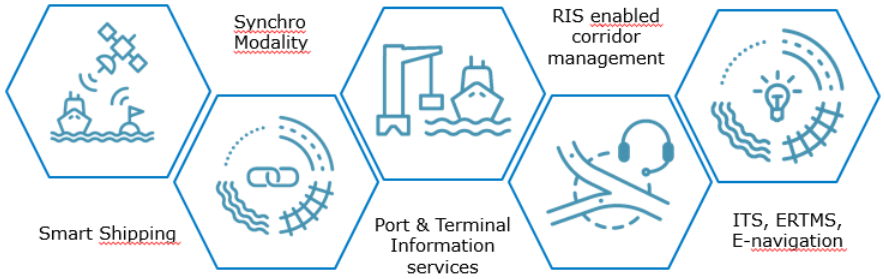
Business Developments on digitalisation in IWT



Masterplan DIWA project, results activity 2

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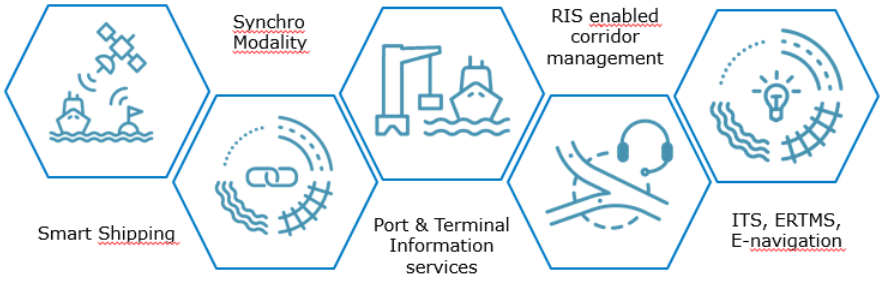
1 Executive summary

The business developments of the Masterplan DIWA project comprise 5 studies.



The 5 studies followed a similar approach by describing the current state of digitalization and the foreseen future state in the next decade(s).

In the upcoming decade it is envisioned that EuRIS will have established itself as the default digital information platform for IWT with respect to real-time and forecasted fairway-, infrastructure-, traffic and transport information, covering the entire European fairway network relevant for IWT (inland Waterway Transport). Harmonised digital services will have expanded to a service catalogue bringing IWT on a par with the other transport modes and supporting the modal shift towards IWT. Standardised service integration and data exchange with other modalities and logistic service providers will have reduced the administrative burden. Data provided once can be shared digitally with all relevant stakeholders in a secure and GDPR compliant way. Ports will be the digital connection nodes between modalities. Increased safety of navigation is reached by more sophisticated navigational information and the reduction of the administrative burden so vessel operators can focus on sailing. Although fully autonomous vessels are not expected to be a sizeable part of the inland fleet yet in 2032, highly automated vessels with reduced crew and/or remotely operated vessels will be a regular part of the inland waterway traffic.

The main findings for each study are:

- 2.1 Smart Shipping: Smart shipping is a relatively new business development for IWT. In addition to the required removal of the current legal obstacles, an increased demand for meta data, higher data quality and the need for new communication standards is foreseen.
- 2.2 Synchro modality: The use of synchromodal transport planning and operations by logistics services providers in Europe can be facilitated through a more intensive use of inland waterway data. With the deployment of EuRIS and expansion of the data services most of the needed data services to facilitate this will be in place. Effort is foreseen helping logistics service providers to recognize and use specific data services.
- 2.3 Port & terminal Information services: A lot of services are already digitized, The inland ports are the central hubs for synchro modal transport. So a strategy needs to be developed how to connect to (inland ports) and port community systems.
- 2.4 RIS enabled corridor management: With the deployment of EuRIS we are able to support IWT and we need to stimulate stakeholders to use the new data services and improve the services. More data services are foreseen that can optimize corridor management, electronic reporting and multimodal integration in the next decade.
- 2.5 ITS/ERTMS/E navigation: An in depth comparison of data services with the other modalities has been made, and the conclusion is that IWT has similar data services on a functional level. We found 7 data services that could be of interest for IWT. The governance of services in other modalities is also interesting for IWT.

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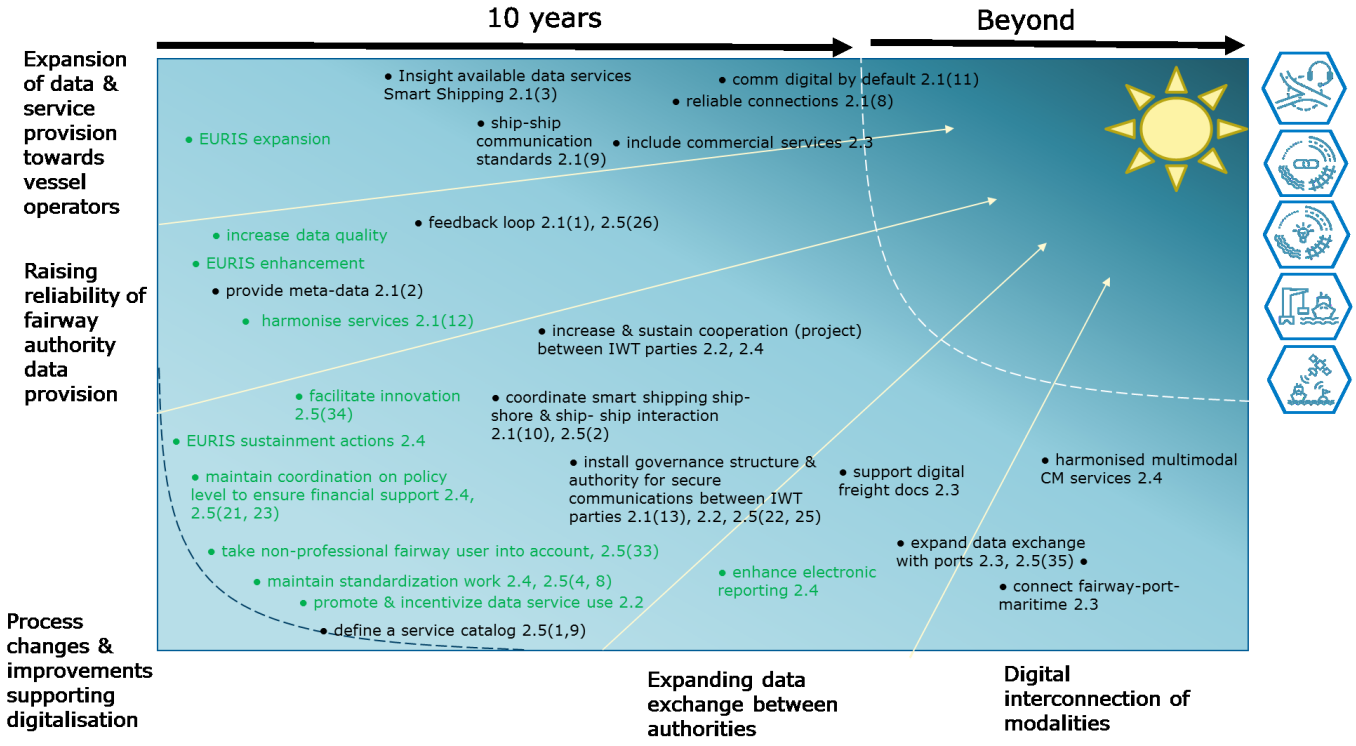
In general we can conclude that the fairway authorities are on track with the digital developments in IWT. Cooperation with stakeholders in the upcoming years to challenge the elaborated (new) data services is key to support the business values. This will lead to the development of new and better services for an IWT service catalogue. A number of recommendations for the roadmap are already identified, that can be categorized by:

