TOWARDS A STRATEGIC RESEARCH AGENDA

INLAND WATERWAYS TRANSPORT AND PORTS IN HORIZON EUROPE

January 2019

Presenting vision, strategy, time-path and expected benefits of targeted research into inland waterway transport and ports

Work in progress

INTRODUCTION

The ability of society and industry to address global challenges, to meet the UN Sustainable Development goals and the COP21 objectives, to tackle societal needs and to adopt emerging technologies, will determine the world of tomorrow and the life of future generations.

With more than 70% of the globe covered by water, the Waterborne sector in Europe will be pivotal in the coming decades, both in Europe and globally. 50% of Europeans live close to the coast and the valleys of the 15 largest rivers, requiring inland waterway transport to transform into a green, clean, safe, secure, digital and automated mode of transport while combining the use of waterways with a changing climate and altering energy use.

Facing these challenges, goals and needs, the inland waterway transport sector, public and private, in Europe is determined to take up its responsibility. To that end, the sector has developed, in close cooperation with key stakeholders, an ambitious vision, based on a series of cross-sectoral missions.

Inland waterways are a precious resource and asset with multiple values and fit for multi-purpose use: transport infrastructure, natural habitat, energy production, leisure environment etc. When developed responsibly and in an innovative manner, they offer uniquely attractive and sustainable opportunities for our economy, society and environment under safe conditions.

To implement its ambitious vision, the inland waterway transport sector commits to make significant investments in research, development and innovation (RDI), as well as in education and training. These investments will have to be underpinned by an integrated, holistic and coordinated policy and strategy, across all parts of EU framework programmes and other relevant EU funding programmes.

The first basis for future research and innovation needs is laid down in this document, to be able to contribute to the strategy for long-term EU greenhouse gas emissions reductions, to climate adaptation and to reach seamless transport, mobility and logistics towards 2050. The further development of the Strategic Research Agenda will be taken up in cross-sectoral partnerships with key stakeholders of the inland waterway transport sector.

Healthy and easy-to-reach cities

- **People and goods** reach their destination in a reliable, affordable, healthy and safe way.
- The **waterfront is a shared space** in urban areas where it is good to live, work, enjoy and trade

Zero-emission & resource efficient economy

- **100% renewable energy and no harmful emissions**
- **Clean refuelling infrastructure** is available all along the network
- Vehicles and equipment are **fully recyclable**
- Logistics enable the **circular economy**

Easy-to-use and reliable mobility & logistics

- Digitalisation and automation
- Easy-to-use and secure **door-to-door trips**, adaptive and **integrated across modes**
- Optimized **safe operation of assets, capacity use of available space and infrastructure**, i.e. the whole life cycle management of assets

Climate resilient, thriving & sustainable waterfront

- **Sustainable passenger & cargo shipping co-exist with nature and other water functions** without additional land use
- People and business are **protected against floods and droughts**
- **Nature hosts a rich fauna and flora**

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1 | VISION 2050

How inland waterways transport and ports contribute to the integration of climate, energy and mobility objectives

HEALTHY AND EASY-TO-REACH CITIES

In the future, 80% of the EU population will live in urban areas. People and goods reach their destination in a reliable, affordable, healthy and safe way. The waterfront is a shared space in urban areas where it is good to live, work, enjoy and trade.

While expansion of the existing land infrastructure is often challenging and expensive to meet the increasing demand for public transport and city logistics, EU cities located along uncongested waterways fully seize the potential of transporting goods and people by smart, clean and modular ships and embed these services in multimodal solutions.

Inland ports are integrated in the urban fabric. The location of inland ports in urban environments has created opportunities for seamless multimodal logistics and mobility. Land use planning schemes have replaced mono-function management of space with a shared use of the waterfront for housing, distribution, leisure, mobility, industry, logistics and alternative energy.

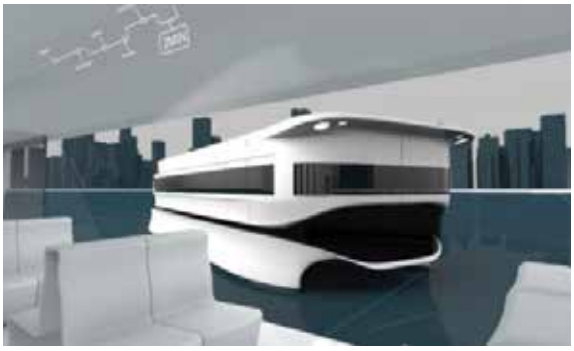
The multiple use of waterside space covering water management, climate-neutral transport, recreation, climate-effect mapping and economic activity are all combined on the same surface. These multi-functional spatial concepts provide a unique asset in dense areas thanks to a smart and economical use of scarcely available infrastructure along city waterways and enable the regreening of public space in the city.

Better use of uncongested waterway transport in multimodal logistics and mobility has drastically reduced the impact on the living environment, safeguarding air quality, safety and living and working conditions in cities while increasing their competitiveness through effective and reliable transport as well as sustainable jobs.

