DIWA Report

Sub-Activity 2.3.: Port and Terminal Information Service

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Executive Summary

Under Activity 2 – Business Developments of Masterplan DIWA, SuAc 2.3 focused on business development in the field of Port and Terminal Information Service. The study looked into possibilities of enhancing services in IWT for ports and terminals and how the fairway authorities can act and improve the services with the ultimate aim of increasing the attractiveness of IWT over other modalities.

Key research findings

Using stakeholder interviews and desktop research, the current status of digitalisation of IWT was studied. To this point, the focus was on current information services available and under development that support the inland ports and terminals.

The navigational processes were found to be mature and digitised with services that facilitate planning and execution. Services bundled under the RIS, such as NtS, Inland ECDIS, VTT, and ERI have been making steady progress. However, there has been slow growth of information services that influence the reliability of IWT to cargo owners and operators. Moreover, there has been slower growth in connectivity for cargo exchange between inland ports and sea ports with inland connectivity. Integration of inland ports with the port and cargo community of the larger hybrid ports is still at a nascent stage.

Opportunities and benefits

From the perspective of ports and terminals, one of the main opportunities is to increase the integration of IWT into the entire logistic chain. This ultimately helps to optimise not only the transport chain but also the complete value chain and results in safe, reliable, resilient, cost and time-efficient transport for its users (BENGA, SAVU, SAVU, Adrian OLEI, & IACOBICI, 2019).

Another key argument for shifting cargo operations toward IWT is its lower environmental impact compared to other transport modes (Durajczyk & Drop, 2021). For instance, Table 1 shows a comparison of time, costs and carbon dioxide emissions of transporting 30 individual 40-foot containers by inland waterway and by road between Opole and Wrocław in Poland.

Table 1: Environmental Benefits of IWT

	Inland Navigation	**Road Transport**
Distance	153 km	100.6 km
Average speed	Downstream 25 km/h Upstream 10 km/h	55 km/h
Travel time	Downstream 6 h 8 min Upstream 15 h 18 min	1 h 50 min
Fuel consumption per 100 km	300 L	38 L *(x30)*
Fuel consumption en route	459 L	41.8 L *(x30)*
CO2 emissions per 1 L of fuel	3.15 kg	2.35 kg
CO2 emissions en route	1445.85 kg	2946.90 kg
Cost of transport	1404.30 Euro	4768.44 Euro

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Source: Durajczyk & Drop, 2021

From the table, the environmental and cost benefits of transport via inland waterway is evident. The travel time difference between inland navigation and road transport decreases with increasing distance due to the working time requirements of the truck drivers.

Challenges

Current challenges to the digitalisation of services are centred around a few topics, such as standardisation of information, data privacy and sharing of commercially sensitive information.

Summary of recommendations

The following summarises the recommendations for fairway authorities to improve information services in IWT in general and therefore also in port and terminals[1]:

- Continue working together with other fairway authorities towards more harmonisation in different aspects of IWT. Harmonized procedures along a corridor, data sharing and reducing repetitive obligations in each country/jurisdiction along the corridor will improve operational efficiency and attractiveness for the barge operator.
- Either seamless transfer or no switch from one user interface to another for skippers while crossing borders through the use of a single information platform (EuRIS) or harmonised national platforms with the same design and functionality.
- Information exchange/reporting forwarding between fairway authorities reduce redundant reporting for barge operators/skippers on border crossings.
- Review and develop API/interface standards to facilitate data exchange with
    - Local port authority systems/PCS platforms, forwarding barge voyage information
    - Navigation devices/onboard computers, software applications on barges, facilitate automated reporting, NtS distribution
    - Terminal operator systems receiving information on berth availability, operational data
- Agreements between fairway authorities and port authorities/PCS operators towards more integration and data sharing between their systems to reduce redundant reporting for barge operators/skippers. Offer single sign-on for multiple platforms. Develop a vision for future integration of fairway/port/PCS platforms with complete coverage of a corridor. Ideally there should be a common interface standard to exchange barge traffic data (based on ERINOT) between FA platform and seaport PCS.
- The common / consistent maintenance of master data and reference codes, e.g., for vessel identification European Hull Data Base (EHDB) or port/terminal/object coding (RIS Index), needs to be defined and organised. Develop fairway information platforms as a centrepiece for information sharing and data exchange on IWT as the main tool for barge operators/skippers.
- Develop fairway information platforms as a tool to facilitate exchange of information (load/discharge reporting and confirmation, freight document exchange etc.) among commercial platforms, considering blockchain technology as a mechanism for document

[1] During the time of writing the EURIS data services weren't available yet, EURIS dataservices will cover some recommendations.

security, reliable user administration, and data security. The FA (Fairway authority) platforms could be extended with a separate hub area for commercial data exchange; this system area may also be operated by a neutral user group entity including stakeholders and their associations. The FA are in a good position to facilitate the formation of a neutral exchange platform (similar as PCS organisations in seaports). Fairway authorities may take advantage to obtain statistical data.

- Make reliable AIS traffic data from fairway authority networks available to barge operators to allow traffic view in other areas than their actual position[2];.
- Provide AIS coverage and ensure mobile internet coverage on all navigable inland waterways used for commercial transport of cargo.
- Provide visibility of the current traffic situation at locks/bridges and other important passage points. Forecast upcoming traffic, offer slot management and estimated passage time for the barge.
- Support initiatives to establish digital cargo/freight documentation in IWT (eFTI, e-CMR), which would enhance fairway platforms functionally as a standard communication channel for cargo documentation.
- Evaluate current traffic management to determine improvement potential, if any, for traffic management, emergency response, and statistical data collection.
- Facilitate creating minimum standards for equipment (navigation, reporting) onboard to stimulate the digital interaction between the vessel, FA and cargo party.

[2] Via EuRIS it’s possible to view vessel positions and to share AIS data with consent of the data owner

Abbreviations

ADN	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
AIS	Automatic Identification System
API	Application Programming Interface
APICS	Antwerp Port Information and Control System
AT	Austria
BAPLIE	Bay Plan Including Empties (EDIFACT)
BE	Belgium
BERMAN	Berth Management (EDIFACT)
BI	Business Intelligence
BICS	Barge Information Communication System
BTS	Barge Traffic System
CCNR/ZKR	Central Rhine Commission/Zentrale Kommission für die Rheinschifffahrt
CDNI	Convention relative à la collecte, au dépôt et à la réception des déchets survenant en navigation rhénane et intérieure/waste convention
CEERIS	Central & Eastern European Reporting Information System
CEF	Connecting Europe Facility
CESNI	Comité européen pour l'élaboration de standards dans le domaine de la navigation intérieure
CoG	Course over Ground
COPRAR	Container discharge/loading order message
COMEX	Corridor Management Execution
DAKOSY	Datenkommunikationssystem (Data Communication System)
DE	Deutschland/Germany
DIWA	Digitalisation of Inland Waterway
DORIS	Donau River Information System/Danube Riv. Inf. Sys.
DVW	De Vlaamse Waterweg
e.g.	Example given
ECDIS	Electronic Chart Display and Information System
e-CMR	Electronic version of Convention relative au contrat de transport international de Marchandises par Route
EDI	Electronic Data Interchange
eFTI	Electronic freight transport information
EHDB	European Hull Database
ELWIS	Elektronischer Wasserstraßen-Informationsservice
ERDMS	European Reference Data Management System
ERI	Electronic Reporting International
ERINOT	ERI Notification Message
ERIRSP	ERINOT response and receipt message
ERIVOY	ERI Voyage Plan Message
ETA	Estimated Time of Arrival
ETC	Estimated Time of Completion

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ETD	Estimated Time of Departure
Etc.	Et cetera/and others
EU	European Union
EuRIS	European River Information Services
EUROSTAT	Statistical Office of the European Union
FA	Fairway Authority
FR	France
GDWS	Generaldirektion Wasserstraßen und Schifffahrt
GNSS	Global Navigation Satellite System
GoS	Gate Operations
GPS	Global Positioning System
HAM	Hamburg
HAROPA	association of three ports all along the Seine; Le Havre, Rouen, Paris
HVCC	Hamburg Vessel Coordination Center
i.e.	In example
ID	Identification
IENC	Inland Electronic Navigational Chart
IFTMIN	Instruction message (EDIFACT)
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
IoT	Internet of Things
ISPS	International Ship and Port Facility Security Code
IT	Information Technology
IWT	Inland Waterway Transport
JIT	Just in Time
MIB	Melde und Informationssystem der Binnenschifffahrt
NL	Netherlands
NSW	National Single Window
NtS	Notice to Skippers
PAXLST	Passenger List Message
PCS	Port Community system
RIS	River Information System
ROI	Return on Investment
RoT	Rate of Turn
RPIS	Rhine Ports Information System
RTA	Requested Time of Arrival
RTM	Rotterdam
RWS	Rijkswaterstaat
SCM	Supply Chain Management
SoG	Speed over Ground
SuAc	Sub Activity
TEN-T	Trans-European Transport Network
TEU	Twenty-Foot Equivalent Unit
TOS	Terminal Operating System
VDR	Verband Deutscher Reeder/German Shipowners Association
VELI	Voyage en Ligne
VHF	Very High Frequency/Radio

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VNF	Voies Navigables de France
VTS	Vessel Traffic Services
WSA	Wasserstraßen- und Schifffahrtsämter
WSV	Wasserstraßen- und Schifffahrtsverwaltung des Bundes
XML	Extensible Markup Language

1. Introduction

Digitalisation is a global megatrend and will be an important element over the next years in most industrial and private areas around the globe. The cost and efficiency gains that can result in comparative advantages over others motivate businesses to question their current setup and the need for digitalisation. But also the benefits of holistic and accurate information, safety and reliability are drivers for the transformation of information exchange between the different actors and stakeholders. Like any other logistic area, Inland Waterway Transport (IWT) will benefit from efficiency gains and therefore needs to undertake a change to keep up with other highly competitive transport options such as road and rail. To strengthen the sector and not miss market opportunities, information exchange in IWT needs to be investigated and improved.

The Inland Water Transportation sector is strong in its traditions and offers a wide variety of processes, standards and procedures. Throughout the processes and information exchanges, the stakeholders involved can vary by each terminal or port so that standards are often far from being implemented. The differences get even bigger when looking at it from an international perspective. This challenge has been identified so that many systems and initiatives (such as AIS, RIS, ELWIS, RIS COMEX, and many others) have already paved the way for a digitalised future. At the current point, this path is to be gone by IWT. To what extent digital solutions exist in the market and support information exchange in IWT already is being investigated in a study on the TEN-T corridor for which the GDWS awarded HPC Hamburg Port Consulting GmbH[3].

The GDWS participates in the EU project Digitalisation of Inland Waterways (DIWA), which is funded by the EU program Connecting Europe Facility (CEF). In addition to the Federal Republic of Germany, four other countries (the Netherlands, Belgium, France, and Austria) - represented by the respective national inland waterway authorities (Rijkwaterstaat (NL), The Flemish Waterway (BE), Voies Navigables de France (FR), Viadonau (AT)) – are participating. The objective is to develop a joint and integral strategy for the digitalisation of inland waterways (master plan) to make the inland waterway transport mode more competitive and sustainable in the long term by integrating it into the (digital) processes of the ports and inland terminals.

[3] The *Generaldirektion Wasserstraßen und Schifffahrt* (GDWS; engl.: Directorate-General for Waterways and Shipping) is the supreme federal authority of the *Wasserstraßen- und Schifffahrtsverwaltung des Bundes* (WSV; engl.: Federal Waterways and Shipping Administration). As an intermediate authority, it is subordinate to the *Wasserstraßen- und Schifffahrtsämter* (WSA; engl.: Waterways and Shipping Offices) and the *Wasserstraßenneubauämter* (engl.: Waterways Construction Offices) as local sub-authorities. The GDWS is responsible for safe, smoothly flowing and thus economical shipping traffic and for the maintenance, operation, expansion, and new construction of federal waterways, including locks, weirs, bridges, and ship lifts.

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In this study, the three main processes (1) voyage, (2) cargo and (3) navigation, will be analysed in a quantitative and qualitative approach to derive their digital maturity. This information will support and guide future measures in inland waterway transportation and pays directly off to the Digital Masterplan of Inland Waterway Transportation.

2. Work approach

The study was conducted in three different phases:

Phase 1: Inventory
Phase 2: Potential Analysis
Phase 3: Digital Roadmap

2.1 Inventory

In this phase, an evaluation has been done of the European port industry (inland and seaports) with regard to the digitalisation of processes between port and inland waterway vessels to make a statement about the level of digital maturity.