1. Expansion of data & service provision towards vessel operators and logistic service providers
2. Raising reliability of fairway authority data provision
3. Expanding data exchange between authorities
4. Digital interconnection of modalities
5. Process changes & improvements supporting digitalisation

The recommendations are plotted in the following figure. The recommendations will be further elaborated in cooperation with stakeholders and within the other activities of the Masterplan DIWA project. In order not to "overload" the picture, some recommended actions have been summarized using a general encompassing term. Where applicable a reference to the sub-activity and action point is mentioned. Items in green signify an ongoing effort across the entire timeline.



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2 Introduction

Inland Waterway Transport (IWT) requires a digital transition of the business processes of stakeholders in IWT. The availability of digitalised Inland Waterways information is essential for the digital transition. The digitalisation of Inland Waterways will support the digital transition of business processes in IWT and will facilitate the IWT stakeholders with harmonised and standardised digital services and data on the European network level.

The result of the project "Masterplan Digitalisation Inland Waterways" or DIWA has to become an essential basis for the Digitalisation of Inland Waterways by the Fairway Authorities in the upcoming years and has the objective to lead to a digitalised Inland Waterway Network for those waterways under the responsibility of the participating fairway authorities.

This report on business developments and digitalisation in IWT includes:

- 5 attachments of individual reports on the themes: Smart Shipping, Synchro modality, Ports & terminals, RIS corridor management and a comparison with digital services in rail, road and the maritime domain
- An overview of relevant business developments on digitalization in relevant thematic areas.
- A description of the services, information processes and information requirements to support the digital transformation in IWT related to traffic, transport and logistics.
- Consequences for data and information needs

3 Work approach

Within Activity 2 the business developments in the Inland Waterborne Traffic and Transport domain have been described. We focused on the services, information processes and information requirements related to traffic, transport and logistics that were in a development phase. The consequences for data and information have been assessed.

In the Masterplan DIWA project the participants represent 5 countries and cover a large part of the TEN-T network (corridors): North Sea - Baltic, North Sea - Mediterranean, Rhine - Alpine and Rhine - Danube.
Also the Danube region has been taken into account in the study by interviews and accessing other European projects.

Activity 2 Business developments of the Masterplan DIWA projects consists of 5 relevant Sub Activities/themes.

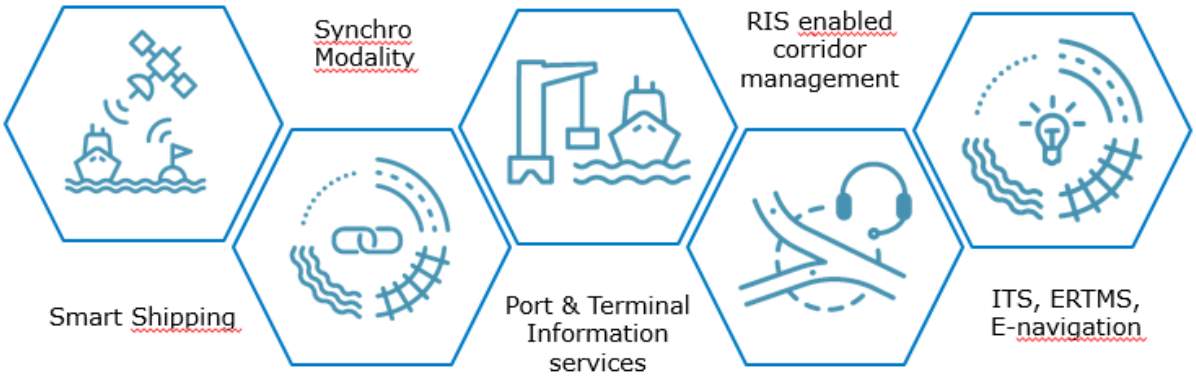

Figure: the 5 Sub Activities with Activity 2 business developments in the Masterplan DIWA project

These Sub Activities are managed by employees (or delegated expert consultants) of the participating countries. The Sub Activities (SuAcs) are manned by experts from the different countries to get the best possible overview. Also, external experts and business representatives have been involved.