People commute in a relaxed way into the city over water swiftly switching to clean vehicles and soft mobility to reach their end destinations. Visitors enjoy cities and landscapes from the waterfront thanks to sustainable cruise and leisure tourism.

E-commerce, building logistics, the increased freight and waste volumes in general as a result of growing urban population have been met with cargo consolidation services maximizing the use of water transport. Ships act as flexible and mobile floating stocks for onwards last-mile distribution.

Paris floating stock project
© HAROPA - Harchinomak & O. Bui



Zero emission & automated Urban Water shuttle
© Maritime CleanTech

Multi-functional cityscape © HAROPA

ZERO-EMISSION AND RESOURCE EFFICIENT ECONOMY

Transport runs on sustainable options, including 100% renewable energy and no longer emits harmful environmental emissions (including gaseous and carbon emissions) as well as water pollution and noise emissions during production and operation. Vehicles and equipment are fully recyclable. Clean refueling infrastructure is available all along the network. Logistics enable the circular economy.

Clean batteries © Skoon Energy

Roboats © AMS

Green leisure shipping ©Vedettes du Pont Neuf

Small, medium size and large vessels for freight and passengers sail on sustainable energy sources/carriers. Clean energy refueling infrastructure is available at well accessible berths along waterways, in ports and port facilities. Synergies are exploited between clean energy grids and waterway networks to make optimal use of hydropower generated at rivers and canals, wind energy and other clean energy sources at waterside mobility hubs like ports and multimodal nodes for supplying transport, households and industries while minimizing distribution costs.

Land use plans allocate eco-industrial sites and recycling hubs to waterside port areas allowing circular processing and closed loops of products and materials backed by waterborne transport solutions that enhance bundling of freight flows and reverse logistics. They also allocate multimodal mobility and tourism hubs to waterside port areas to promote attractive and sustainable public transport and tourism activities by water.

New business models and innovation rewarding regulation provide strong incentives for continuous investment in optimal capacity use, zero-emission and resource efficient development of infrastructure and assets.

EASY-TO-USE AND RELIABLE MOBILITY AND LOGISTICS

Digitalisation and automation have improved door-to-door trips by making them user-centric, adaptive and integrated across modes while respecting data privacy and ensuring cybersecurity. They also optimize safe operation of assets, capacity use of available space and infrastructure, i.e. the whole life cycle management of assets and equipment by constant monitoring, thereby enhancing business and policy decision making.

Important EU industries and agriculture rely on reliable and cost-effective supplies by water. It is a very safe carrier for dangerous goods and unrivalled for high and heavy cargo. Inland ports connect long-distance corridors with the last mile turning them into hubs in logistics chains and in mobility networks.

Digitalisation connects smart vessels and ships with smart ports and smart infrastructure. It enhances data flows, self-diagnosis and swift machine interaction, allowing a progressive and safe increase in automation and autonomy, automated and autonomous systems, vessels and ships operations and remote controls from the shore.

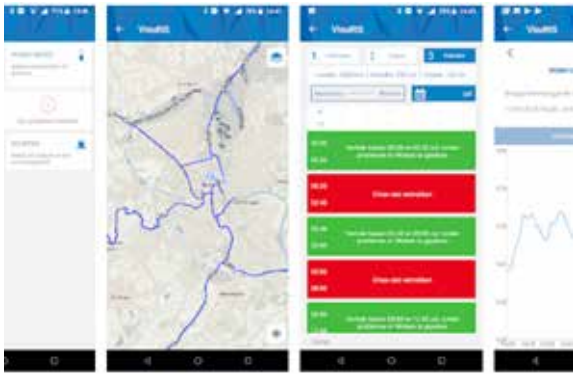
Dynamic traffic management provides in-advance and real-time information in an integrated way to logistics and mobility users. Blue wave operation of locks and bridges guarantees fluid and clock-proof shipping traffic on waterways across borders. Smart sensors support continuous monitoring and diagnosis and optimize the rehabilitation and regeneration of infrastructure and assets in a life cycle approach.

Vessels are designed so that they can be continuously updated with the latest digital technologies throughout their lifecycle. Connectivity and automation increase operations performance, capacity use, safety and energy-efficiency of inland navigation. Data are interoperable across transport modes on a “one record, once only” basis, making inland waterway transport easy-to-use in synchro-modal operations.

For freight, inland waterway transport and ports are fully integrated in interconnected logistics solutions. People commuting into and within urban conurbation over water swiftly switch to other transport modes to reach their end destinations on a multimodal single ticket.

With this development, EU companies strengthen their position in digital and autonomous technology and education.

Remote control © SEAFAR



RIS app © De Vlaamse Waterweg

Collaborative digital data collection © CoVadem & Deltares

CLIMATE RESILIENT, THRIVING AND SUSTAINABLE WATERFRONT

The majority of the EU population lives near the coast and in the valleys of the most important rivers where bursts of activities co-exist. Passenger and cargo vessels co-exist with nature and other water functions without additional land use. People and business are protected against floods and droughts. Nature hosts a rich fauna and flora providing a backdrop for sustainable transport, tourism and recreation.