For this purpose, the following topics and issues for information services for inland navigation in ports and terminals were considered within the scope of the inventory:

Business Value
- Who are the stakeholder groups?
- What represents business value for the stakeholders?

Technical aspects
- Which services and processes are digitised?
- What are the technical challenges and hurdles arising from the identified processes and services?

Organisational and operational implications:
- What added values should be realised through digitalization?
- Do the digitalised services and processes that have been implemented achieve the intended added values?
- What are the organisational and operational challenges that exist?
- What are the implications for inland waterway authorities/inland navigation (IWT/RIS)?
- Are there any legal or regulatory obligations for the identified services and processes?

Financial aspects
- What costs and efforts have been invested in the implementation of the digitalised processes and services?
- What financial added value (e.g. cost optimisation) resulted from the implementation?
- Do the benefits outweigh the effort/costs?

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Regional status/scaling

- Are the implemented processes and services applied across regions (e.g. in the TEN-T network or the EU)?
- Are there any differences by region, and what are they?

2.1.1 Market Research

The inventory phase was started with market research. Here the Consultants relied on three pillars for procuring the information:

1. Desktop research to capture information freely available on the market,
2. Expert interviews within the reference group defined in the preparation phase,
3. Consultant's experience and expertise in the field of inland navigation, maritime information technology as well as digitalisation.

Desktop research

- Documentation from previously conducted IWT projects and other related studies were evaluated. In addition, internet research on stakeholder websites was conducted.

Interviews

- Interview partners were proposed and coordinated by the DIWA project partners, and interviews were conducted by the Consultant. Among the interview partners, there were representatives of barge owners/operators, port/terminal operators, industry associations/platforms, IT/PCS providers and other industry experts.

- Interview insights and statements were evaluated and are reflected in this report. There might have been, however, some findings based on interview statements that are not representative of the entire industry segment and are not valid for all countries/regions involved in the DIWA project.

Internal expertise

- The Consultants also used their prior experience in conducting studies and from projects related to IWT to enrich the inventory.

2.1.2 Market Analysis

Within the framework of the market analysis, the research results were systematically evaluated, and best practices were identified. In addition, structured assessment criteria were used to assess the digital maturity (within the European port industry in the context of inland waterway context). The analysis was used to derive a statement on where the European port industry stands in terms of the digitalisation of processes between the port and inland waterway vessel at the time of the study. To this end, the project team was guided by the DIWA project's defined maturity model for digitalisation.

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2.2 Potential Analysis

In the course of the potential analysis, the focus is on trends and future potentials. To this end, the Consultant examined the trends emerging in the market in the area of digitalisation in the port industry. For the trends, a distinction was made between concrete approaches with the goal of implementation as well as theoretical research and feasibility studies.

On the basis of this information and taking into account the results of the analysis of the stocktaking, the potentials and realisable added values for inland navigation in the port was elaborated by the Consultant.

Against the background of the knowledge gained from the potential analysis, a target best case was created based on a greenfield scenario. This solution is the best case scenario in terms of the objective of a digital transformation for information services of ports and terminals in the context of inland navigation. The scenario was visualised in a process-oriented manner and incorporated into the study.

The target scenario is expanded to include the overarching requirements for the provision of services as well as data availability and quality of the involved actors (port community and inland community, and inland navigation).

With the completion of phase 2, a defined target scenario and the requirements necessary for its realisation are made available.

2.3 Digital Roadmap

In the final part of the study, the target scenario identified in the potential analysis is used to define the next steps for the stakeholders.

Using the gap between the current state and the ideal future state, the Consultants derived concrete measures for achieving the objectives. In addition, the preparation of the digital roadmap included a risk assessment. In a structured risk analysis, the Consultants identified the risks resulting from digitalisation and suggested measures to minimise the risks.

At the end of phase 3, a digital roadmap is made available that shows how to implement the target scenario, taking into account the implications and risks for inland navigation and the port.

3. Objectives of the study

The objective of this SuAc is to describe the business developments regarding port and terminal Information Systems with a focus on:

1. The services, information processes and information requirements related to traffic, transport and logistics that are in a development phase.

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2. Consequences for data and information needs.
3. Major hurdles to overcome in ways of business value, technical aspects, organisational and operative implications, financial aspects, and regional scalability.

4. Description of the current situation and level of digitalisation for Port and Terminal Information Service

This chapter aims at giving an overview of the current situation and level of digitalisation for port and terminal information services. In 4.1, the process landscape for IWT is described briefly to understand which information flows currently exist. Sub-chapter 4.2 displays the standard IT system landscape for IWT to build the basis for the following chapters. The current level of digitalisation (using the maturity model) is meant as a guide for determining the level of digitalisation for this topic in the logistics community and the involved IWT/RIS authorities. The level of digitalisation of the logistics community and the involved IWT/RIS authorities with regard to this topic (pertaining to IWT) will be described in 4.3.

Across all participating countries, the scope of ports for the study shows a mix of companies, roles and modalities. A variety of ports from Germany, The Netherlands, Belgium, France, and Austria were considered to reflect this mix. The focus on IWT suggests taking inland ports into account only. However, many European seaports act as hybrid ports (sea and inland handling).

From the largest to the smallest ports in the named countries, turnover ranges from below one mil. TEU up to 15 mil. TEUs, whereas the type (inland vs hybrid) significantly influences this number. Hybrid ports will likely have higher values. Also, the cargo type has a mentionable effect. The differentiation between container business and others (e.g., dry bulk, liquid bulk, project cargo) can indicate scalability. At this point, it is important to mention that seaports usually come with a higher amount of TEU compared to inland ports, but this does not necessarily amount to the number of barges to load. For having a well-differentiated portfolio, inland ports and port clusters were picked along different TEN-T corridors. As mentioned above, the differentiation between container business and others (e.g., dry bulk, liquid bulk, project cargo) can indicate scalability.

4.1 Process Landscape for IWT

It is necessary to identify relevant processes for the scope of the study. To this point, the Consultants focused on processes centred around information exchange.

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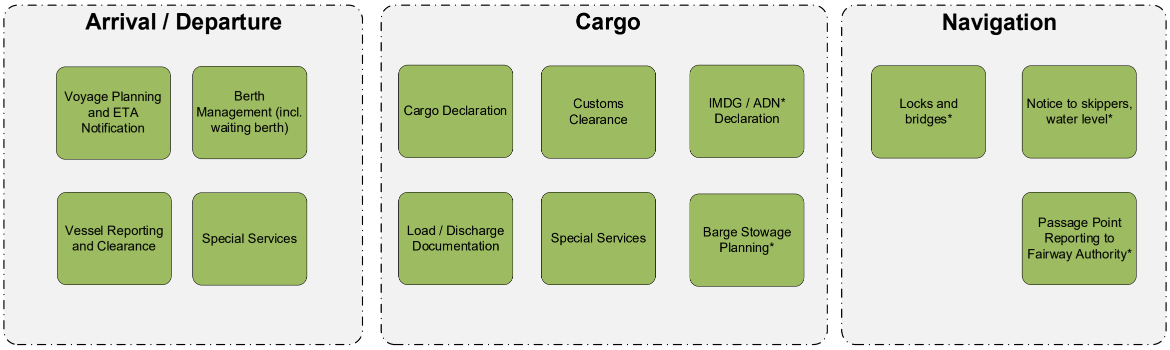
Figure 1: Process Landscape for IWT



* process exclusive to inland barge traffic

Source: HPC Hamburg Port Consulting GmbH

The processes were categorised into three separate sections, as described as follows.

(1) First section: Arrival/Departure

This section deals with the arrival and departure of vessels at ports/terminals. The processes cover information exchange needs of different stakeholders (barge operators/skippers, authorities, cargo-related parties, terminals, service providers) to plan and perform the arrival and departure of vessels.

<u>Voyage planning and ETA notification</u>
Barge operators/skippers are planning the voyage and report an ETA to ports/terminals and, if required, to authorities or lock/bridge administrators. The ETA may be updated during the voyage; also, a port/terminal may communicate a requested/required time of arrival (= RTA) to the barge in order to plan the voyage accordingly.

<u>Berth management (including waiting berth)</u>
Barge operators/skippers may need information about awaiting berths along the voyage.
Ports/terminals need to manage their berth occupation/availability requesting reliable and up-to-date information on voyage schedules from barges and seagoing vessels.
Operators of port community systems may organise roundtrips of vessels/barges over multiple terminals within a port or port cluster considering the respective berth availabilities.

<u>Vessel reporting and clearance</u>
Skippers must report voyage and cargo information to authorities, usually in structured formats and established communication paths.
Authorities may respond with clearance messages (e. g., customs clearance, lock passage time, RTA).

<u>Special services</u>
Skippers may request special services at ports/terminals (e. g., water, electricity, provisions, garbage/cleaning services, bunker).

(2) Second section: Cargo

This section deals with all cargo related processes. The processes cover different information exchange needs around cargo declaration and clearance, operational data documentation, and stowage planning.

Cargo information
Barge operators/skippers may need to send cargo declarations to competent authorities .
Authorities may respond with clearance information (e. g., border crossing, passage waypoint).
Barge operators/skippers receive cargo information (e. g. transport offer, transport order, waybill) from cargo-related parties (cargo owner, forwarder, logistics company).
Barge operators/skippers may confirm transport orders to cargo parties.
Terminals receive cargo declarations (e. g., load/discharge notice) from barge operators and/or cargo-related parties.

Customs clearance
Barge operators/skippers may need to send cargo declarations to customs authorities.
Authorities may respond with clearance information (e. g. customs clearance).

IMDG/ADN declaration
Barge operators/skippers may need to send cargo dangerous declarations to competent authorities (
Authorities may respond with clearance information (e. g. border crossing, load/discharge permission).

Load and discharge documentation
Barge operators/skippers and/or cargo related parties receive load/discharge documentation from terminals (e.g., Load/discharge report, cargo/weight certificate, work/shift report).

Special services
Ports/terminals or service companies may send barge operators documentation/certification about special services (e.g., cargo survey, CDNI document, ISPS permission).

Barge stowage planning
Bargo operators/skippers send stowage plans to ports/terminals.

(3) Third section: Navigation

This section deals with navigational processes. The processes cover different information exchange needs for skippers and various authorities associated with inland navigation.

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Locks and bridges

Skippers may send ETA and vessel information to locks/elevator/bridge administrations. The respective administrator may respond with an RTA for the planned passage.

Notice to skippers, water level

Skippers receive navigational information (e.g., limitations/closures of locks or waterways, restrictions, weather warnings) from fairway authorities over various channels (e.g., information portals, NtS over e-mail or VHF).

Passage point reporting to fairway authority

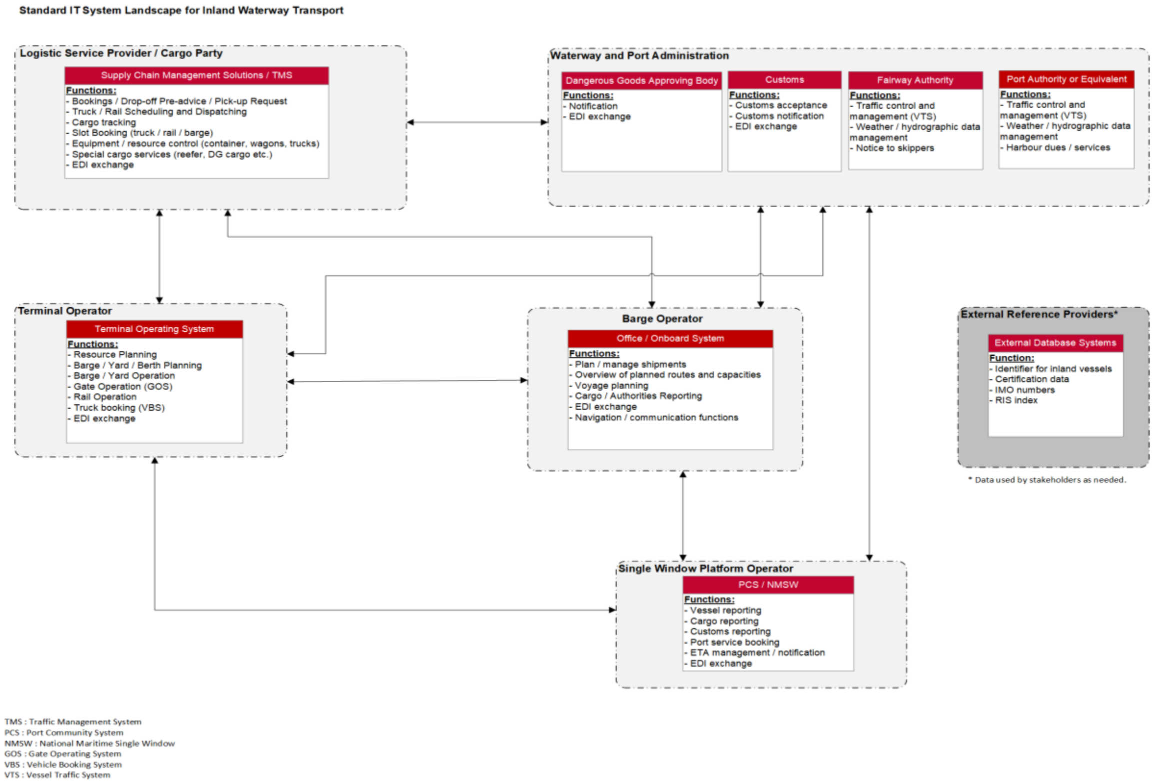
Skippers may need to report to authorities at specific passage waypoints.