For ordering all these digitalisation initiatives a maturity model was introduced (see figure 2). For each Sub Activity the current situation of digitalisation and level of digitalisation was described. Subsequently issues (blocking, obstructing, hindering) and opportunities/possibilities/challenges were investigated from a business perspective (i.e. things that block business benefits or interesting business possibilities/opportunities in the Sub Activity subject area). Next a description of topics and business developments foreseen in the upcoming years has been given. E.g. a description of the most optimal situation (long term) of the Sub Activity topic based on a greenfield situation.

For the resulting (digitalisation related) issues and opportunities it was described (in general) what needs to happen on technological (e.g. expand mobile internet coverage), organisational, operational, financial level and regarding facilitators in order to remove or mitigate an issue and/or capitalise on an opportunity which allows making the step to a next digitalisation level. Also considering any major regional factors. All these elements have been addressed in the Sub Activities to make similar and equal scenario's in the roadmap.

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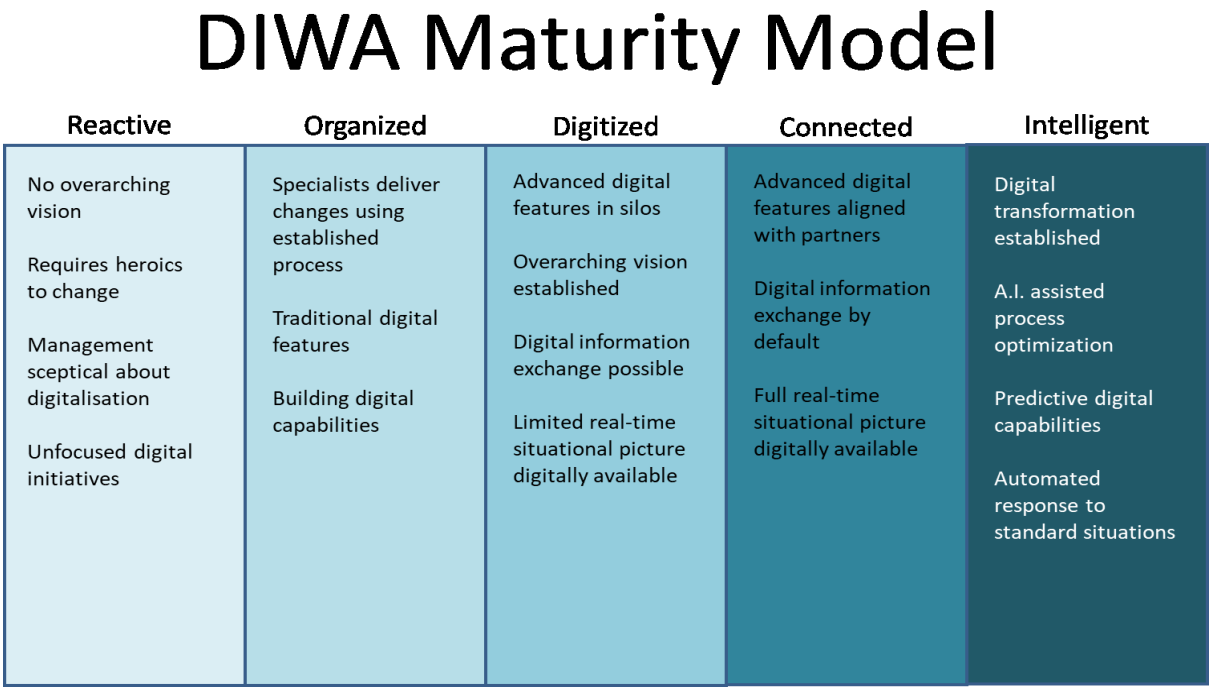


Figure: The DIWA digitalization maturity model

Technological developments (activity 3) and facilitation topics (activity 4) will follow a similar approach. First present an overview of the current (digitalisation related) state of things, discerning incremental innovation, new innovation and disruptive innovation, possibly addressing logistics and fairway & navigation separately as a sector. Finally all relevant information will be integrated in the Masterplan report (activity 5).

The described 3-step approach was carried out for each SuAc, as shown schematically in the figure below.