Energy generation © Aerophoto

Integrated water management © viadonau

Sustainable, congestion-free distribution © HAROPA

Global warming has caused changes in rainfall and river flow patterns, resulting in more frequent and abrupt water level variations. Flood and drought warning and emergency relief programs have been put in place together with the application of flood and droughts tolerant design and construction standards. Risk mapping as well as real-time, in-advance information and seasonal forecasts advise transport users and waterfront residents and users.

Structural water management measures balance periods of prolonged drought. All locks are equipped for efficient use of water (e.g. water-saving basins, pumping stations, Archimedean screw turbines, power generators). Flood control areas have been developed and transformed into nature reserves. Local stakeholders are involved for a joint vision on water management, transport, nature, recreation and tourism development.

Water resources are protected with preventive and structural action taking into account the needs of reliable and fluid waterway transport in combination with other water functions.

2 | STRATEGY AND INNOVATION STEPS 2021-2027

Why and how to act short & medium term to accelerate market introduction and achieve mass market implementation and deployment by 2050

COMBINATION OF TYPES OF RESEARCH

To achieve mass market implementation by 2050, the strategic research agenda has to combine technological research with innovation-rewarding regulation and innovative business models that make the shift attractive and affordable for all stakeholders. In some areas, such as green short-range vessels and connectivity solutions, the first promising examples are emerging, but they will not become mainstream without socioeconomic and pre-normative research that fosters innovation in regulation and financing (instead of encouraging business-as-usual) and boosts engagement of market players to ensure the right promotion and framework conditions for wide market uptake. A coherent approach on technology, regulation, education, awareness raising, stakeholder involvement and financing creates trust among public and private partners to cooperate on innovation and enhances steps towards investments which only yield return in the long term. The solutions towards a green and connected economy will be more successful if they respond to the different needs and deliver quality for all in society.

Also for technological research such as green long-range vessels, smart logistics concepts in multimodal terminals, automated supply chains and innovative waterway management, the coherent involvement of the relevant public and private partners is necessary.

DEDICATED RESEARCH

While inland waterway transport benefits from further integration with other transport modes, it requires at the same time specific areas of attention. For example, the greening of different sizes of inland vessels operating in shallow waters and urban environments is different from maritime applications. Innovative waterway life cycle management and climate resilience requires other solutions than in the marine and maritime environment. Idem for the development of transport in free-flowing rivers in protected areas. On the other hand, research and development activities, including the creation of the supporting measures needed, is best exploited in broad partnerships, however taking into account the specific requirements of the inland waterway transport sector and accompanying a small scale but promising sector in future-oriented developments and investments.

PROGRESSIVE RESEARCH

Innovation is accelerating in some areas and stalling in other. Nobody knows exactly how the world will look like in 2050 apart from the fact we need to take steps towards a livable future for next generations. We will need to flexibly react to new upcoming developments and challenges and continuously finetune research needs and activities.

A STRICT TIME PATH

To achieve the vision 2050, the combined research efforts must be done in the short and medium term to facilitate market introduction from 2023 onwards and become mass market afterwards, progressively towards 2050.

3 | RESEARCH & INNOVATION APPROACH 2021-2027

Research & innovation activities will address the different levels of transport: physical and digital infrastructure, traffic management, transport and mobility services. This ensures an integrated approach.

Three research & innovation **activity clusters** are key to achieve the vision by 2050:

- Waterways fit for next generations
- Smart & connected shipping
- Green & competitive transport

These clusters work across the 4 layers of physical infrastructure, digital infrastructure and traffic management, transport and mobility services to deliver effective and integrated solutions

The **physical infrastructure** is the hard infrastructure layer consisting of waterways, waterfronts, locks, dams, bridges, jetties, berths, port facilities etc. which are multi-purpose next to the transport function. **Digital infrastructure and traffic management** cover the infrastructure and services for digitalizing and automating the waterway. **Transport services** include the services and solutions to make the transport assets green, clean, safe, secure, digital and automated. **Supply chain and mobility** ensure the integration of inland waterway transport in multimodal supply chains and mobility networks.

All layers are complementary and one layer cannot function without the other. This requires both integrated and dedicated tasks for inland waterway transport.

Infrastructure planning shapes mobility. Greening of vessels and equipment requires clean energy refueling infrastructure and changes the management and the infrastructure of the energy system for modal and multimodal transport services on the one hand and the interaction with other energy uses. Optimal asset utilization at all levels is another important driver for green shipping which thrives with increasing cooperation. Water transport takes place in a natural and changing environment. Its long-term competitiveness depends as much on decarbonization and zero-emission developments as on the climate resilience of fleet and infrastructure. In a multi-purpose water environment, interventions for navigation are integrated in a win-win approach for all water functions.

Fairway and traffic management will evolve with the increasing use of automated vessels and equipment. Inland waterway transport can only integrate in synchro-modal transport systems with high quality physical waterway and port infrastructure if the digital infrastructure and traffic management are in place to supply data on the infrastructure and the services. Besides, attention for appropriate knowledge and skills for the current and future workforce of the sector need to be incorporated in research and development activities where relevant, in order to allow a smooth implementation of the new concepts together with the related actors.