4.2 Standard IT System Landscape for IWT

In IWT, there are three main categories of actors. Firstly, the logistics service providers are the users of IWT. This group includes stakeholders such as shippers, forwarders and other cargo parties who are interested in getting the cargo transported. The second category of users is the transport services providers such as the barge operators, skippers, and similar roles in connecting modalities. The third category comprises authorities such as customs, fairway authority, port authority etc. This group deals with the administration of the inland waterway transport.

All three actor groups have different stakeholders involved (see figure below). These stakeholders use systems to enable services that help them and other stakeholders perform activities in a digitalised manner. These systems are specified for each stakeholder. The actors have different requirements which are fulfilled by the functionalities offered by these systems. These functionalities are described briefly in the diagram.

Figure 2: IT System Landscape for IWT



Source: HPC Hamburg Port Consulting GmbH

A company or public entity (fairway or port authority) may incorporate multiple stakeholder roles. There seems to be a tendency towards vertical integration in the supply chain, so some bigger companies are acting at the same time as forwarders, terminal operators, barge operators or even in more roles. In these cases, the data exchange between IWT actors is more often organised internally within the same company but may face similar challenges as if it were between different companies.

In business schemes and stakeholder landscapes, a multitude of differentiating factors can be observed. There is no catch-all business process model. In the context of this study, it is intended to apply some abstraction and to describe the processes and information flows by role.

4.3 Evaluation of the Processes with the Maturity Model

The evaluation of the processes was conducted in both quantitative and qualitative manner.

The quantitative evaluation was formed with the assumption that for each process, the number of solutions currently supporting it in a digitalised manner represents the level of digital maturity of the process. A desktop research is performed for individual solution providers for each process which is summarised in the table below.

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Figure 3: Qualitative Evaluation of the processes with the Maturity Model

Information Process	Systemsupport (Maturity)	Fairway Authority Systems: FA-NL RWS Vaarweg-informatie BICS	FA-DE DWS ELWIS NaMIB	FA-BE DVW VisuRIS eRIBa	FA-AT viadonau DORIS	FA-FR VNF e-RIS VELI	FA-EU Project: COMEX	Port Authority / PCS: PA / PCS BE-ANR C-Point/ NxtPort BTS APICS	PA / PCS NL-RTM Portbase Nextlogic HCN Barge	PA / PCS DE-HAM HVCC ELBA	PA / PCS FR-DKK Ci5 / AP+	PCS: PCS ANR / RTM UAB-Online	PCS Rhine RPIS	Commercial Systems: Commercial Autena Marine	Commercial Tresco
1 Voyage Planning and ETA Notification	10	1	1	1	1	1		1	1	1		1	1		
2 Vessel Reporting and Clearance	11	1	1	1	1	1		1	1		1	1		1	1
3 Berth Management (incl. waiting berth)	6							1	1	1	1	1	1		
4 Special Services Barge	3							1	1			1			
5 Cargo Declaration	5	1							1		1	1	1		
6 Customs Clearance	5	1							1		1	1	1		
7 IMDG / ADN Declaration	10	1	1	1	1	1			1	1	1	1	1		
8 Load / Discharge Documentation	6	1						1	1		1	1	1		
9 Special Services Cargo	2							1				1			
10 Barge Stowage Planning	2	1												1	
11 Locks and bridges	8	1	1	1	1	1		1		1			1		
12 Notice to Skippers, Water Level/Meteo	8	1	1	1	1	1		1		1					1
13 Passage Point Reporting to FA	7	1	1	1	1	1								1	1

Source: HPC Hamburg Port Consulting GmbH

In the qualitative section, the Maturity Model proposed by DIWA is used (Masterplan's content and framework 2.0, Version 1.1, 2021). The DIWA Maturity Model is categorised into five pillars. These five pillars consist of a set of criteria that leads to its definition. These criteria can be used as parameters to evaluate processes, and based on the evaluation, a classification of the process can be determined. As seen in the below-mentioned figure, the five pillars of categorisation and the assigned score are:

- Reactive – 1.0
- Organised – 2.0
- Digitised – 3.0
- Connected – 4.0
- Intelligent - 5.0

The interpretation of the categorisation is relatively simple; the categorisation Reactive is the least mature in comparison to the categorisation Intelligent. Naturally, the criteria to be fulfilled to attain higher Maturity levels are also correspondingly/significantly challenging.

Figure 4: DIWA Maturity Model

No overarching vision Requires heroics to change Management sceptical about digitalisation Unfocused digital initiatives	Specialists deliver changes using established process Traditional digital features Building digital capabilities	Advanced digital features in silos Overarching vision established Digital information exchange possible Limited real-time situational picture digitally available	Advanced digital features aligned with partners Digital information exchange by default Full real-time situational picture digitally available	Digital transformation established A.I. assisted process optimization Predictive digital capabilities Automated response to standard situations

Source: 2012_02_12 DIWA Masterplan content and frameworkV2.0.docx

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Using the DIWA maturity model, a scoring method of 1 to 5 was invented to evaluate the processes defined at the beginning of the study. A score of 1 represented 'Reactive', and a 5 represented 'Intelligent' state. The following table evaluates the digital maturity of every process considered relevant for information services in IWT. Using the input from the quantitative assessment and the interviews, the consultants summarised the maturity of each process.

Table 2: Process Evaluation according to the DIWA Maturity Model

Process name	Description	Score
Voyage Planning and ETA Notification	The digitalisation level for this process group is higher in the seaports than in the inland ports. In this process area, IWT vessels are limited by the visibility of incoming cargo from seagoing vessels as well as navigation-related factors in the inland waterway. There are advanced features available to address these gaps, but the partners are yet to be aligned on these features.	3.0
Berth Management (incl. waiting berth)	The information exchange for vessels calling smaller inland ports is not digitised compared to the seagoing vessels. For waiting for berth requests, from the skipper's perspective, there is no dedicated service available. Therefore, skippers depend on commercial solutions for this process. This process depends on traditional digital features and lacks a vision for digitalisation.	2.5
Vessel Reporting and Clearance	Digital systems are available in seaports to support this process, but they are mostly missing for inland ports.	2.3
Special Services (Arrival/Departure)	There are not many systems supporting this process for inland ports. Most of the services are requested by barge operators or skippers via phone or e-mail.	2.0
Cargo Declaration	This process is digitised for seaports and inland ports. This communication could be among various stakeholders such as authorities, cargo owners, terminals, barge operators etc. There is a limited real-time picture available, and reuse of digital information is not possible in most cases.	3.0
Customs Clearance	For barges leaving the EU or entering the EU, customs declaration is necessary. Some systems, such as RPIS, support this process. For vessels calling seaport, typically, customs clearance is completed upon arrival.	2.5
IMDG/ADN Declaration	This process is digitised to the same level as the process cargo declaration.	3.0
Load/Discharge Documentation	Dry bulk cargo has physical paperwork involved for quality/quantity related information, leading to challenges in digitalisation. On the contrary, this process shows a higher level of digitalisation for container cargo.	2.5
Special Services	The cargo-related special services such as sampling, weighing, survey, lashing etc., are not highly digitised.	2.0
Barge Stowage Planning	Commercial systems are available to support this process, but only for containerised cargo.	3.0
Locks and bridges	The process has two main parts - the first deals with visibility and the second with slot reserving. For the first part, the score is 3. For the second part, it is 2.	2.5
Notice to skippers, water level	Support to this process is available widely in digital platforms provided by authorities. Some of them also forecast the water level.	3.0

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Passage Point Reporting to Fairway Authority	Reporting needs to be done at loading points or when crossing the border to another fairway authority zone. Websites support this reporting. The majority is digitalised, sometimes paper-based/VHF procedure.	2.5

Source: *HPC Hamburg Port Consulting GmbH*

In general, the processes related to container cargo have a higher level of digitalisation than other cargo types in the inland waterways. Recently inland ports have started investing to increase the digitalisation of services related to other cargo types such as bulk, general cargo and passenger (The INTERREG V A-project "RPIS 4.0", 2019).

Moreover, compared to inland ports, seaports have a higher level of digitalisation in cargo related services such as reporting and clearance.

4.4 Five-Point Segregation Approach

The current state of existing services and processes may be analysed under five different key aspects:

(1) Business value – which services/processes provide a business value to the respective stakeholders?
(2) Technical – which services/processes are implemented, and what are the technical impediments/issues experienced in practice?
(3) Operational and organisational – do these services/processes work in daily operations, what are the challenges, what are the consequences for the involved IWT/RIS authority, is there a legal base, are there any impediments connected to facilitation topics?
(4) Financial – what are the costs or effort implications of these services/processes, and what are the potentials for cost optimisation?
(5) Regional status – are the services/processes applied across all regions, or are there any regional specialities that may be relevant?

In the following sub-sections, the Consultants describe the findings accordingly.

4.4.1 Business value: What is business value for the stakeholders?

The business value needs to be analysed under the view of the different stakeholders separately.

(a) Terminal

From a terminal operator perspective, operational efficiency gains, cost reductions and better customer service can be obtained by receiving, sending, and processing digitalised information. Higher digitalisation may also result in better data quality and more options for statistical evaluations.

These advantages apply more to bigger terminal operators with higher barge traffic volume, not as much to small terminals with few barge calls per week.

- Cargo details for planned load/discharge operation requested berthing time, cranes/gangs and on-carriage information for unloaded cargo may be received from cargo parties and be processed automatically in the terminal system.
- Arrival/departure information (ETA/ETD) for barges, barge master data, convoy composition and berthing requests may be received from the barge skipper or barge operating/managing office and processed automatically in the terminal system. The terminal system may calculate a berthing slot (RTA) and send it back to the barge.
- Terminal planning for bigger terminals (berth planning, operations planning, crane utilisation) may be more efficient with automatically updated information.
- If real-time operation (barge, rail, truck/gate) is reflected in the terminal system, then during operations, constant updates on progress (e. g., containers/cargo already loaded/discharged), an estimated time of completion (ETC), real-time inventories and track & trace options per container or cargo lot may be offered to terminal customers.
- After finalising barge operations, the load/discharge confirmation and invoices may be sent from the terminal system to the barge/barge operator/cargo parties. If a standard or agreed format is used, the receiving parties can also process the information into their systems.
- Suppose the respective port environment for the terminal (port authority, fairway authority, locks/bridges administration, port community system, etc.) offers a high level of digitalisation. In that case, the terminal may also benefit indirectly through data sharing and may improve its berth planning and resource planning.

(b) <u>Skipper/Barge operator</u>

From the barge/skipper perspective, a higher level of digitalisation may result in more efficient voyage planning, savings of time and bunker consumption.

- Traffic visibility and/or slot booking options for locks and bridges would allow voyage planning with just-in-time arrival, the potential for fuel/emissions reduction, cost savings, improvement of reliability on voyage schedule, and improvement on barge utilisation.
- Navigation technology used on barges with integrated components (e.g., radar, ECDIS, AIS, electronic reporting, NtS) supports safe navigation (Directive 2005/44/EC Of The European Parliament, 2005) combining multiple sources of information into fewer devices. Future developments may still increase the integration of navigation components. Future technology on navigation aids, automated trace finding, or semi-autonomous navigation may have some more potential to reduce costs and workload for skippers and crew.
- Onboard system options to receive digital transport orders and to process this information to cover cargo/voyage reporting requirements to authorities would simplify skippers' workload and improve data quality.