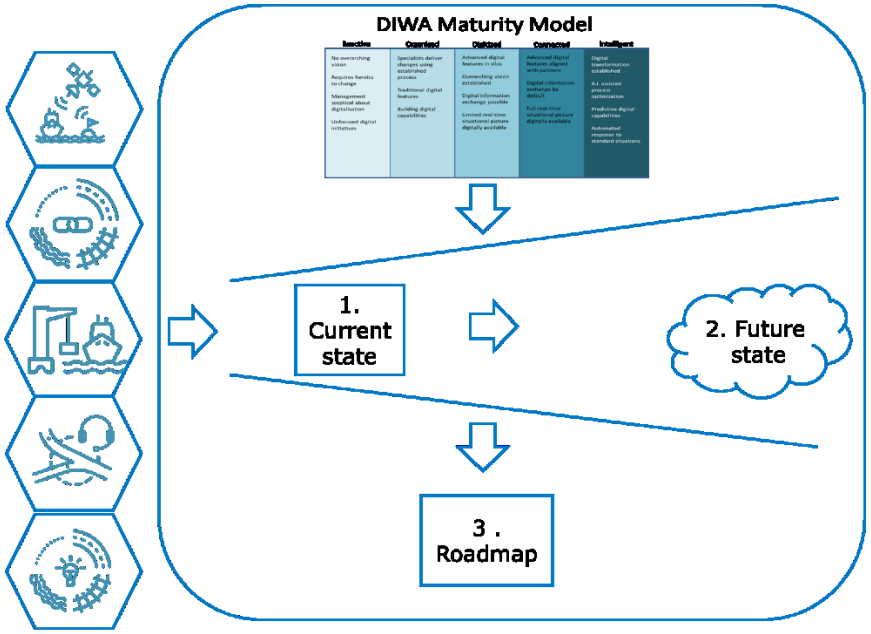


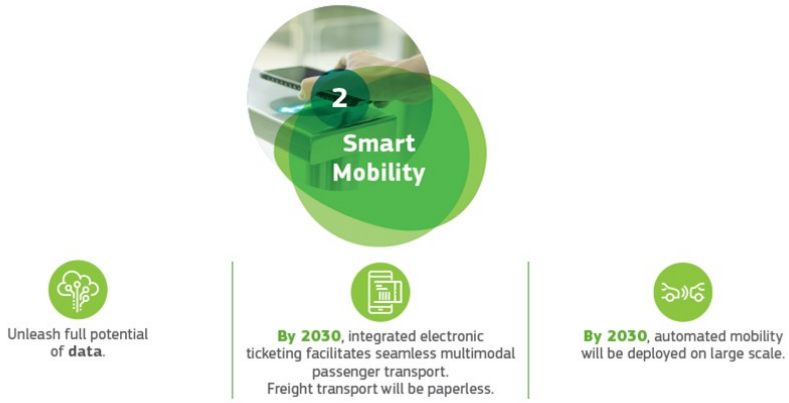
Figure: Work approach for all sub activities

The summary for each Sub Activity is described in chapter 4. The coherence and synthesis will be described in chapter 5-7 based on the output of the five Sub Activities. Also other relevant topics will be briefly taken into account that aren't covered in one of the five Sub Activities regarding

digitalization in IWT. For more information please read the individual reports as they contain a much more detailed description.

To gather input from the stakeholders we (together with the other European projects Platina 3, Masterplan DIWA, RIS COMEX and DIONYSUS) organized a very successful digital workshop (with over 100 participants) where we aimed to bring together a broad range of expertise and professional insights from shippers, skippers, barge owners and operators, logistics service providers and representatives of ports and terminal operators. The input has been reflected in the reports from each individual Sub Activity. Apart from the workshop several interviews with experts in the field have been conducted within the several Sub Activities to gather input and feedback from stakeholders.

EU policy documents, like the Green Deal data spaces are not described in itself as 'business developments' although they are highly relevant for shaping the future of digitalisation in IWT. For example the Green deal states about Smart Mobility:



And about the modal shift, sustainability (and synchro modality):

Obviously the digital transformation of IWT and the foreseen future state of IWT (Chapter 6) should support these objectives. The policy documents have been used as input for several sub activities within the Masterplan DIWA project and will be input for activity 3 and 4 of the project.

There are a number of EU projects regarding digitalization that more or less run in parallel with the Masterplan DIWA project, like the Novimove, Dionysus and Platina 3 projects. Relevant output of these projects will be incorporated.

Last but not least CESNI, DTLF (e.g. eFTI), DINA work will been taking into account, as do a lot of work regarding the digital transformation of IWT and to foster interconnection and data exchange into the multimodal logistic chain.

These initiatives will be incorporated into activity 5, the actual and final Masterplan for digitalization of Inland Waterways.

4 Summary of the five Sub Activities of the business developments studies

4.1 Business developments Sub Activity Smart Shipping

Sub activity 2.1. focused on smart shipping developments: all relevant developments regarding the development of highly automated ships. The study assessed the current status of the development in the five participating countries and elaborated on the challenges that current developments encounter. The possible value of these developments is described for businesses but also for society. Based on these findings, the needed requirements are generally described in relation to the role that fairway authorities can play in the further development and maturing of smart shipping into an operational environment.

Key findings
The maturity level of smart shipping developments in the logistic sector is quite low. Systems that are used in an operational environment are in most countries limited to navigational support for the skipper on board. The first remote controlled operation exist but the usage is mainly limited to Flanders.

Research showed that value of smart shipping for business and society exists by supporting policy goals regarding sustainability goals, safety and the seamless integration of inland shipping in a connected (synchromodal) transport system, therefore smart shipping systems could improve the competitiveness of the sector, attract more business and therefore create business value.

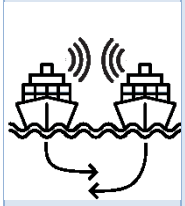
Uncertainty on future use of systems in an operational environment, limited knowledge on the business value and limited investment capabilities prevent a steady adaptation.

Challenges
The current challenges regarding the implementation of smart shipping systems in an operational environment centre around a few topics, such as: legislation, connectivity, availability of data and information, standardisation and harmonisation of information services across corridors.

To describe requirements towards the future, a model is made based on the ideas of Connected and Automated Driving on the road (CAD). This model uses three tracks: basic automation, connectivity and coordination.

The summary of the recommendations of this model can be found in the table below

Topic	Conclusion	Functional requirement
Basic automation 	With the increase in automation on board of the ship, the need for external data and information to created redundancy and allow for safe navigation will grow.	1. Increase the quality of the data by investing in quality of existing data instead of a focus on sharing new types of data. A solution might be to build a digital twin of the waterway with the possibility for users to add or suggested changes.
	In the near future, the need for new data or information might be less than getting insight in the quality and availability of the data that is present for the whole European inland waterway network.	2. Need for more clarity on the quality (meta data) of existing data. This allows users to verify on critical functional parameters.

		3. Need for insight in the levels of support for automated navigation (ISAD). Give automated systems and their operator's guidance on the "readiness" of the waterway network for (further) automation.
	Without the necessary legal framework, developments are hard to implement safely in an operational environment.	4. Need for a legal framework that allows for navigation with less crew.
		5. Need for non-ambiguous digitalised traffic rules to allow for safe navigation (especially in mix traffic situations).
		6. Need for a clear demarcation where navigation with smart shipping systems is allowed and under which circumstances. Create parameters and apply them on the waterway. The operational envelops concept may be used.
		7. Need for more clarity of responsibilities and liability issues in case of an accident when using smart shipping systems.
Connectivity 	Connections between users and the infrastructure will increase. Connections ill grow to make sure that the safety on the waterway can stay as it is today with a mix of automated and less automated ships.	8. Need for reliable connection on the waterway – especially on critical sections.
	There should be a common language to communicate between ships and ships and shore with attention for cyber security and privacy.	9. Need for agreement of a common language to share information between users (like C-ITS) on the road following the work of CESNI.
		10. Need for a governance structure that allows for safe (cyber secure) communication and making sure that all privacy aspects taken care of (like Ishare).
Coordination 	A cooperative network where ships (and VTS) is connected and share intentions is seen as possibility to reduce complexity and allows for a safe (and easier) implementation of smart shipping	11. Need for increase in system to system communication – sharing data not by voice but with digital messages.
		12. Need for harmonized data.
		13. Need for coordination on the way in which a cooperative network should work.