ANNEX: RESEARCH & INNOVATION ACTIVITIES

1. WATERWAYS FIT FOR NEXT GENERATIONS

1.1. STRATEGIC PLANNING

Objectives

With over 40,000 km of navigable waterways and over 250 inland ports, inland waterway transport- contrary to the congested land transport networks- disposes of free capacity, offering a huge modal shift potential over long and short distances. The organization of space and infrastructure determines mobility and energy choices which impact the climate.

The aim is to enhance the use of waterway transport in an integrated context where all waterway uses are matched and prepare together for climate change with win-win solutions.

1. Moving more people and goods by water over quality waterways and relieve the congested land transport network
2. Climate resilient infrastructure and integrated water management

Inland waterways, besides being a transport infrastructure, typically serve multiple purposes, like natural habitat, energy production, leisure environment, water supply. In many cases (rivers in particular), they also pose a threat to assets and human beings through floods. Therefore any development activity for waterways must take into account multiple criteria which represent the multi-usage character of the respective water body- a situation unique for transport infrastructure.

1.2. R&I ACTIONS

MOVING MORE BY WATER

Short term

- Broadening stakeholder engagement and cooperation;
- Awareness raising, durable engagement broadening and impact improvement among logistics and mobility stakeholders
  - creating flexible teaching and learning modules on waterway transport for logistics education and vocational training and vice versa;
  - effective coordination and integration of different mobility actors, networks and modes adopting a user-centric approach in a stakeholder-based innovation platform for a comprehensive approach of regulation and standards, viable innovation business models;
  - multi-criteria assessment of scenarios, policy measures, technological and organisational innovation of infrastructure, fleet to ensure sustainable innovation from research to deployment;

- Increasing the quality of the infrastructure:
  - research on better navigation/navigability status; new finance models for waterway and port infrastructure projects;
  - modelling for increased accessibility and multimodal interconnections through ports, including harmonisation of waterway infrastructure along corridors and in the European waterway network;
- Improving the use of existing infrastructure:
  - elaborating multi-disciplinary land use planning models and future-proof infrastructure handling multi-functional demand
  - mapping and modelling port-city opportunities and integration of water freight & passenger solutions in new forms of mobility and spatial planning for urban and suburban areas covering assessment approaches, scenario evaluation, external costs, innovative tools and recommendations for Sustainable Urban Mobility Plans (SUMPs) and public procurements of innovation (PPI) aiming at improving urban mobility;
  - optimizing design of shore-side infrastructure, mooring places, calamity access and other facilities along waterways and in port terminals.
- Testing new markets:
  - researching conditions for successful entry in new continental markets such as e-commerce, bio and circular economy and pilots;
- Lifting barriers for waterway transport:
  - pilots to decrease transshipment and inventory costs, increase flexibility and reliability;
- Infrastructure fit for green and smart shipping linking to activities 2 + 3.

Medium term

- Develop models for detailing the benefits of waterways in their multiple usage context

CLIMATE RESILIENT INFRASTRUCTURE & INTEGRATED WATER MANAGEMENT

Short term

- Waterway maintenance and life cycle management is supported by the analysis and monitoring and surveying results, historical water level records and forecasts to adequately plan interventions and inform users. Current work can be considerably optimized by remote sensing and smart monitoring and decision support:
  - Test and extend the use and implementation of collaborative floating ship data, aquatic and flying drones: definition of framework conditions, evaluate accuracy for hydrography and quality check of water installations, development of business cases and governance models;
  - Development and testing of smart buoys and navigation signs with ability to measure water temperature, flow velocity, water depth, water quality;
  - Development and testing of automatic monitoring of dredging material and draught sensors;
- Advanced research into sediment management and dynamics and role of sediments to support the achievement of WFD ecological objectives GES and GEP;
- Environmental monitoring (including pre-monitoring and post-monitoring), combination of hydrological and hydrodynamical models;
- Increasing quality (short-term, monthly and seasonal) and lead-time of hydro-meteorological forecasting and automatic update of models;
- Climate projections and climate adaptation modelling and simulations for coping with droughts and floods, integrated water management;
- Design and testing of climate adaptation strategies for transport users, waterfront business and residential communities and nature (erosion of wetlands) with stakeholder involvement;
- Innovative hydraulic engineering;
- Innovation in hydraulic structures (maintenance, retrofit, rehabilitation, regeneration, new construction) like locks, weirs;
- Inclusion of smart infrastructure solutions and resulting data in River Information Services, linking to activity 2 and usage of RIS-generated data for optimisation of the infrastructure and its maintenance;
- Eco-benefit models for inland waterways covering multi-purpose use: transport, biodiversity, tourism and leisure, water supply, energy generation;

- Best practices for integrated waterway development taking into account the multi-usage character of waterways are established for different application scenarios.

Medium term

- Remotely piloted systems to infrastructure upgrade and maintenance works;
- Robotized equipment to perform routine periodic or emergency works.