From the barge operator office perspective, there would be similar business value through efficiently digitalised communication, as the office depends on up-to-date information from barges, customers and other actors involved. Data handling between barges, barge operator offices, terminals, authorities, and cargo parties could be faster and more accurate, and data can be re-processed for other purposes.

- The operating office may receive transport orders from cargo-related parties (forwarder, cargo owner) and may forward these to the barge system to be processed

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by the skipper. The office may also use an integrated system to create required reporting formats from the cargo data, which can then be sent to authorities.

- Before accepting transport orders, a system application may be used to administrate operating costs and revenues on a voyage basis and calculate the profitability of freight or compare profitability against other offers, e. g., from a freight platform.
- The office may receive load/discharge confirmation directly from a terminal system or indirectly from the barge and process the data into their system, providing accurate visibility on the status of barges.
- Position tracking and visualisation of barges may be achieved via AIS (currently by commercial providers) or by installing a proprietary system (e.g. GPS transponders). Using commercial AIS providers is legally a grey area, not supported by authorities but may be possible in future over FA platforms using compliant access control[4]. Barge operators may also provide position tracking or ETA updates via a web portal or API to their customers.

(c) <u>Cargo related party (cargo owner, shipper/forwarder/consignee, logistics company)</u>

Depending on the business scheme, the cargo-related parties interact with barge operators and/or terminal operators. Cargo parties (forwarder/logistics company) may also organize transport of goods over multiple transport modes (rail, truck, barge, vessel) and exchange information with numerous transport operators. Digitised data exchange will usually improve the efficiency and reliability of transport organizations.

- Cargo parties may send cargo bookings to terminal operators in order to announce cargo to be received on terminals or release orders in order to allow retrieval of cargo from terminals. For containerised cargo, there are standard message formats available that allow efficient and uniform communication among many terminals and cargo parties.
- Furthermore, local/regional port platforms (Port Community Systems) can allow the standard exchange of booking/release information and slot booking for truck visits between cargo parties and terminals.
- Forwarders/logistics companies may make barge voyage schedules visible in their systems along with rail schedules and possibly transport management information from their trucking fleet, allowing them to take better decisions on modality usage and to save costs along their logistics chain.
- Forwarders/logistics companies may receive cargo data and shipment orders electronically from cargo owners/shippers to be processed in their system. Logistics systems provide visibility of cargo shipments, options to combine/consolidate shipments and opportunities to create transport orders to carriers (barge, rail, truck) using system applications for synchromodal transport control.
- Cargo parties will benefit from track & trace options provided by terminals or barge operators to follow their cargo along the supply chain and to control inventories on terminals. This may also refer to cargo equipment (e.g., empty containers, push barges, trailers).

(d) <u>Authorities (fairway, port, dangerous cargo, customs)</u>

[4] The functionality to provide access controlled AIS data has become available with EURIS

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From the authorities' point of view, benefits from more accurate communication through higher digitalisation could result from better visibility of barges and cargo, more efficient traffic control at locks/bridges/other check-points, more efficient waterway management, and generally from a higher level of safety in IWT.

By standardising and simplifying requirements for barges and other stakeholders, the authorities can help increase the efficiency and attractiveness of IWT and support political goals to promote more sustainable transport.

- Fairway and port authorities benefit from AIS infrastructure, VTS systems and barge reporting schemes to improve traffic visibility on inland waterways and take decisions on traffic planning and management.
- Fairway authorities may benefit from digitalised communication flow between important infrastructure/passage points, e. g. automated status exchange from one lock to the next lock and from locks to traffic management centres, working towards a concept of integrated corridor management.
- Higher visibility of barges and quick access to related information on relevant cargo details allow contingency planning and quick response in emergency situations for respective fairway/port/police/customs authorities.
- Authorities may re-use and forward information and reports received from barges to other relevant authorities and to the next control/reporting points along the passage, reducing some administrative workload for skipprs/barge operators.
- Authorities or statistics agencies will benefit from more complete and more reliable, and uniform data on IWT. Future decisions on infrastructure investments, reorganisation projects etc. would have a more solid data basis.

The current digitalisation levels in IWT could be ranked by cargo type; the highest level would be the container transport segment, followed by liquid bulk and then the dry bulk segment. The higher complexity of container operations and the example of container handling in seaports may have pushed digitalisation developments for containers in IWT.

4.4.2 Technical: Which services/processes are implemented?

The following services/processes are in use.

(a) Reporting

Reporting requirements are established by authorities to support traffic management on waterways and respond to emergencies.

Usually, skippers are required to report voyage and cargo data in a standardised format (ERINOT). The respective reporting services are implemented in various regional systems (with some differences). Reporting requirements are established to a vast extent on the Rhine corridor and also coordinated through the Rhine-Commission (CCR).

Local reporting requirements are handled through community systems, e.g.

- PCS in seaports (ANR – C-Point/BTS/APICS Barge, RTM – Portbase/Nextlogic, HAM – HVCC/DAKOSY)

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- Regional community systems for inland port clusters (e.g. RPIS for container terminals on the upper rhine area),
- Commercial platforms for specific user communities (e.g. UAB online for liquid bulk operators in the RTM/ANR area).

The standardised formats are based on the EU RIS directive (Directive 2005/44/EC Of The European Parliament, 2005) and respective CESNI/TI (CESNI, 2021) standard documents.

Reporting formats are uniform, but the reporting obligations depend on the regions and waterways and do not apply to all types of barges. Further harmonisation of reporting rules may be beneficial for fairway administrations and possibly increase the reporting work for barge operators and make it more uniform.

The local reporting in seaports/local community systems is sometimes linked to the national fairway reporting system. Ideally, local reporting should be integrated with the national fairway system, and for cross border voyages, a national system should forward voyage reporting to the next country.

Sometimes the reporting functionality are also integrated into commercial software applications used by barge operators for stow planning or fleet management (e.g. the Autena or Tresco software packages).

An increasing portion of the barge fleet manages the required reporting to authorities electronically. Sometimes additional reporting by VHF is also required at certain locks or passage points.

(b) Fairway information platforms

Platforms are provided by national authorities and offer visualisation maps of waterways with regularly updated notifications on ports, locks, water levels, weather and other relevant information for navigation.

Table 3: Information Platforms and ER in the countries

	Information Platform	ERI Reporting
NL - RWS	Vaarweginformatie	BICS, IVS-next
BE - DVW	VisuRIS	eRIBa
DE - WSV	ELWIS	NaMIB
FR - VNF	VNF/e-RIS	VELI
AT - viadonau	DoRIS	CEERIS

Within the RIS COMEX project, the implementation of a new integrated platform has started, based on the VisuRIS system. The new platform (EuRIS) is currently in a test phase with fairway authorities and selected barge operators.
The new integrated supranational platform project will be further developed but probably not replace the national systems in the foreseeable future.

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The fairway information platforms are included or linked to the NtS service.

(c) NtS (Notice to Skippers)

Authorities from most countries involved in IWT are obliged to report Notices to Skippers, usually via multiple communication channels. NtS information includes:

- Fairway and traffic-related data about certain fairway sections or objects,
- Water level related data (least sounded depth, vertical clearance, barrage status, discharge, regime, predicted water level, least sounded predicted depth or the predicted discharge),
- The current ice situation,
- Weather data (optional).

(d) Traffic management, VTS/Radar/AIS/VHF

Important sections of waterways are covered by traffic management centres to improve safety and efficiency and to protect the environment. Traffic management is usually supported digitally by VTS and other integrated systems, using radar, AIS and message information (electronic reporting). The traffic authorities get a complete picture of the covered waterway situation and may also use tactical/strategic tools for traffic management.

(e) Seaport Integration/PCS

Barge traffic at seaports is often integrated into existing local PCS (e. g. RTM: Portbase/Nextlogic, HAM: HVCC/Dakosy, ANR: C-Point - BTS/APICS barge) to manage ETA reporting, berthing slots on ocean terminals, lock passages and harbour dues.

(f) Regional IWT PCS

Some regional community systems allow stakeholders to exchange relevant information for barge calls over common platforms (e. g. Upper Rhine: RPIS for container terminals, RTM/ANR: Modality, UAB online for liquid bulk).

(g) AIS, GNSS

Many countries and respective authorities have concluded programs for barge transponders and shore-based infrastructure to increase the coverage of inland AIS.
The AIS infrastructure is used for VTS traffic management and by barges onboard for navigation, integrated with radar and ECDIS (Ninnemann, Tesch, & Werner, 2019).

Sometimes, barge operators use proprietary GPS transponder solutions to allow visibility independent from AIS and only for authorised actors (barge operator control office).

(h) ECDIS

A very high percentage of commercial vessels and many pleasure boats are equipped with Inland ECDIS for navigation and/or for viewing.

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Electronic Navigational Charts are provided by authorities and authorised providers for the major European waterways.

Integrated navigation devices onboard combine technology components and information sources (radar, ECDIS, AIS, electronic reporting, NtS), reducing the number of devices and the workload for the skipper.

Following issues and constraints are linked with the above processes (a-h):

- The common maintenance of master data and reference codes, e. g., for vessel identification European Hull Data Base (EHDB) or port/terminal/object coding, needs to be defined and organised.
- Sometimes the existing reference databases are not reliable because of outdated information.
- The implementation of common information platforms or data exchange on RIS across borders will require a common understanding of data elements, common data models and respective political willingness among partners to agree on standards.
- Adequate infrastructure along the waterways (Radar, AIS, VHF) technical equipment at traffic management centres and locks and bridges is needed to improve visibility and transmission of operational status data.

4.4.3 Operational and organisational: What are the challenges?

Ongoing project work on EuRIS and CEERIS is an essential element to improve harmonisation and integration between fairway authorities along a corridor.

Reporting (ERI) is not mandatory for all barge traffic (usually only containers, dangerous cargo, specific types of barges). For complete visibility by authorities and to obtain a more complete data set for statistics and policy recommendations, it would be beneficial to extend mandatory reporting to all IWT.
The current legal base of the EU RIS directive (Directive 2005/44/EC Of The European Parliament, 2005) provides guidelines to enable ER. Additionally, there has been regulations and standards which are not yet harmonised in all involved partner countries .

The role of reference databases will become more important (RIS index, ERDMS, EHDB, etc.), therefore, the maintenance of reference data needs to be reliable, and responsibilities for reference data need to be defined.

Private stakeholders need to agree on data sharing and solutions for commercially sensitive data, which may be stored on trusted platforms with controlled information access.

Currently, commercial AIS providers play a role in IWT, and barge operators and other actors are using their information. The commercially available AIS information is potentially unreliable, has incomplete waterway coverage and is legally questionable on the publishing of barge information.
Currently, barge skippers/operators have no reliable and legal access to view the traffic situation along a scheduled voyage using AIS position data. The skipper will only see the situation in the range of his navigation equipment around his current position.

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Checking traffic at other areas of interest is possible by using commercial AIS providers but may raise legal concerns and result in questionable reliability.

A new integrated platform will be developed within the RIS COMEX project, which allows traffic visualisation based on AIS infrastructure owned by fairway authorities with anonymisation of some vessel data.

4.4.4 Financial: What are the costs/efforts?

For authorities and public stakeholders, the investments into IWT infrastructure, including digitalisation investments, often do not directly relate to quantifiable benefits but are also strategic investments to improve the competitiveness of IWT against road and rail and to raise the attractiveness of a transport mode with less emission and higher compatibility with sustainable development.

Private terminal operators in IWT see the digitalisation initiatives and benefits of their industry peers in other ports and seaports. They are also aware of industry trends through their business relations with cargo owners or logistics companies or by being a part of a bigger logistics company themselves.

For barge operators, the scenario looks more diverse. The ownership structures among operators (single barge owner/self-employed skipper vs bigger barge operating companies) may affect technology investment options and digitalisation implementation.

Depending on the business scheme and the usual operation pattern, some digitalisation options may also lack a valid business case and not show a reasonable ROI. Specifically, in dry bulk transport, the data volume on cargo data and the barge calls at dedicated terminals with sufficient berth availability may not justify much investment in system-based data exchange.

However, in recent years, investments that target non-container cargo have grown. For example, the Upper Rhine ports have secured an investment of EUR 1.3 mil. for the RPIS 4.0, which plans to extend services towards bulk and river cruise (The INTERREG V A-project "RPIS 4.0", 2019).