More information, the full report and the list of recommendations and conclusions can be found in the Su Ac 2.1 Business development Smart Shipping report.

4.2 Business developments sub activity Synchro Modality

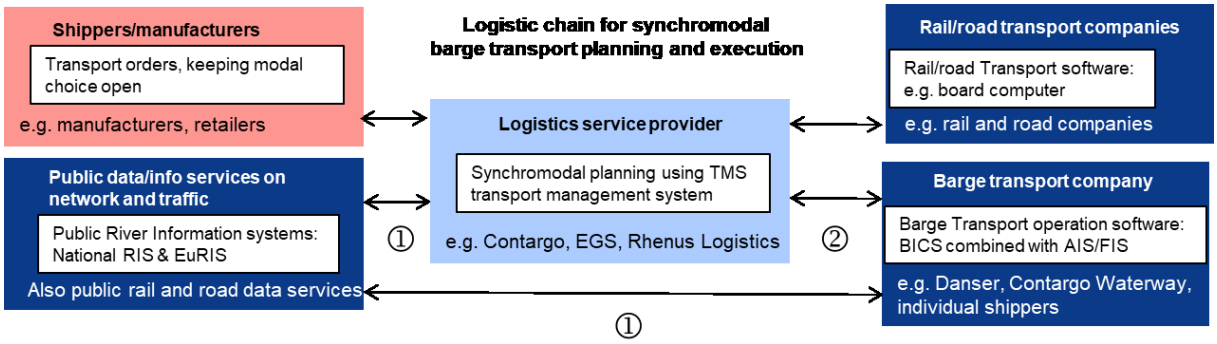
The objective of Sub-Activity 2.2 Synchro Modality is to describe the recent, current and possible future business developments for Synchro modality.

The study concerned the following steps:

1. Overview of current use of synchro modal transport services in each of the five countries, including a description of the modal split and government policy and overview of investments and opportunities for increased IWT in Europe.
2. Inventory of opportunities for inland waterway authorities to support synchro modal transport through digitalisation including an overview of differences in offered digital services for inland waterway transport per country
3. The study concluded with conclusions, recommendations for improved and harmonized use of digital services to support synchro modal transport in the five participating countries and as input for the roadmap.

To gain input one workshop for public and private representatives mixed and two only with member state representatives were organised. Also about 10 bilateral interviews have taken place divided between public and private stakeholders.

The major data and information exchanges between public and private parties to facilitate synchromodal planning are summarized in the figure below. The logistics service provider has a central position, because this company performs the synchromodal planning. The figure also mentions the major data and information elements that are reported incomplete or missing by logistics service providers.



①

Mentioned as missing by logistics service providers in data exchange between public and private	
Static infra	maintenance of locks
Static infra	height of bridges
Static infra	availability of shore power
Dynamic infra	daily lock planning
Dynamic infra	current & future water levels
Dynamic infra	availability of overnight berths
Dynamic infra	availability of berths in ports

②

Mentioned as missing by logistics service providers in data exchange between private parties	
Static infra	qualification of personnel
Static infra	capacity of barge
Dynanic infra	availability of personnel barge
Dynamic infra	availability of barge
Dynamic infra	Amount of weight 3rd row containers
Dynamic traffic	Postponed ETA at deep sea terminal
Dynamic traffic	Postponed ETA at inland terminal

Figure 4: data exchange in the logistic chain for synchro modal barge transport and planning

The necessary data can for a part be provided through inland waterway data information services from fairway authorities, like the national RIS and EuRIS. By advancing the digitalization of information in inland waterway transport, the opportunity to implement synchromodal planning can increase. However, the analysis has shown that sometimes specific inland waterway data can be provided but is not yet used by logistics service providers. In both cases, specific European companies, such as frontrunners among barge operators and logistics service providers, can have a leading role in using data information services to increase the use of freight transport by inland waterways or rail. The opportunities when data is already available is clear: through a marketing

campaign the logistics service providers will have to be informed that required data is already available and could be used.

In addition, ambitions for improvement are given to reach higher levels of maturity for digitalisation and synchromodal transport. This includes higher transparency on key performance indicators for mode choice as prices or costs, reliability of travel times and sustainability. This can fill the potential for modal shift for IWT.

More information, the full report and the list of recommendations and conclusions can be found in the substantive Sub Activity report: Masterplan DIWA Su Ac 2.2: Opportunities to support synchro modal developments in Europe.

4.3 Business developments Sub Activity Port and Terminal Information Service

Sub activity 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 contribute to improve their data services with the ultimate aim of increasing the attractiveness of IWT over other modalities.

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.

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

Summary of recommendations
The following summarises the recommendations for fairway authorities to improve information services in port and terminals:

- 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.
- 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.

More information, the full report and the list of recommendations and conclusions can be found in the substantive sub activity report: Masterplan DIWA sub activity 2.3: Port and Terminal Information Service.

4.4 Business developments sub activity RIS enabled corridor management

SuAc 2.4 focused on business developments in the field of RIS enabled Corridor Management and identified actions for the further development of RIS and grouped them into short-term, medium-term and long-term category along with potential benefits, risks and requirements. The results of the study are concluded in a roadmap proposing specific measures and timing to realise the identified actions. These actions will contribute to the ultimate aim of increasing the attractiveness of IWT over other modalities by fostering digitalisation within IWT and to enable multimodal service integration in the future. River Information Services are contributing to digitisation and digitalisation within IWT per se, so any further development and improvement of RIS, including ES-RIS (European Standard for River Information Services) and the work of CESNI/TI, on which the majority of the proposed actions are focusing, is considered as contribution to digitisation and digitalisation within IWT.