IMPACT

Who is affected and how it will benefit stakeholders
Business & society, public & private

- Increased use of inland waterway transport
- Waterways relieve congested land transport systems
- Land use planning integrates waterway transport
- Waterfront is a shared space for transport, biodiversity, energy generation, housing, tourism and leisure
- Shared win-win use of waterfront infrastructure leads to better capacity use and water management
- Reduced infrastructure management cost
- Improved life-cycle and resilience management
- Extended infrastructure lifetime
- Climate proof infrastructure planning
- Improved climate adaptation strategies protecting people and businesses against floods and droughts

1.3. ONGOING AND PAST ACTIVITIES

- **PLATINA 2** (2013- 2016) is a European Coordination Action supporting the implementation of the NAIADES 2 policy package "Towards quality inland waterway transport", which aims at promoting this sustainable mode of transport. PLATINA 2 brings together all the relevant actors in the inland waterway sector in a multi-disciplinary knowledge network to foster the development of inland navigation into an even more sustainable and competitive part of multimodal European transport networks. The project strongly builds on the results of the PLATINA project (2008-2012).
- **FairWAY Danube**: FAIRway Danube aims at increasing the knowledge on shallow sections of the Danube waterway so that the fairway routing will be optimized and rehabilitation measures drafted.
- **ECCONET** gathered the expertise of partners from different fields related to meteorology, hydrology, infrastructure operation, transportation and economics in cooperation with WEATHER and EWENT in order to assess the effect of climate change on the transport network, taking the inland waterway network as a case-study.
- **IMPREX** will improve society's ability to anticipate and respond to future hydrological extreme events (floods, droughts...) in Europe. It will enhance forecast quality of extreme hydro-meteorological conditions and their impacts. The knowledge developed by the project will support risk management and adaptation planning at European and national levels. Although the inland waterways offer a congestion-free network, the ease, safety and efficiency of it is sensitive to hydrological impacts from the short-term up to the climate time scale. Accurate forecasts are needed over a range of time scales.

- **ProWaS** aims to prepare the regular provision of projections for the effects of climate change on waterways and navigation. The project is coordinated by BfG (Bundesanstalt für Gewässerkunde, German Federal Institute of Hydrology), working closely with its partners DWD (Deutscher Wetterdienst, German Weather Service), BSH (Bundesamt für Seeschifffahrt und Hydrographie, Federal Maritime and Hydrographic Agency) and BAW (Bundesanstalt für Wasserbau, Federal Waterways Engineering and Research Institute).
- **HEPEX** is a global community of researchers and practitioners in hydrological ensemble prediction. It brings together people contributing and working on specific topics related to hydrological forecasting and hydrometeorological ensemble prediction.
- **Danube STREAM:** The objective of the project is to establish and maintain an efficient and environmentally-friendly transportation network (Danube and its navigable tributaries) by further developing effective waterway infrastructure management. In addition to consolidating common standards and tools, the project's results and outputs include user-oriented information services. These enable rapid information transfer on the quality of the waterway's infrastructure. On the strategic level, cooperation with stakeholders (ecology, navigation) and coordination with political level EU Strategy for the Danube Region (EUSDR) are important project activities.
- **SIGMA** plan protects Flanders from flooding. In extreme weather conditions, the river Scheldt and its tributaries can reach dangerously high water levels and can even overflow their banks. That is why the Sigma Plan invests in sturdier and higher levees and in a chain of natural flood control areas in the river valleys. Areas like these can catch excess river water in a controlled manner. This gives the rivers room to flow and to overflow.
- **PIANC WwN ("Working with Nature")** is a proactive, integrated philosophy which focuses on achieving waterborne project objectives in an ecosystem context rather than assessing the consequences of a predefined project design and focuses on identifying win-win solutions rather than simply minimising ecological harm. Working with Nature considers project objectives from the perspective of the natural system rather than from the perspective of technical design.
- **Integrated River Engineering on the Danube East of Vienna** covers a multitude of river engineering measures designed to stabilise the decrease in water levels, preserve the unique habitats of the Danube floodplains and create a waterway infrastructure that fulfills the requirements of safe and economic navigation.

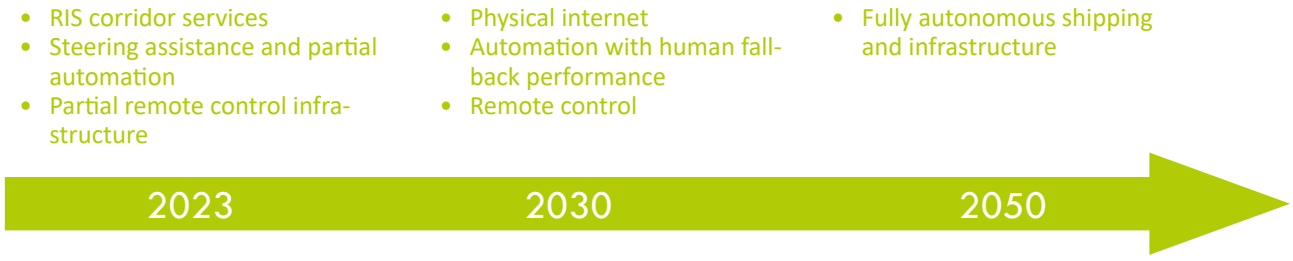
2. SMART AND CONNECTED SHIPPING

2.1. STRATEGIC PLANNING

Objectives

Digitalisation and automation aims to support the further integration of the inland waterway transport into seamless mobility and logistics improving efficiency, safety and sustainability. Smart shipping is an integrated approach and covers:

1. Smart communication: enables smart cross-border navigation by using real-time and in-advance data from ships, infrastructure and third parties. The interaction between ships, infrastructure and logistics/mobility parties evolves into a smart, smooth and flexible process facilitating synchro-modal transport.
2. Smart infrastructure: the management of the waterway infrastructure network and navigational environment uses real-time and in-advance data from ships, infrastructure and third parties to offer proactive traffic management. Infrastructure is operated via remote control from a traffic centre and operations are organised from a corridor perspective. In combination with smart infrastructure, smart cargo and passenger handling increases safety, reliability and sustainability across the transport chain.
3. Smart vessels: increased automation of vessel operation towards highly automated ships that are equipped with automated systems using (external) data to optimize the key functions of the vessel (vessel command, monitoring and responding to the navigational environment, real-time planning, fuel consumption management, etc.) .) and autonomous vessels.
4. Smart regulation and facilitation: Smart interaction between the ship and government parties for regulation or inspection. Smart regulation supports smart shipping while safeguarding the users of the waterway and society.



2.2. R&I ACTIONS

DIGITALISATION

Big data collection and analytics

Development and validation of multiple, resilient and cost-effective sensor technologies on systems/structures for automated data collection, with particular links to smart management of the infrastructure network (hydrological, meteorological, infrastructure status, traffic patterns) to support infrastructure monitoring, diagnosis, maintenance, rehabilitation and regeneration.

Short term

- Data quality;
- Legal and governance issues on data collection and operations;

- Full digital coverage and internet connectivity of the waterways;
- More reliable and long-term water level and weather forecasting.

Medium term

- Exploring opportunities to exploit big data analytics for improved insight and more flexible transport operations, such as demand forecasting, expected arrival times, congestion, cargo peak estimation and resilience management;
- Prepare computation networks powered by artificial intelligence and machine learning systems.

Advanced traffic & transport management and RIS

Building on the Digital Inland Waterway Area (DINA) leading to the creation of an internal market for inland waterways harmonised digital services.

Short term

- Corridor and network management;
- Single window: development of standards for data collection and sharing across different public and private stakeholders for freight and passengers to create reliable and seamless electronic information exchange while guaranteeing privacy and cyber-security for harmonised cross-border traffic, route and voyage planning, berth management and less red tape to enable single reporting and remove administrative burdens;
- Security, privacy and cybersecurity, fault tolerance.

Medium term

- Models for prioritization of traffic;
- Digitalisation of paperwork, one record and once only;
- Differentiation between public and private services;
- Legal and regulatory framework;
- Standardisation;
- Connection with port community systems and port/terminal information services.

Long term

- Responsive and pro-active decision structures which account for external and internal system perturbations to achieve more resilient and competitive inland waterway transport to attract cargo and passenger flows to relieve roads.

Cross-modal

Short term

- Inland waterway single window connection to ports and other transport modes across borders;
- Tools for optimized asset utilization at all levels;
- Physical Internet, IoT, Blockchain: Systems, technologies and business models for open interconnected logistics integrating inland waterways and ports.

Medium term

- Paperless business environment.

Long term

- Effective coordination and integration of different mobility actors, networks and modes adopting a user-centric approach;
- Integration into Mobility as a Service (MaaS) and Logistics as a Service (LaaS);
- Policy responsive and dynamic network management tools.

AUTOMATION

Connected and automated transport

Short term

- Next steps towards automated navigation (navigation support): Improved/extended "automatic track-keeping systems", bridge collision warnings etc. (possibly in combination with tools for energy-efficient navigation from activity 3);
- Research on how to develop, deploy and manage currently locally automated infrastructure of bridges, locks, dams and connected port terminals to safe and secure cross-regional/cross-border planning and remote control taking into account waterway operation as a whole;
- Cybersecurity;
- Interaction between waterway & port infrastructure and ship incl. blue wave applications (remote control of bridges and locks on cross-border corridors);
- What is needed at infrastructure level to enable smart shipping;
- Sensor systems and situation assessment for anti-collision;
- Pre-normative research on goal-based standards and open integration;
- Acceptance criteria for autonomy.

Medium term

- Impact of connected and automated mobility on transport network and traffic management needs (including business models)
- Behavioural aspects and the deployment and use of fully- or partly automated vehicles/vessels and interaction between automated and non-automated users and infrastructure, and dynamic adaptation;
- Voyage management for manned and unmanned navigation;
- Shore control centre design and testing;
- Port and waterway infrastructure for automated vessels and assets;
- What standards are needed for man/machine and machine/machine communication;
- Remote piloted systems to infrastructure upgrade and maintenance works;
- Pre-normative research regarding manning, technical requirements, safety, security and liability issues;
- Socioeconomic research and assessment of working environment and skills.