Sometimes stakeholders prefer direct personal phone-call contact over e-mails or system-based data exchange. The information content might be straightforward and does not require a written statement; the skipper might be at the helm and prefers talking over the phone or radio.

Future extension of fairway reporting requirements may be covered by on-board devices which use automated reporting based on geo-fencing triggers and do not require activation by the skipper.

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4.4.5 Regional status: Are there any differences per region?

Some advances and standardisation on digital information exchange are established on the Rhine corridor, coordinated by the Rhine commission CCR (CCNR/ZKR), due to the high cross-border freight volumes and good cooperation between countries along the Rhine.

The Rhine corridor might serve as an example and blueprint for further harmonisation on other EU corridors and smaller national waterways.

Areas for more harmonisation and digitalisation potential:

- Barge construction, engines, navigation equipment, crew, all respective certifications,
- RIS services, reporting to authorities, reporting to locks/bridges to receive passage slots or an estimated passage time,
- Framework for commercial documentation (transport order, load/discharge confirmation).

5. Developments in Port and Terminal Information Service

5.1 Trends in digitalisation of IWT

<u>General</u>

General trends in society and industry sectors are related on different levels with the digitalisation efforts of public and private stakeholders in IWT.

Ongoing trends are determined by economic, technical, and political developments, e.g.

- Cooperation and mergers between ports (HAROPA, North Sea Port, bilateral/multilateral cooperation agreements).
- Companies moving towards more vertical integration of the supply chain (petrochemical sector, shipping companies, bigger logistics companies are also terminal and/or barge operators), higher levels of synchromodality and more seamless handover moves in transport modes.
- Ongoing developments of new technology and continuous technical improvements can be integrated into digitalisation strategies and projects. A few examples of new technology are sensors and IoT, drones, communication technologies, blockchain, digital twins, big data/BI, remotely controlled/automated/autonomous mobility).
- Many industry sectors must move towards safer, more sustainable, de-carbonized and environment friendly operation standards.

<u>Port Authorities and Fairway Authorities</u>

Trends related to digitalisation

- Exploring and incorporating technological developments (GNSS/geofencing/AIS/radar, track and trace, communication technologies, drones, video surveillance).

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- Cooperation and collaboration on a national and international level (e.g., RIS COMEX, DIWA project).
- Adapting to political and social demands towards more sustainable and cleaner operations, alternative energy sources, compatibility and cooperation with cities and communities.
- PCS platforms in seaports (RTM, ANR, HAM) are increasingly covering solutions for hinterland connectivity (truck, rail, barge) to keep smooth operations throughout the entire supply chain (HVCC, 2019). The aim is to avoid disruptions at seaport terminals and improve customer service for all actors in hinterland logistics.

<u>Barge Operators</u>

Trends related to digitalisation

- Adopting technology for commercial and technical information exchange between barges and operating office (E-mail, integrated software applications with onboard modules and sensor integration). Increasing visibility of barge positions and voyage data for the operating office and customers.
- Exploring and incorporating options for digitised information exchange with customers, ports/terminals, and freighting platforms (UAB-online, Bargelink).

<u>Cargo Parties</u>

Trends related to digitalisation

- Improving real-time visibility of cargo along the supply chain for cargo operators and their customers (IoT, sensors, track and trace).
- Exploring options for simplified/automated data exchange with partners in supply chain logistics (e-CMR, e-Billing, other EDI, eFTI initiative).
- Improving interoperability between transport modes (truck, rail, barge, vessel), harmonizing and simplifying data structures and information exchange.

<u>Terminal/Port Operators</u>

Trends related to digitalisation

- Improving standardisation/automation in information exchange with business partners (cargo party, barge/rail/truck operator) along the supply chain (implement TOS, interfaces, other EDI).
- Exploring and adopting automation options for cargo planning/handling and terminal inventory control (implement TOS, sensors, remote-controlled/automated cranes).

5.2 Potential added values from the trends

Digitalisation efforts by IWT actors can support the development and strengthening of business values as described above under 4.4.1.

Potential impediments and limitations mentioned under 4.4.3 and 4.4.4 need to be considered to realise these benefits. Legislation and regulatory frameworks, data sharing and data availability, financial resources for investment into new technologies, a digital mindset and openness to change and innovation are all critical preconditions to transform digitalisation investments into benefit for stakeholders (Punter & Hofman, 2017).

Following common objectives like efficiency, profitability, sustainability, and safety may also lead to situations requiring decisions between competing objectives. Sometimes clear regulations or recommendations from IWT authorities may help private stakeholders in decision-making.

While inland waterway shipping struggles to attract new talent, these trends and initiatives should make the industry more attractive for employment purposes.

5.3 Ideal future state of IWT

5.3.1 Target best case scenario

Best case scenario attributes:

1. Real-time data sharing and visibility for all stakeholders, enabling services such as track and trace. Administration of authorisation levels and authentication.
2. Standardised information exchange - one way (reporting, broadcasting), two way (reporting with approval). Established organisations and procedures on the EU level will continue to develop standard adaptions according to changing conditions.
3. A single submission of information in the entire supply chain. Safe mechanisms to protect information.
4. All port/fairway authorities' systems are interconnected and have harmonized legal framework.
5. Harmonized fairway information platforms for seamless change on cross border navigation or a single supranational platform on a corridor.
6. Barges are equipped and have the systems available. Skippers/crew/barge operators are trained/certified to work with harmonized standards.
7. Horizontal integration among different modes of transport: rail, truck, and barge for efficient and sustainable transport. Commercial and logistical facilitation in the switching of transport modalities.
8. Simple requesting and fast response from authorities to approval/information requests. E.g., customs/port clearance, slot booking for locks, berthing, invoicing for tolls/harbour dues.

One entire voyage - departure from one terminal to arrival at the next terminal - is pictured in the target best case scenario. This journey is divided into seven points, each representing a different combination of time and location of the barge in IWT.

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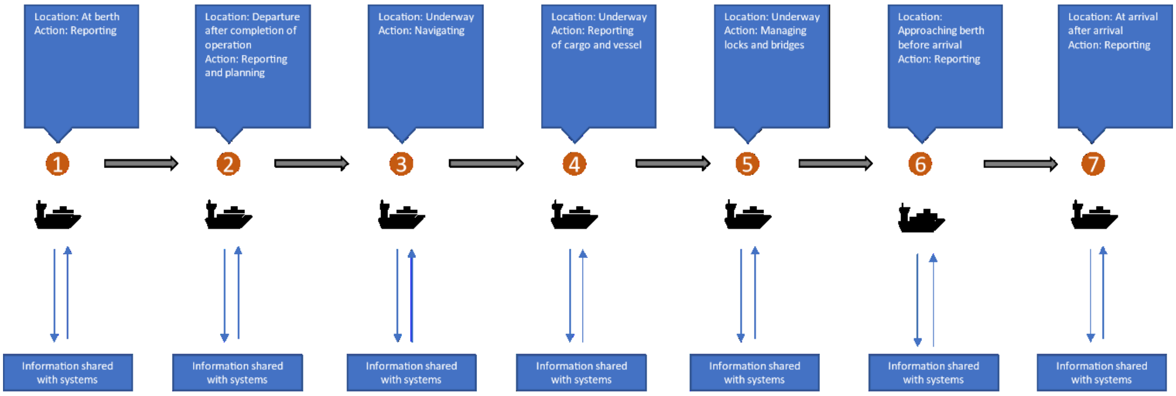
Figure 5: Voyage Process from Departure to Arrival



Source: *HPC Hamburg Port Consulting GmbH*

Point 1

Description	Actors involved	Systems involved
The vessel is at berth, and cargo operation is in progress	1. Barge operator/skipper 2. Terminal/port operator 3. Cargo party 4. Relevant authorities (FA, port, police, emergency response)	1. TOS 2. SCM Solutions 3. Systems of port authority 4. Systems of fairway authorities 5. Customs systems

During and after the completion of the operation, electronic reporting is done using messages in a standardised format. The cargo party at the destination port – terminal/port operator, logistic service provider for all modalities – receive a status update with attributes of cargo and stowage information. This allows them to plan/adjust their next operations in advance. Terminals can plan their berths and cargo handling equipment allocation for this incoming barge using their TOS.

Cargo parties, logistics service providers and relevant authorities have visibility of the cargo status and an up-to-date prediction for completion of cargo operations. They also have visibility of the barge location (authorized by the barge operator).

Point 2

Description	Actors involved	Systems involved
The vessel left the berth after completion of cargo operation	1. Barge operator/skipper 2. Terminal/port operator 3. Cargo party 4. Relevant authorities (FA, port, police, emergency response, customs)	1. Barge operator systems (onboard/office) 2. TOS 3. SCM Solutions 4. Systems of port authority 5. Systems of fairway/other authorities

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Information and certificates/documents about completed cargo operations (cargo detail, stowage plan, waybill, working times, cranes, productivity, etc.) are sent in digital format from terminal to barge operator/cargo party or from cargo party to barge operator, according to transport terms and practice in the respective business scheme.
All information and billing for services completed (cargo related, power/water, garbage removal, etc.) during the completed port call are received electronically and verified/paid by the barge operator/cargo party.

The barge operator plans the voyage using ECDIS/AIS/NtS information and weather and passage point information from systems of fairway authorities. ETA notified to the terminal with follow up notification on adjustment. The terminal can confirm or propose another ETA.
For cross border voyage reporting to an NSW, a port of destination may be required. It is done over the fairway platform.

The barge operator may update information on commercial brokerage platforms that offer barge transport capacity to interested cargo parties.

Point 3

Description	Actors involved	Systems involved
The vessel is underway after departure and navigating	1. Barge operator/skipper 2. Terminal/port operator 3. Cargo party 4. Relevant authorities (FA, port, police, emergency response, customs)	1. Barge operator systems (onboard/office) 2. SCM Solutions 3. Systems of ports 4. Systems of fairway authorities 5. Systems of other authorities (police, emergency response, customs)

The fairway authority provides all relevant navigational information (water level, meteorological information, state of waterway, locks/bridges etc.) through multiple communication channels (NtS/E-mail/VHF, information platform). The barge operator system (onboard/office) can process/display NtS messages and notify the skipper of potentially dangerous hydrographic and weather situations in the upcoming passage.

The water police and emergency response party monitor the barge's movements and can communicate with the skipper.

Fairway authorities offer harmonized information platforms or one EU platform, including a chart visualisation with a reliable AIS-based traffic view for the complete corridor and relevant navigational information. Additionally, information related to incident management such as obstructions in the inland waterway are available.

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The barge operator/skipper continues with updating ETA. If necessary, this might also be automated by detecting discrepancies between computed and actual (AIS based) positions and re-calculating the voyage/travel time.

Barges are equipped with integrated navigation devices supporting new technologies and online updating mechanisms for charts and other navigational data.

Point 4

Description	Actors involved	Systems involved
The vessel is underway after departure and reporting to authorities	1. Barge operator/skipper 2. Fairway authority 3. Relevant authorities (port, police, emergency response, customs)	1. Barge operator systems (onboard/office) 2. Systems of ports 3. Systems of fairway authorities 4. Systems of other authorities (police, emergency response)

Reporting is done at required points on the passage in a digital standard format through the push of a button or automated by a geofence trigger. Further reporting for the same voyage can use the information provided in the first reporting. The skipper updates relevant changes in information (e.g., cargo detail, convoy composition/dimensions, destination) via the onboard system.

Mandatory reporting at border passage points is automated or simplified and does not cause significant additional action for the barge skipper.

For other authorities involved the fairway system provides the logic to determine the related parties and trigger a forwarding mechanism to their respective systems:

- If dangerous cargo detail is part of the message, the respective information is forwarded by the FA platform to other relevant authorities.
- Customs notifications are submitted when required upon entering/leaving EU waters. The format and communication method will be standardized, e.g. using a FA platform or community system offering an interface to customs authorities.

Customs response/clearance is received by the barge operator/skipper through the same mechanisms.

Point 5

Description	Actors involved	Systems involved
The barge is underway and passing through locks/elevators/bridges	1. Barge operator/skipper 2. Fairway authority 3. Relevant authorities (lock administrator, port, police, emergency response, customs)	1. Barge operator systems (onboard/office) 2. Systems of ports 3. Systems of fairway authorities, lock management

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		4. Systems of other authorities (police, emergency response)

The administration for locks/elevators/bridges is integrated into the Fairway information platform(s), current state and predicted occupancy is visible to barge operators.