Starting point: RIS in Europe are developed approximately since the turn of the millennium and are regulated within the RIS Directive since 2005. Whereas the developments focused on national RIS infrastructure, it became more and more clear that harmonised services on international level need to be provided in order to achieve the potential benefits of RIS. Therefore, within the project CoRISMa the concept for RIS enabled Corridor Management was developed. This was taken up by the project RIS COMEX where considerable progress was made in the realisation of harmonised RIS services on Corridor and even on European level by implementing the common systems EuRIS and CEERIS.

The following main business requirements, to which RIS can potentially contribute, are identified:

- Increase accessibility to relevant fairway-, infrastructure-, traffic- and transport-info
- Reduce administrative barriers and reporting burdens
- Optimise waiting times at infrastructures (locks/bridges)
- Protect the environment coupled with economic benefits
- Integrate RIS into a multimodal transport architecture
- Providing RIS data to logistics platforms (business sensitive services)

Based on practical experiences and feedback from the stakeholders, numerous actions for the further development of RIS Corridor Management were identified, described and grouped.

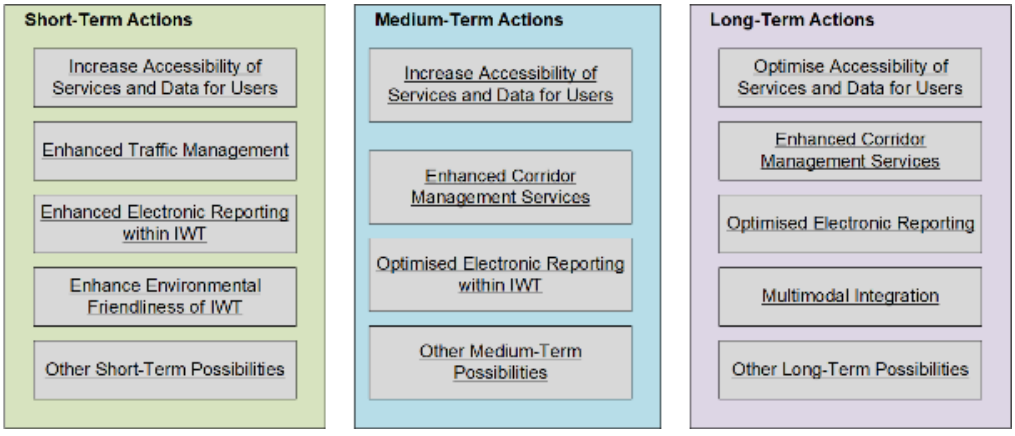


Figure 1: Categories of short-, medium- and long-term actions

Main result of the SuAc 2.4 Report is certainly the Roadmap for the realisation of the proposed actions. The actual and future setup of RIS Corridor Management related activities within the upcoming years is visualised within the following figure and put in relation to the timeline for the identified short-term, medium-term and long-term actions:

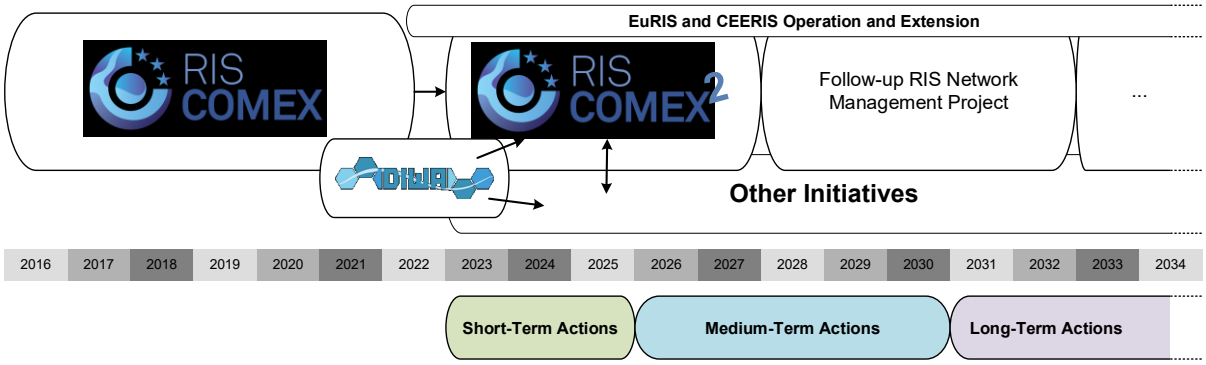


Figure 2: Roadmap for RIS enabled Corridor Management and proposed actions

This approach shall be accompanied by specific continuous measures for ongoing control and coordination:

- Maintain and communicate the big picture of RIS Corridor Management (overview of systems and services, open issues and gaps, planned future developments, etc) in order to optimise coordination and cooperation among related organisations and initiatives as well as for planning of future projects and initiatives
- Keep close contact with the users and stakeholders of RIS Corridor Management
- Monitor the identified and potential future benefits towards their realisation and set appropriate measures
- Keep an eye on the identified and potential future risks and challenges, set preventive actions and draft reactive measures for those risks
- Continuously maintain the identified and future requirements to further develop RIS Corridor Management and to reach the envisioned benefits and initiate appropriate actions to tackle them
- Maintain coordination on the level of policy makers in order to ensure financial support for the further harmonised development and operation of River Information in Europe.

4.5 Business developments Sub Activity ITS, ERTMS and E-Navigation

The objective of SuAc 2.5 is to describe the business developments regarding road (i.a. ITS), rail (i.a. ERTMS) and Maritime (i.a. e-Navigation), with focus on the services, information processes and information requirements related to IWT and the related consequences for data and information needs.

The study was conducted in three steps:
Step 1: A study was done on ITS, ERTMS and e-Navigation and the consequences were assessed for the digital transition for IWT in the period 2022-2032. This inventory was made based on the PIANC (Permanent International Association of Navigation Congresses) table and extended with the RIS COMEX (RIS Corridor Management Execution) inventory tables. The combination of these two tables forms the backbone of the inventory table used for the report. It describes the services and information offered to the users of a transport modality, called functions.