Long term

- Autonomous sailing incl. automated height and draught control, automated steering, automated navigation routing and reporting, autonomous mooring, automated command of bridges and locks, other automated driving services part of smart shipping
- Concept development of safe and secure on-board automation covering self-diagnosis, safety and security support, situational awareness, collision avoidance, machinery control and remote support for vessels and floating structures;
- Port and waterway infrastructure for unmanned vessels and assets;
- Development of technical and legal standards and interfaces that support automatic data capture and processing;
- Exploration and concept development for the skills and training requirements of traffic controllers, pilots, on-board crew, terminal operators and port authority staff in order to take full advantage and benefit of the evolution towards logistics.

IMPACT

Who is affected and how it will benefit stakeholders
Business & society, public & private

- Harmonised cross-border traffic management
- Secure, faster and user centric data sharing and supply
- Real-time and in-advance reliable information to improve public and private decision making
- Safe, reliable and efficient operations resulting in reduced accidents and delays
- Fluid traffic across borders and reliable ETAs
- Reduction of hauls (consolidation of cargo, reverse logistics)
- Reduced administrative burdens
- Improved capacity use
- Energy savings
- Improved resilience management of infrastructure, assets and operations for both mobility and logistics reducing technical and operational risks
- Harmonised automated infrastructure and standards for smart shipping
- New professional opportunities and training
- Increased integration and attractiveness of waterway transport in synchro-modal logistics and mobility solutions
- Less congested urban conurbations and corridors

2.3. ONGOING AND PAST ACTIVITIES

- **River information services (RIS)**: the CEF **RIS COMEX** project works on RIS corridor management overcoming the current national data barriers and covering 3 corridor service levels 1) enabling route planning by providing reliable fairway and infrastructure information; 2) enabling voyage planning and traffic management by providing reliable actual and predicted traffic information; 3) providing vessel specific information (e.g. positioning, cargo and voyage information, calculated ETA) to authorised users to support logistics processes and to decrease administrative burdens. The aim is to provide all available information to authorised users via a central access point and enable the integration of specific information into existing in-house systems.
- **Working Group on administrative processes** (EU Danube Region Strategy - Priority Area 1a – "To improve mobility and multimodality: Inland waterways" in cooperation with Priority Area 11 - "Security"): simplification, harmonisation and digitalisation of border control procedures, e.g. by developing Danube Navigation Standard Forms (DAVID forms) applicable to all border controls along the river (arrival and departure report, crew list, passenger list).
- **DANTE** (Danube Transnational Programme (Interreg) project) that focusses on improving administrative procedures and processes for Danube navigation a pre-requisite for digitalisation and automation, e.g. by supporting the development of the DAVID forms. The project works follows with the concept "same river, same rules" for simplification, harmonisation and digitalisation in Danube waterborne transport".
- **VisuRIS** portal and app.

- **ST4W Interreg project**
- **Barge Traffic System** (BTS), **Upper Rhine ports** (RPIS).
- **NOVIMAR**: EU H2020 project, platooning concept for transport by water, i.e. vessel train transport concept consisting of one crewed leader vessel followed by a number of lowly manned or unmanned follower vessels from different class.
- **SEAFAR**: industrial initiative developing technology to remotely operate automated barges for inland shipping covering integration of technology, remote operating of barges from a shore control center, in combination with a mobile intervention unit and barge management.
- **Elbe 4.0**
- **Joint BE-NL test area**
- **SMASH**: NL public private exchange network.
- **Urban Water Shuttle**: automated mooring.
- **LAESSI** project.
- **PIANC** working group 210 on “Smart shipping on inland waterways”.
- **Central Commission for the Navigation of the Rhine (CCNR)** works on levels of automation for inland waterways. Important reference to use these levels for all inland waterway research on CAT.
- **Synchronization Model for Belgian Inland Transport (SYMBIT)** is a computational model that combines features of geographic information systems, agent-based modelling and discrete event simulations.
- **AEOLIX** aims to design an architecture for a collaborative IT infrastructure for operational connection of logistics information systems, to implement an appropriate data access management model and to build a common but user-tailored interface and tools to enable the IT infrastructure.

3. GREEN AND COMPETITIVE TRANSPORT

3.1. STRATEGIC PLANNING

To make transport services more sustainable different areas need to be addressed, being the resource of its power, the design of the vessels, new engines as well as the human factor. To maximize the effects all measures should be combined to a maximum and research into the various areas is required. One of the drivers will be the energy transition within the entire logistics and mobility chain to green and the second one the transition towards auto- mated and connected transport.

The approach concerning transport services covers:

1. Towards zero-emissions: currently, there is not one single solution which fits all vessel types and operational profiles. Towards ze-ro-emission from well to wheel requests dedicated research, and in the meantime, a transition fuel might be put in place. Besides, water pollution and noise have to be eliminated.
2. Safe and secure transport services: new technologies and new methodologies will radically improve the management of the safety of vessels and of their operations and will contribute to zero fatalities.