Locks administrations use management systems to register barge passage announcements /ETA or passage slot requests and return a time slot or an estimated passage time to barge operators who can adjust their voyage planning accordingly.

Point 6

Description	Actors involved	Systems involved
The barge is underway and approaching the next port of destination	1. Barge operator/skipper 2. Terminal/port operator 3. Cargo party 4. Relevant authorities (FA, port, police, emergency response, customs) 5. Service provider	1. Barge operator systems (onboard/office) 2. TOS 3. Systems of ports 4. Systems of fairway authorities 5. Systems of other authorities (police, emergency response) 6. Systems of service providers

The barge operator updates ETA to terminal/cargo parties and reports to all relevant authorities (port, police, customs, etc.) with required information through single reporting on the fairway platform.

Skipper/barge operator requests for special services (cargo related, power, water, provisions, etc.), sending notifications to service providers.

Point 7

Description	Actors involved	Systems involved
The barge is at berth after arrival	1. Barge operator/skipper 2. Terminal/port operator 3. Cargo party 4. Relevant authorities (FA, port, police, emergency response, customs) 5. Service provider	1. Barge operator systems (onboard/office) 2. TOS 3. Systems of ports 4. Systems of fairway authorities 5. Systems of other authorities (police, emergency response)

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Barge operator/skipper and terminal update actual arrival/start of work in their systems and report to authorities if required.

Barge operator/skipper registers any services performed to cargo or vessel. Barge operator/skipper registers any changes in convoy composition/convoy dimensions in onboard systems to be applied for AIS messaging and electronic reporting (ERI).

The barge operator may update information on commercial brokerage platforms that offer barge transport capacity to interested cargo parties and receives transportation offers/loading orders for the next voyage.

5.3.2 Information Requirement for ideal future state

For this ideal state to come true, digitised information must be used. The following information services are necessary for realising the future state:
(Original list of information requirements is based on the list prepared in the working group for SuAc 2.5. Additional information requirements added by SuAc 2.3 have been highlighted using orange colour.)

Table 4: Information Requirement for ideal future state - Waterway/Locks/Navigation

Provide navigation-based information on fairway and/or navigable water area		Relevance for SuAc 2.3
	Provide information on bank of waterway, boundaries of the fairway, etc.	
	Provide information on the depth profile of the fairway	
	Provide information on non-navigable or un-surveyed water area	
	Provide information on anchorage areas, mooring facilities and berths	
	Provide information on permanently moored vessel or facility in waterway	
Provide meteorological information		
	Provide continuous weather information	
	Provide predicted weather information	
	Provide weather warnings	
	Provide actual ice information	
	Provide predicted ice situation	
	Provide information on expected restrictions caused by predicted ice situation	
	Provide information on ice breaking measures	
Provide water level-related information		
	Provide actual water levels	
	Provide predicted water levels	
	Provide actual discharge information	
	Provide predicted discharge information	
	Depth profile of the fairway	
	Shallow sections/critical sections	
	Provide information on water level info (or correction data) for critical stretches	
	Provide information on restrictions caused by high water conditions	

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	Provide least sounded actual depths information (shallow section)	
	Provide least sounded predicted depths information (shallow section)	
	Provide barrage status	
	Provide regime status	
Provide information on obstructions and limitations		
	Provide information on long-term/permanent obstructions (in the fairway/route)	
	Permanently moored vessels/parked vehicles or facility in the fairway/on the route	
	Provide information on temporary obstructions (in the fairway/on the route)	
	Provide information on ferries	
Provide information on navigation rules and regulations		
	Provide information on official aids-to-navigation	
	Provide information on malfunctions of aids to navigation	
	Provide information on short term changes of aids to navigation	
	Provide information on traffic signs	
	Provide information on traffic rules and regulation	
	Provide information on anchorage areas, mooring facilities and berths	
	Provide information on waterway charges, harbour dues and infrastructure charges	
	Provide actual status of light signals	
	Provide IENC, new charts and updates for ECDIS upload	X
	Provide AIS messages	
	Information to/from port authorities/PCS/other authorities	X
	Information exchange between barge and barge operator office, document transfer	
Provide information on harbours		
	Provide information on opening hours of harbours	X
	Provide information on harbour area and basin	X
	Provide information on the category of harbour facility	X
	Provide information on port schedule/working hours	X
	Provide information on harbour dues, services (fuel, water, shore power, garbage, etc.) and related costs	X
	Provide information on waiting berths, availability, related costs	X
	Provide information on shipyards, repair facilities, other relevant sites for barge crew	X
Provide information on terminals		
	Provide information on opening hours of terminals	X
	Provide information on category of terminal	X
	Provide information on cranes and boat ramps	X
	Provide information on terminal schedule	X
	Provide information on cargo types handled, capacities/limitations	X
	Provide information on cargo related services (weighting, sampling, survey, fumigation, etc.)	X
Provide information on locks and ship lifts		
	Provide information on construction and facility	
	Provide information on short term changes of lock operating hours	
	Provide information on regular lock operating times	
	Provide information on lock schedule	
	Provide operational status of locks	

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Provide information on bridges		
	Provide information on construction	
	Provide information on short term changes of bridge operating hours	
	Provide information on regular bridge operating times	
	Provide information on openable bridge schedule	
	Provide operational status of openable bridges	
	Provide information on vertical (bridge) clearance	
	Provide information on predicted vertical bridge clearance	
Provide information on cables/pipes overhead and other special constructions		
	Provide information on construction	
	Provide information on vertical clearance	
Provide information on waste reception facilities		
	Information on reception of waster/bilge water, sludge, garbage, etc. and cleaning services	X

Table 5: Information Requirement for ideal future state - Terminal/lock information (dynamic)

Provide berth/harbour/terminal information		Relevance for SuAc 2.3
	Number of vessels at berth (public/private)	X
	Percentage of occupied berth space (public/private)	X
	Exact location of vessel at berth (public/private) - anonymized	X
	Predicted number of vessels at berth at a certain time/ in a time period	X
	Predicted percentage of occupied berth space at a certain time/ in a time period	X
	Reserved berth space (in percent of list of vessels) at a certain time/ in a certain period	X
	Timeframe of reservation	X
	Available berth space within the defined timeframe	X
	Vessel/convoy dimensions, respectively occupied berth space	X
	RTA from terminal to barge operator	X
Provide information on lock chamber planning		
	RTA from the lock master to the skipper	
	Assigned position of the own vessel from lock master to skipper	
	Assigned positions of all vessels in the lock chamber	
	Actual positions of all vessels in the lock chamber	
	Requested sequence of entering the lock chamber from lock master to skippers	
Provide information on operational status of locks		
	Door status (open, closing, closed, opening, malfunction, unknow)	
	Chamber availability for navigation (Yes or No, if No then vessels entering, vessles leaving, locking in process, not in operation, unknown)	
	Water level at lock chamber (low, leveling up, high, leveling down, unknown)	
	Position of vessels in a lock chamber including number of blue cones or passenger vessel or certificate	
	Number of announced vessels approaching the lock per sailing direction (arriving in short term)	
	Number of vessels waiting for locking per sailing direction	

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	Signal light status (green, red, other, unknown)	
	The still available length and/or width	

Table 6: Information Requirement for ideal future state - Vessel information (static/current state)

Provide vessel/vehicle dynamics (i.e., RoT, velocity, CoG, SoG, …)		Relevance for SuAc 2.3
	Provide actual vessel/vehicle dynamics (i.e. RoT, velocity, CoG, SoG, …)	
	Provide historic vessel/vehicle dynamics (i.e. RoT, velocity, CoG, SoG, …)	
Provide event-based triggers for vessel position		
	Provide notifications of arrivals at defined (passage) points of the waterway/route	X
	Provide notifications of arrivals of departures at defined locations on the waterway/route	X
Provide information on hull/vehicle body data		
	Provide specific information on hull/vehicle body data	
	Provide data for the identification of vessels/vehicles (minimum hull/vehicle body data set)	X
	Provide full hull/vehicle body data	
	Provide information on vessel/vehicle name, ENI, MMSI	X
Provide information on craft certificates		
	Provide community certificate	
	Provide ADN tank certificate	
	Provide ADN dry certificate	
	Provide measurement certificate	
	Provide other certificate (e.g., garbage, health and sanitary)	
Provide overall convoy/platoon data		
	Provide information on convoy type	X
	Provide information on the hulls of convoy	X
	Provide information on the characteristics of a convoy	X

Table 7: Information Requirement for ideal future state - Voyage Information

Provide path coordination information		Relevance for SuAc 2.3
	Provide information on origin (voyage)	X
	Provide information on intermediate discharge locations	X
Provide path coordination information		
	Provide path offer & path request	
	Provide Re-routing (pre-arranged paths and reserve capacity in case of temporary capacity restrictions)	
Provide information on passage points		
	Actual Passage Time (timestamp) at a specific waypoint of a stretch (e.g., river km)	
	Actual passage duration (hh.mm.ss) required for navigating through a specific stretch or section (e.g. between two locks) considering the actual traffic situation (density)	
Provide information on destination voyage		
	Provide information on the related destination	X

	Provide information on port of destination	X
Provide information on data/time of arrivals		
	Provide estimated data/time of arrivals	X
	Provide information on ETA (data source AIS)	X
	Provide requested data/time of arrivals	X
	Provide date/time of actual arrivals	X
Provide information on estimated data/time of departures		
	Provide estimated data/time of departures	X
	Provide requested data/time of departures	X
	Provide date/time of actual departures	X
	Provide information on the predicted deviation of the original voyage plan (of the skipper) at defined points on the route (locks, crossings, berths) and terminal /ports	X

Table 8: Information Requirement for ideal future state - Cargo/Passenger Information

Provide information on origin		Relevance for SuAc 2.3
	Provide information on origin of cargo	X
	Provide information on destination of cargo	X
Provide information on cargo details		
	Provide details of cargo sender	X
	Provide details of cargo receiver	X
	Provide details of non-dangerous cargo	X
	Provide details of dangerous cargo	X
	Provide port of loading	X
	Provide estimated date/time of departure at loading place	X
	Provide port of discharge	X
	Provide estimated date/time of arrival at discharge place	X
	Provide information on ERINOT	
	Provide information on ERIVOY	
	Details of transport offer	
	Acceptance of transport offer	
	Details of transport order/loading order	
	Acceptance of transport order/loading order	
	Waybill/bill of lading/freight certification	X
	Load/discharge confirmation, cargo detail/container list, stowage plan	X
	Operation report, working hours, cranes, productivity	X
Provide loading unit related information		
	Provide number of containers on board	X
	Provide information on type of containers on board	X
	Provide information on free loading space (tonnage, type of cargo, containers, etc.)	X
	Provide information on statistics reports according to EUROSTAT regulation	X
Provide crew/passenger related information		
	Provide information on number of persons (crew, passengers, …) on board	X
	Provide details on persons on board (e.g., relevant for ISPS facilities)	X

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5.3.3 Requirements from actors and systems for ideal future state

What should the actors provide to make this ideal future state possible:

Fairway authorities

- Continue working together with other fairway authorities towards more harmonisation in different aspects of IWT. Harmonized procedures along a corridor, data sharing and reducing repetitive obligations in each country/jurisdiction along the corridor will improve operational efficiency and attractiveness for the barge operator.
- Either seamless transfer or no switch from one user interface to another for skippers while crossing borders through the use of a single information platform (EuRIS) or harmonised national platforms with the same design and functionality.
- Information exchange/reporting forwarding between fairway authorities reduce redundant reporting for barge operators/skippers on border crossings.
- Review and develop API/interface standards to facilitate data exchange with
    - Local port authority systems/PCS platforms, forwarding barge voyage information
    - Navigation devices/onboard computers, software applications on barges, facilitate automated reporting, NtS distribution
    - Terminal operator systems receiving information on berth availability, operational data
- Agreements between fairway authorities and port authorities/PCS operators towards more integration and data sharing between their systems to reduce redundant reporting for barge operators/skippers. Offer single sign-on for multiple platforms. Develop a vision for future integration of fairway/port/PCS platforms with complete coverage of a corridor. Ideally there should be a common interface standard to exchange barge traffic data (based on ERINOT) between FA platform and (seaport) PCS.
- The common / consistent maintenance of master data and reference codes, e.g., for vessel identification European Hull Data Base (EHDB) or port/terminal/object coding (RIS Index), needs to be defined and organised. Develop fairway information platforms as a centrepiece for information sharing and data exchange on IWT as the main tool for barge operators/skippers, taking into account private related issues.
- Develop fairway information platforms as a tool to facilitate exchange of information (load/discharge reporting and confirmation, freight document exchange etc.) among commercial platforms, considering blockchain technology as a mechanism for document security, reliable user administration, and data security. The FA platforms could be extended with a separate hub area for commercial data exchange; this system area may also be operated by a neutral user group entity including stakeholders and their associations. The FA are in a good position to facilitate the formation of a neutral exchange platform (similar as PCS organisations in seaports). Fairway authorities may take advantage to obtain statistical data.
- Make reliable AIS traffic data from fairway authority networks available to barge operators to allow traffic view in other areas than their actual position; establish a legal basis.
- Provide AIS coverage and ensure mobile internet coverage on all navigable inland waterways used for commercial transport of cargo.