Step 2: The integral and harmonized service, information and data requirements were defined related to the digital transition of Inland Waterways for each "development".

Step 3: A study was conducted on the ITS, ERTMS and e-Navigation inventory, resulting in conclusions and recommendations on the (shared) use of services, systems, applications and technologies in the different modalities. The content of the report is mainly based on recent studies and publicly available documentation regarding the different transport modes and gathered in several workshops with member state representatives.

For the different transport modes researched, the ambitions and principles are quite similar to each other. Therefore, the services deployed under these digitalisation initiatives can be easily applied across the different modes.

The inventory compiled during the research and clarified in the report, has been made as generic as possible. This promotes the synchromodal idea.

This inventory clarifies whether a particular service provides static, slow moving or fast moving data. Based on this column, it is possible to start selecting technologies to implement these services. Another characteristic that is given is whether it is pre or after trip information for a particular service. This is again descriptive information to clarify the service.

Overall, it is possible to conclude that, apart from the gaps found in the gap analysis, the current inventory is extended with services and concepts inspired by other transport mode, synchro modality and finally by the implementation of EuRIS within the RIS COMEX project.

More information, the full report and the list of recommendations and conclusions can be found in the substantive Sub Activity report: Masterplan DIWA Sub-Activity 2.5: ITS, ERTMS, e-Navigation.

5 Overall conclusions of the current situation and level of digitalisation for the study business developments

In the following table the conclusions of the 5 Sub Activities have been merged into one coherent overview regarding the current state of business developments and digitalisation. For more detailed and extensive information see the individual Sub Activity reports.

The table consist of 4 Columns:

1. Number
2. Conclusion/findings
3. For which stakeholder group is it relevant
   - FA Fairway authority
   - LSP Logistic Service Provider
   - V0/B0 Vessel operator/barge owner
   - IP/SP Inland/Seaport
4. Reference to Sub Activity:
   - 2.1 Smart Shipping
   - 2.2 Synchro modality
   - 2.3 Ports and terminal information services
   - 2.4 RIS enabled corridor management
   - 2.5 ITS, ERTMS, e-Navigation

Although there has been made a distinction in column 3 for different stakeholders groups, the individual conclusion and findings show that all stakeholders groups are involved in each conclusion/finding. Therefore generally speaking a successful digital transformation means involving all the stakeholders. This includes taking into account the different level of digitalisation and the willingness and capability towards digitalisation of the concerned IWT stakeholders (e.g. vessel operators, port and terminal operators, authorities)

Number	Conclusion/findings	For which stakeholder group	Reference to Sub Activity
1	Digitalisation can help provide insight in the current and near future traffic conditions on the fairway and provide transit operations with accurate ETA's to optimise transit times. The majority of IWT is bulk transport (less suitability for synchro modal operations than container transport), however bulk transport has a large impact on the overall traffic situation, so digitalisation of all inland waterway transport is relevant.	FA, LSP, V0/B0, IP/SP	2.2, 2.4, 2.5
2	Synchro modality/multimodality means LSP need to have information to be able to decide to choose a particular modality or combination for freight transport. These decisions are based on cost, transit time, reliability, flexibility[1]. With digitalisation transit time and reliability (of ETA) of IWT can be enhanced. This includes higher transparency on key performance indicators for all modes and mode choices.	FA, LSP, V0/B0, IP/SP	2.2, 2.3 2.4
3	The EuRIS platform has the potential to establish itself as the single information hub for IWT. Both for vessel operators and logistic service providers. The accuracy and reliability of the services depends for a substantial part on the willingness of vessel operators and logistic service	FA, LSP, V0/B0, IP/SP	2.1, 2.2, 2.3 2.4, 2.5

[1] Mode choice in freight transport research report 2022; International Transport Forum

	providers to share their data and information in addition to the different fairway authorities. The EuRIS platform facilitates the business by: • Increasing accessibility to relevant fairway-, infrastructure-, traffic- and transport-info • Reducing administrative barriers and reporting burdens (also part of electronic reporting systems) • Optimising waiting times at infrastructures (locks/bridges) • Protecting the environment coupled with economic benefits • Integrating RIS into a multimodal transport architecture • Providing RIS data to other platforms (business sensitive services)		
4	EuRIS can cover, to a certain extent, the IWT part in a synchro modal architecture, to be interconnected and data to be exchanged with the pendants of the other transport modes, although not all EuRIS services are fully implemented for all waterways. By advancing the digitalization of information in inland waterway transport, the opportunity to implement synchromodal planning can increase. However, the analysis has shown that sometimes specific inland waterway data can be provided but is not yet used by logistics service providers. In both cases, specific European companies, such as frontrunners among barge operators and logistics service providers, can have a leading role in using data information services to increase the use of freight transport by inland waterways or rail.	FA, LSP, VO/BO, IP/SP	2.2, 2.4 2.5
5	Data sharing platforms is a development in all modalities with comparable services although road is mainly serviced by the automotive industry. Most services accessed in the other modalities seem already covered by IWT (EuRIS) and the navigational processes were found to be mature and digitised in IWT. 7 possible useful additional services employed in other modalities have been identified for IWT: 1. Easy feedback on discrepancies between provided data and real-life situation 2. Provide path offer & path request 3. Provide Re-routing 4. Provide pro-active alerts 5. Provide overview of affected vehicles 6. Communication with affected vehicles 7. Easy feedback on discrepancies between provided data traffic information and the real-life updates or even initiate the abnormal state. Digital developments in other modalities also contain valuable lessons learned for IWT, like standardisation and governance (taking into account existing bodies like CESNI)	FA, LSP, VO/BO, IP/SP	2.3, 2.5
6	Developments within modalities typically focus on the modality itself with limited attention for cross modal data exchange. For the different transport modes researched, the ambitions and principles and data services are quite similar to each other. Therefore, the services deployed under these	FA, LSP, VO/BO, IP/SP	2.2, 2.5

