability Management:

- Passenger Experience
- Crew Management (connected crew)
- Cargo Management
- Financial Management and Optimization



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