- Provide visibility of the current traffic situation at locks/bridges and other important passage points. Forecast upcoming traffic, offer slot management and estimated passage time for the barge.
- Support initiatives to establish digital cargo/freight documentation in IWT (eFTI, e-CMR), which would enhance fairway platforms functionally as a standard communication channel for cargo documentation.
- Evaluate current traffic management to determine improvement potential, if any, for traffic management, emergency response, and statistical data collection.
- Facilitate creating minimum standards for equipment (navigation, reporting) onboard to stimulate the digital interaction between the vessel, FA and cargo party.

Port authorities/PCS operators

- Ports may develop standards for harbour dues, uniform procedure/format to report to the port authority, uniform billing criteria.
- Develop PCS platforms towards (further) integration with fairway platforms to reduce redundant reporting for barge operators/skippers.
- Extend coverage of community platforms, define boundaries to next areas, develop a vision for future integration of fairway/port/PCS platforms.

Barge operators

- Ensure internet connectivity and necessary communication equipment on board, adopt to reporting standards ERI/AIS.
- Support and adopt initiatives for digitalised information exchange with FA/ports/PCS and with terminals and cargo parties.

Terminal operators

- Support and adopt initiatives for digitalised information exchange with barge operators, other modality operators, cargo parties and fairway authorities/ports/PCS.
- Publish and promote all barge cargo handling options and available services for barges and cargo on the terminal or other nearby facilities.
- Publish and promote all cargo handling and transport options for all modalities on the terminal or through other nearby facilities.
- Support and adopt initiatives in the port community for digitalised information exchange between terminals, authorities, transport operators and other port stakeholders.

General requirements

Standards and systems

- Multi-modal transport requirements standards must account for the requirements of different modes of transport (truck, rail, barge etc.) to enable interoperability between systems for all stakeholders during the voyage. Depending on the business scheme and cargo type the cargo party ordering or controlling the transport may indicate the required or preferred mode of transport; other actors (logistic companies, terminals) along the transport chain should have visibility of the required / preferred transport mode to schedule oncarriage

/ transshipment accordingly. Documentation per transport mode should be as uniform as possible.

- Implementation of data exchange using API technologies and file transfer, look for the automated triggering of data exchange by events (e.g. geofencing), use platforms for a single point of communication with distribution to multiple stakeholders.
- Mechanisms for user authorization, authentication and access control, data security.
- Adequate infrastructure along the waterways and for stakeholders, mobile internet, AIS, traffic surveillance (radar, camera coverage), etc.

Mindset and change management

- Organisations should be ready to address the human factors involved in making such a significant change. Some IWT segments are already optimised using available technologies, so participants must embrace the mindset that implementing new technologies and digitalising processes will improve communication and eliminate inefficiencies.
- Building up trust and transparency.

6. Roadmap for Port and Terminal Information Service

6.1 What are the next steps and consequences for implementation

Some steps proposed in this chapter may have already been implemented by any of the fairway authorities or may have been already discussed or planned in the context of some ongoing IWT projects.

Future efforts and initiatives will need to consider individual commercial interests from stakeholder groups (in data sharing) and balance against common interests for the IWT community.

Improvements towards digitalisation and seamless/automated data exchange are more often realised in smaller environments. An example of this type of environment could be a port or branches of the same company. In this case, with a limited number of actors, agreements on data exchange, formats, and related development of platforms can be achieved more easily, and faster results are available.

From the perspective of a barge operator, there is still a scattered landscape of systems and procedures along the voyage, even more on a border crossing trade. Therefore, further harmonization and integration on a higher level along a corridor is desirable and can only be achieved by fairway authorities taking the role of facilitators.

The FAs have taken steps to integrate their national information platforms, which will provide a more harmonized outlook for barge operators and other actors in the future. In addition, barges are dealing with more information exchange with other entities along the voyage, which could offer some potential for further integration. Here the FAs can get involved and may act as a facilitator or sometimes as a platform provider to provide integration options in other areas apart from their genuine role as regulators.

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Action items and next steps can be grouped into three areas:

1. Ongoing development of integrated supranational fairway platforms.
2. Integration of fairway information systems with local community systems.
3. Enhancement options for fairway authority platforms.

1. Ongoing development of integrated supranational fairway platforms (EuRIS/CEERIS, etc.)

   Enhancement projects on the national fairway platforms have to be balanced against the move forward towards the unified EuRIS/CEERIS platforms.

   The supra-national integrated platforms (EuRIS, CEERIS) are still in a pilot/project stage and will take some time to be developed for release to users. In the meantime, the FAs should discuss/decide their policy, a possible plan to phase out their national platforms at some point and support the new integrated systems or still develop the national platforms in parallel.

   The national platform may offer features/services to IWT users which are not considered in the integrated platform projects. But also, the new common platforms may consider a modular approach with architecture and administration options which would allow optional functionality and modules as considered necessary on a national level.

   For any pending enhancement projects on the national platforms, it should be evaluated how functionalities, timelines, efforts and resources relate to potential similar results in supporting the future integrated platforms.

   Faster results can be achieved by developing in phases and with an agile approach; system modules are available to users at an early stage, and user feedback can still be considered for ongoing development.

   The integrated platforms should be designed both with public and user authenticated access. The user authenticated area for barge operators should allow the current vessel and voyage data storage.

   With more detailed data on the vessel, voyage/ports/ETA, convoy composition, cargo detail, crew, passengers, etc. there will be more options to use the platform as a centrepiece for information exchange with other entities like port authorities, other authorities, and community systems along the voyage.

   If a barge voyage with all relevant data is registered on the platform and position tracking from the related fairway traffic management system is linked, then the reporting obligations for the barge might be partially automated/self-triggered. The system will detect the relevant position and create the reporting for the barge internally.

   The distribution of responsibilities between fairway authorities regarding development, maintenance and other general IT aspects are important to consider: System architecture and administrative tasks like user maintenance, authentication, access control, cyber security, system maintenance and support, etc. must be determined.

Concepts for multilayer access control seem to be necessary, where authorized platform users (level 1) may create other users with limited access (level 2), which are acting on their behalf. The administrative and support effort will grow with increasing features and options for users and with more integration and interfaces with other systems.

2. Integration of FA platforms with other community systems

The FA platform is used by the barge operator along the complete voyage and therefore has the potential to be developed into a more central application from where access and information exchange to other relevant entities can be achieved. The bigger seaports are increasingly developing their local PCS to integrate also hinterland connectivity (truck, rail, barge) to maintain smooth operations and avoid disruptions at seaport terminals and improve customer service for hinterland logistics actors.

This looks like an opportunity for FAs to offer a uniform standard for barge ETA reporting from the FA platform to seaport PCS and other community systems. Also, to transmit real-time positions (automatically) once barges approach the respective PCS area.

Barge operators should work with a limited number of applications and not have to switch between too many platforms and websites along the voyage. Integration points with seaport PCS and other local community and authority systems should be determined.

A potential scenario for FA to enhance the platform with services for the barge operator can include these steps:

a. FA to investigate typical barge voyage patterns along the corridor and identify the most common relevant points of information exchange for the barge operator (port authorities, other authorities, locks, PCS/community systems, terminal/cargo parties).
b. Determine required information/data fields exchanged and connectivity options (file exchange, API, manual input, etc.). Differentiate between data for mandatory reporting to authorities and private commercial data, which can be exchanged on a voluntary basis but still using the FA platform and harmonised standards.
c. Determine the external systems with the best overlapping potential for integration with the FA system. The overlapping potential is measured in terms of technical feasibility and user benefit, such as avoiding redundancy of data submission.
d. Develop respective interfaces and communication options with FA platform respective configuration options on the FA platform.
e. Develop mechanisms for user access control with external systems allowing a single sign-on for the user/barge operator.
f. Provide option to capture/update relevant vessel and voyage data (port rotation, ETA/ETD, cargo detail, DG cargo, convoy composition, crew, passengers, etc.) for authenticated user /barge operator on the FA platform.

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g. Visualize integration points on chart display/menu and provide users with the choice to start the procedure manually or some trigger point/geofence to automate the data transfer.
h. Result: User/barge operator can initiate the required information exchange with various parties from the FA platform along the voyage.

First options to determine the potential integration points and data sharing include the PCS platforms in seaports (ANR – C-point/BTS/APICS, RTM – Portbase/HCN, HAM – Dakosy/HVCC, etc.), other established local community systems (RPIS, UAB-online), bigger inland ports (Duisburg – Duisport, North Sea Port – Enigma) and port/police authorities at bigger inland ports.

Additional integration potential might be identified in the billing for harbour dues, berthing fees and other services for barges. Also, some inland waterways and locks are subject to tolls. Respective rules and tariffs might be stored on the platform, and barge procedures for registering and billing would need to be investigated with relevant port authorities and other entities in charge of service billing. If the process is accessible over an interface, then it could be developed to be initiated from the FA platform and result in another simplification for the barge operator.

3. Options for FA platforms

Regardless of the platform, whether national or supra-national, some key elements and functionality ideas may be considered for future new or enhanced development. Some items on the list are already implemented but still have the potential to be developed in a uniform standard on all fairway platforms.

Considerations and potential enhancements for FA information platforms to facilitate more integrated information exchange along a corridor:

- Consider publishing any relevant information from FA traffic control systems (replication of VTS screens, aggregated data from reporting and AIS) which is useful for barge operators and other stakeholders. Possibly with anonymised vessel names if there is no legal basis to show real names.
- Show waiting berths and real-time occupancy. Consider making reservation functionality available for waiting berths.
- Offer API connectivity options for external systems from logistics companies, barge operators or terminal operators. Evaluate actors' interest in connectivity to FA platforms and retrieval of information.
- Offer access to reference databases (e.g., vessel ID databases, RIS index, harmonised IENC library), interactive on the websites and through APIs.
- Provide standards and input options to publish/retrieve information on barge voyage schedules (line schedules, usually for container traffic); interested parties could retrieve voyage schedules into their system.
- Provide publishing options for IWT actors like ports and terminals to present their facilities and services in a structured format on the FA platform. Information update and maintenance could be done by the FA or also be delegated to the users.
- Evaluate options to use FA AIS data with approval from barge operators and publish barge visibility, continuous track and trace services, etc., for authorised and authenticated users.

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- Follow up on initiatives for management of locks, bridges, barge elevators to cover all available information on FA platforms. Wherever instruments like slot management or passage prediction are introduced, the respective online access should be available on FA platforms.
- Investigate options to store certifications (hull, engine, crew, cargo, etc.) on the FA platform. Barge operators could then forward digital certification over the platform to any concerned authority or visualize the certificate on a mobile device.

- There might be still some improvement potential in reviewing reporting.
    - All barge types, all waterways: Reporting requirements are not uniform among regions and waterways and do not apply for all barges. Further harmonisation may be beneficial for fairway administrations and create more uniform rules along the waterways.
    - Auto-triggered reporting on national or future international platforms (EuRIS, CEERIS, etc.): If barge operator is logged in, current vessel selected, and relevant/voyage/cargo details captured, then the reporting could be covered and automated within the platform, without any need for the barge to do BICS/ERINOT reporting over an external system.
    - Review reporting formats: Apart from the ERINOT message, widely used in current reporting systems, there are other formats (ERIVOY, PAXLST, BERMAN) where the usage may be evaluated and possibly promoted.
    - Or a harmonized standard message may be designed, which could serve for RIS/ERI purposes and DG/ADN reporting and for Customs, Police or NSW reporting, then would be sent to one authority or to a platform and distributed to other authorities. The goal is to avoid duplication/redundancy of messaging for barges.

- Evaluate the future potential of FA platforms for commercial/operational information exchange.