3.2. R&I ACTIONS

Greening of the fleet and energy infrastructure

Short term

- External costs calculation:
  - collect and validate at larg scale real-life information on fuel consumption, sailing speeds of vessels, average loading, empty sailings of vessels with differentiation of vessel size classes, taking into account the geographic location, collect data on real world emissions and derived emission factors (in g/kWh) through on-board measurements under actual sailing conditions
  - validate model calculations on external costs of inland waterway transport;
- Develop, evaluate and demonstrate systems to measure the airborne emissions of pollutants from inland navigation to shore and assessment of their share in urban air pollution and the health exposure risk to adults, children, foetuses;
- Develop and validate innovative propulsion systems as well as effective retrofit solutions for existing and new inland shipping fleet.
  - Low impact engines with transition fuels;
  - New/alternative energy carriers/sources (e.g. electricity, green hydrogen, green methane, LOHC and sustain-able biofuels);
  - Renewable energies on board;
- Design modelling and pilot activities to transform inland ports into clean energy hubs for transport, industry and residential: production, storage, waterborne and land transport refueling and battery swap/recycling, energy grid integration and related pre-normative research;
- Design and test cost-effective multiple refueling infrastructure matching demand: shore-side electricity, hydrogen, bio-energy;

- Total cost of ownership modelling for the different transition pathways towards zero-emission inland waterway transport from well-to-wheel viewpoint;
- Business models, financing solutions and cases for “greening of the fleet”;
- Demonstrate the capability of Vessel-to-Grid (V2G) applications;
- Assess and recommend cost-effective refueling along waterways in urban areas for multi-modal transport, integration in Sustainable Urban Mobility Plans (SUMPs) and related pre-normative research.

Medium term

- New Business models;
- Pre-normative research.

Materials and vessel design

Medium term

- Develop and deploy advanced and smart eco-design and lightweight materials and concepts which are economically viable for ship applications, e.g. composites with tailored strength properties, bio-based materials and smart materials with added functionalities such as sensorisation; redesign of hulls and propellers, air lubrication, anti-fouling paints;
- Develop and apply multi-material approaches that allow cost-effective material separation, recycling and recovery, taking into account environmental impact through life cycle assessment.

Energy Management and Energy-efficient Navigation

Medium term

- Tools and Simulations for energy-efficient navigation;
- Shipborne Measurements.

IMPACT

Who is affected and how it will benefit stakeholders
Business & society, public & private

- Zero emission, efficient, reliable, safe, green transport benefiting the environment and the quality of life of people
- Optimization of energy generation, storage, network equalisation and refueling locations benefiting transport operators and users, industries and households

3.3. ONGOING AND PAST ACTIVITIES

- **PLATINA 2** (2013- 2016) is a European Coordination Action supporting the implementation of the NAIADES 2 policy package "Towards quality inland waterway transport", which aims at promoting this sustainable mode of transport. PLATINA 2 brings together all the relevant actors in the inland waterway sector in a multi-disciplinary knowledge network to foster the development of inland navigation into an even more sustainable and competitive part of multimodal European transport networks. The project strongly builds on the results of the PLATINA project (2008-2012).
- **EIBIP**: European Inland Barging Innovation Platform, founded as part of a contract with the European Commission – DG MOVE to stimulate the uptake of innovations by the inland waterway transport sector. The platform has innovation centres in Germany, France, the Danube area, and associated innovation centres in the Netherlands and Poland. These innovation centres give support to ship-owning companies in the uptake of innovations by direct assistance and a set of (online) tools and services.
- **PROMINENT**: H2020 project. Development and demonstration of more standardized solutions for emission reduction (after-treatment, LNG, diesel-electric, right-sizing and energy-efficient navigation), development of monitoring and certification procedures and tools for human factor (e-learning courses, e-service record book). The outcomes are used to assess the costs and benefits of the solutions, giving ship-owners insight into the application of these solutions and to provide recommendations for policy-makers.
- **CLINSH**: LIFE project. Demonstration and monitoring of emission reduction technologies on more than thirty vessels to provide insight into the real emissions from inland waterway vessels and the possible reductions of these technologies. The outcomes are used in the development of emission models and used in recommendations for policy-makers and ship-owning companies.
- **Green Deal COBALD**: to achieve validated instruments, measuring methods and methods that can measure and monitor the emissions of inland vessels using Continuous On Board Monitoring (COBM) of emissions from inland waterway vessels.
- **Breakthrough LNG** deployment in inland waterway transport will create a critical mass in LNG supply through facilitating LNG bunkering stations for inland shipping while at the same time creating demand by equipping 6 vessels with LNG engines.

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Work process

This document 'Towards a strategic agenda for IWT and ports' is a work in progress. This strategic plan will be reviewed, updated and extended over the coming months. It will also remain a work in progress, as a strategic document is not a finished product, but a continuous process based on changing developments and requirements, newfound knowledge and insights.

Authors & contact

Karin De Schepper
Inland Navigation Europe
info@inlandnavigation.eu

Jaap Gebraad
Sea Europe
waterborne@seaeurope.eu

Contributions

Nadège Dewalque, Michael Fastenbauer, Turi Fiorito, Robin Guillon, Theresia Hacksteiner, Bas Kelderman, Gerard Kester, Anne-Sofie Pauwelyn, Martin Quispel, Erik Schultz, Manfred Seitz, Khalid Tachi, Jürgen Trögl

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