  The eFTI standard is planned to be implemented in 2023. A potential implementation could look like current digital waybills (e-CMR) used in road transport, where a trucker does no longer carry cargo documents but is using digital versions on a mobile device. Providers of truck telematics software have implemented the e-CMR in their mobile applications for truck drivers and are communicating any CMR status update to all connected parties.

  With current initiatives (e-FTI/e-CMR, SINLOG, etc.), the ongoing tendency towards paperless and digitised trade facilitation and the upcoming implementation of standards, there will be a need for platforms to handle future data exchange for commercial and operational cargo-related activities. The FA platforms (national/future supra-national) could have a natural opportunity to cover this need:
    - Some actors for commercial/operational data exchange are already users on the FA platforms (barge operators, terminals, cargo parties, authorities, etc.).

- Many reference data needed for data exchange are already available on the FA platforms and can be used for data validation (vessel IDs, port/terminal IDs, voyage data, ETA information, etc.).
- Some reporting requirements which need to be done anyhow via the FA systems could be derived from the operational data exchange, and the commercial actors can cover their reporting obligation (e.g., cargo declaration, DG declaration, statistical information, etc.) in a seamless workflow.

The FAs would need to evaluate and decide on a possible extension of their platforms:

- Determine if there is a political willingness, legal foundation, and resources to act not only as a regulator but also as a trade facilitator through enhanced platforms.
- Follow/evaluate initiatives and standards of current business practices for cargo information exchange.
- Determine which type of commercial/operational data exchange could be covered by FA platforms without interfering with the private sector. The contracting and pricing of barge transport volume is out of scope, but once a transport contract has been confirmed, the documentation and subsequent operational process could be considered for data exchange over the FA platform.

A decision to enhance the platform(s) would obviously show many implications for system development, user authentication, access control, data security, etc.

6.2 Data exchange with seaport systems and relevant data standards

Details of data exchange between FA systems and seaport PCS would depend on individual research and agreement on which data content and data format the PCS/port authority is interested in. Assuming that the FA system will be the only system used by the barge, all communication to/from the PCS/port authority system will be channelled through the FA system.

Potential benefits are as follows:

- FA reports ETA and positions of barges that are approaching the PCS covered area, based on the ERI messaging received.
- FA reports barge planned destination terminal(s) in the seaport area covered by the PCS. If multiple terminals are called, the barge can indicate the preferred rotation sequence, but the PCS/port authority may decide on a different rotation.
- PCS reports back the required rotation and RTA for each terminal on the rotation list. So the barge can adjust speed according to the first RTA.
- If the ETA/destination terminal reporting to the PCS does not cover the reporting requirement to the respective port authority (for harbour dues, public waiting berth, etc.), the FA system may also communicate with respective port authority systems send all required barge data/voyage data.
- If the barge requests waiting for berth/shore power/other services these services may also be ordered through the FA system. The PCS or port authority system would report back confirmation and billing for requested services, visible for the barge on the FA system.
- Reporting requirements for cargo could be covered through the FA system, reporting to PCS/ port authority. The cargo details/voyage should already be known to the FA system. If not, the barge operator is prompted to enter any missing data for the respective port call.

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Data exchange standards help share structured data across different information systems. Fairway authorities can aim for a robust mix of technical and non-technical standards to ensure efficient electronic communication in the IWT.

Using the UN/EDIFACT (UNECE, 2022) standards, messages such as ERINOT, PAXLST, ERIRSP and BERMAN have been used in communication within IWT (International Standard for Electronic Ship Reporting in Inland Navigation, 2021). Further integration of systems used in IWT to systems used mostly in seaports such as NSW and PCS can be achieved using the same standard. Some of the UN/EDIFACT messages that can be considered for IWT are as follows (note some are already used by service providers for IWT):

1. Container pre-notification message or COPINO - A message by which an inland carrier notifies of the delivery or pick-up of containers (UN/EDIFACT Message COPINO, 2000)
2. Customs cargo report message or CUSCAR - This message permits the transfer of data from a carrier to a Customs administration for the purpose of meeting customs cargo reporting requirements (UN/EDIFACT Message CUSCAR, 2000).
3. Container discharge/loading order message or COPRAR - A message to order to the container terminal that the containers specified have to be discharged from a seagoing vessel or have to be loaded into a seagoing vessel (UN/EDIFACT Message COPRAR, 2000).
4. Instruction message or IFTMIN - A message from the party issuing an instruction regarding forwarding/transport services for a consignment under conditions agreed to by the party arranging the forwarding and/or transport services (UN/EDIFACT Message IFTMIN, 2000).

Furthermore, the IMO Compendium is a tool for software developers designing services and interfaces for IWT. By harmonizing the data elements required during a port call and by standardizing electronic messages, the IMO Compendium facilitates the exchange of information ship to shore and the interoperability of single windows, reducing the administrative burden for ships linked to formalities in ports (The IMO Compendium on Facilitation and Electronic Business, 2022). The IMO Compendium is maintained by the IMO Expert Group on Data Harmonisation (EGDH).

Another similar organisation driving standards forward is The Digital Container Shipping Association that has published technical and non-technical standards (Standards of DCSA, 2022) related to the just-in-time port call, track and trace, bill of lading etc. These standards could be a starting point for developing solutions for IWT.

6.3 Fall-back Scenario

Digitalisation in IWT will come with a set of risks that need to be addressed. The risks can cause mild to severe disruption in the services that keep the supply chain moving through IWT. There will be an increased dependency on digital systems for day-to-day operation in IWT. Therefore, the reliability and continuous availability of the services need to be considered in the technical design of the systems.

One of the main risks that can come with digitalisation is cyber security. Digitalisation will not be successful unless a state of the art cyber security measures and safeguards are ensured, which should accompany the further roll-out of multimodal e-communications (Position paper on e-Communication and Digitalisation in Logistics, 2021).

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Additionally, there are specific measures that can be taken to mitigate these risks. Below is a diagram that describes some crucial steps in three different scenarios to prevent or mitigate risk occurrence:

Before occurrence
1. Stress testing of systems
2. Risk assessment
3. Preparing a contingency plan involving stakeholders into the assessment and planning
4. Establish KPIs to monitor risks

During occurrence
4. Early communication of occurrence
5. Step by step implementation of contingency plan
6. Feedback cycles from affected stakeholders

After occurrence
1. Estimation of long-term effect of occurrence
2. Investing the root cause
3. Redesigning processes and infrastructure to avoid repetition

There are other risks of implementing digitalisation in IWT that have been listed below:

- One important aspect that needs to be considered is the integration with systems of seaports. In the perception of the logistics companies and barge terminals, seaport systems often offer only parts of the relevant barge processes. Therefore, it comes to different information levels on both sides and system disruptions which increase costs. To avoid this situation, larger involvement in the process design for barge operators is ideal. At first, an understanding of the process and the interdependencies is needed to create a common understanding and clear responsibilities.
- In practice, not every stakeholder feels equally benefitted from digitalised services. Prior to implementation, stakeholder-specific communication highlights the digitalisation initiative's benefits. The fairway authorities could play a key role in spreading the message that if the whole IWT industry benefits, then individual players will benefit too.
- An alternative approach could be starting small rather than big and trying to achieve it at too many locations simultaneously, covering all processes etc. With increasing digitalisation, it may become more and more difficult to find smaller independent environments.
- Fairway authorities have areas of jurisdiction, and their interests might be limited to focus on their area of jurisdiction. A political and supra-national legal basis needs to be reviewed and utilised before such limitation of interests affect the overarching vision of a digitalised future.
- It is assumed that the local system will be replaced by national or supra-national systems. Additionally, new digital systems were brought into use in IWT. This could create resistance to change from process participants. A change management plan will help to mitigate this issue.
- There might be ongoing parallel projects and initiatives for the digitalization of IWT. These might lead to non-harmonized processes and standards as outputs.
- Early collaboration and communication among these initiatives are necessary to avoid diverging results.
- Funding is not equally distributed across different areas of IWT. This could lead to varying speeds of adaptation to new digitalised services. Therefore, targeted funds allocation is needed to overcome financial barriers.
- Political will is essential for change on such a large scale. One of the best ways to acquire political will is by creating a business case that concludes apparent economic and environmental gain for the countries in question.

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7. Feedback from the business and reference groups on this topic

Various input and comments from discussions and interviews with stakeholders are included in this chapter. The content is not always structured but still presents valuable perspectives and experiences from different actors in the industry.

- Barge skippers are frequently using phone calls for information exchange and coordination of operations. This is easier and safer while steering but leaves no digital confirmation. The use of digital solutions for barges might consider voice recognition.

- Use of phone calls is also often preferred for personal reasons, e.g. maintaining a personal relationship between barge skippers and contacts at terminals, locks, cargo owners, etc.

- Changes towards more standardisation and digitalisation can be achieved by regulation and pressure due to competitive situations; some stakeholders see too many studies/initiatives and funding options without much progress.

- Sometimes barge operators are missing trust in data sharing and platforms; they try to avoid too much transparency, fearing a negative impact on contract/rate negotiations.

- Barge crews are interested in information about places where berthed (schools, events, culture, local authorities, church, sports, etc.), which is often covered by social media communities but could also be an enhancement potential for FA platforms.

- For cargo related data exchange, there are often little benefit in digitalization. Given the simplicity of some operation types in IWT (e.g. transportation of a single dry bulk lot managed directly by the cargo owner) there will be no advantage provided through digitalisation.

8. Conclusion

The study concludes that to increase attractiveness of IWT through digitalised information services in inland ports and terminals, the stakeholders should consider a few key areas of improvement. Firstly, information services that connect IWT to seaports is essential. Secondly, there is a need for harmonisation along the corridors in information-processes. Finally, the commercial players in IWT need to be engaged through services that facilitate their line of work, such as visibility and traceability of cargo being transported.

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To realise these key findings, the recommendations are as follows

- Continue working together with other fairway authorities towards more harmonisation in different aspects of IWT. Harmonized procedures along a corridor, data sharing and reducing repetitive obligations in each country/jurisdiction along the corridor will improve operational efficiency and attractiveness for the barge operator.
- Either seamless transfer or no switch from one user interface to another for skippers while crossing borders through the use of a single information platform (EuRIS) or harmonised national platforms with the same design and functionality.
- Information exchange/reporting forwarding between fairway authorities reduce redundant reporting for barge operators/skippers on border crossings.
- Review and develop API/interface standards to facilitate data exchange with
    - Local port authority systems/PCS platforms, forwarding barge voyage information
    - Navigation devices/onboard computers, software applications on barges, facilitate automated reporting, NtS distribution
    - Terminal operator systems receiving information on berth availability, operational data
- Agreements between fairway authorities and port authorities/PCS operators towards more integration and data sharing between their systems to reduce redundant reporting for barge operators/skippers. Offer single sign-on for multiple platforms. Develop a vision for future integration of fairway/port/PCS platforms with complete coverage of a corridor. Ideally there should be a common interface standard to exchange barge traffic data (based on ERINOT and future eFTI) between FA platform and seaport PCS.
- The common / consistent maintenance of master data and reference codes, e.g., for vessel identification European Hull Data Base (EHDB) or port/terminal/object coding (RIS Index), needs to be defined and organised. Develop fairway information platforms as a centrepiece for information sharing and data exchange on IWT as the main tool for barge operators/skippers.
- Develop fairway information platforms as a tool to facilitate exchange of information (load/discharge reporting and confirmation, freight document exchange etc.) among commercial platforms, considering blockchain technology as a mechanism for document security, reliable user administration, and data security. The FA platforms could be extended with a separate hub area for commercial data exchange; this system area may also be operated by a neutral user group entity including stakeholders and their associations. The FA are in a good position to facilitate the formation of a neutral exchange platform (similar as PCS organisations in seaports). Fairway authorities may take advantage to obtain statistical data.
- Make reliable AIS traffic data from fairway authority networks available to barge operators to allow traffic view in other areas than their actual position; establish a legal basis.
- Provide AIS coverage and ensure mobile internet coverage on all navigable inland waterways used for commercial transport of cargo.
- Provide visibility of the current traffic situation at locks/bridges and other important passage points. Forecast upcoming traffic, offer slot management and estimated passage time for the barge.

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- Support initiatives to establish digital cargo/freight documentation in IWT (eFTI, e-CMR), which would enhance fairway platforms functionally as a standard communication channel for cargo documentation.
- Evaluate current traffic management to determine improvement potential, if any, for traffic management, emergency response, and statistical data collection.
- Facilitate creating minimum standards for equipment (navigation, reporting) onboard to stimulate the digital interaction between the vessel, FA and cargo party.

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