	digitalisation initiatives should be easily applied across the different modes on a functional level.		
7	Ports/terminals (both sea and inland) are the connecting nodes between the modalities (maritime, rail, road and IWT) and are logical candidates to be (become) also digital connecting nodes. Integration of inland ports with the port and cargo community of the larger hybrid ports is still at a nascent stage.	FA, LSP, VO/BO, IP/SP	2.3
9	Digitalisation currently often takes the form of not integrated point solutions (e.g. apps for each port, authority, terminal, etc.) requiring separate accounts/passwords thus increasing the workload for the vessel operator in the wheelhouse, while reduction is actually one of the main aims of digitalisation and also increases the safety as more focus on sailing is possible.	FA, LSP, VO/BO, IP/SP	2.2, 2.3, 2.4
10	Especially regarding reporting obligations towards authorities sharing data already provided with other authorities will further reduce administrative burden (don't ask again, what you've already been told). Information exchange/reporting forwarding between fairway authorities reduce redundant reporting for barge operators/skippers on border crossings.	FA, LSP, VO/BO, IP/SP	2.1, 2.3
11	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	FA, LSP, VO/BO, IP/SP	2.1, 2.2, 2.3, 2.4
12	The common / consistent maintenance of master data (e.g. vessel identification number) and reference codes (e.g. port/terminal/object coding, RIS Index), needs to be defined and organised, as we need an up to date, full coverage of the network of harmonized data set with EU wide organisational agreements on quality	FA, LSP, VO/BO, IP/SP	2.3, 2.4
13	There is a clear need to make reliable AIS traffic data from fairway authority networks available to barge operators to allow traffic view in other areas than their actual position. Launching the EuRIS platform provides a legal basis to do so.	FA, LSP, VO/BO, IP/SP	2.3
14	Research showed that value of smart shipping for business and society exists by supporting policy goals regarding sustainability goals, safety and the seamless integration of inland shipping in a connected (synchromodal) transport system. For businesses smart shipping systems could improve the competitiveness of the sector, attract more business and therefore create business value. Uncertainty on future use of systems in an operational environment, limited knowledge on the business value and limited investment capabilities prevent a steady adaptation.	FA, LSP, VO/BO, IP/SP	2.1

15	The current challenges regarding the implementation of smart shipping systems in an operational environment centre around a few topics, such as: legislation, connectivity, availability or data and information and standardisation and harmonisation of information services across corridors.	FA, LSP, VO/BO, IP/SP	2.1

There are a number of digitization topics that haven't fully been addressed in the individual sub activities although they are relevant for the fairway authorities.

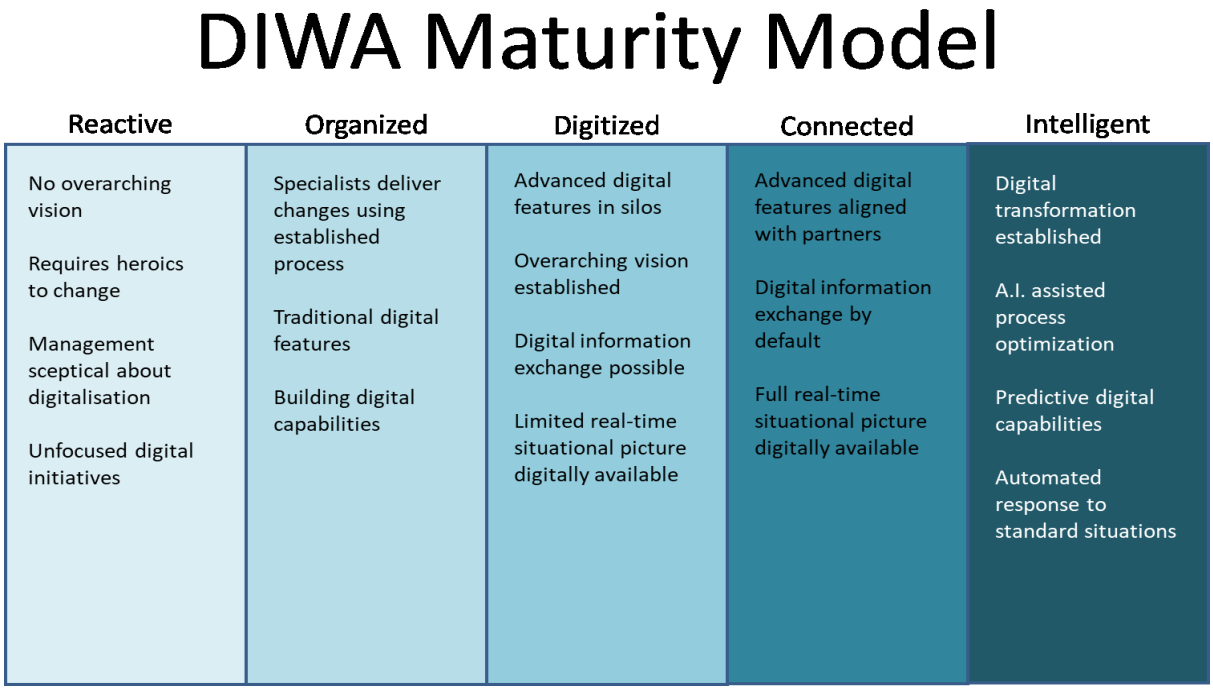
16	Statistics and registration of inland shipping incidents aren't relevant for real time traffic management or logistics. However a EU wide harmonized registration of shipping incidents or near misses (like a specific definition is needed for acurate monitoring) would be very valuable for the digital transformation of IWT, specifically for safe navigation. Statistics are necessary to monitor traffic and transport flows and change of flows and the modal split. A combination with the evolution of the fleet, e.g. to monitor sustainability is very important. The registration of shipping accidents and statistics is mostly covered on a national level, however would probably benefit from an EU wide approach.	FA	

6 Future state of digitalisation in IWT

Within the DIWA sub-activities of activity 2 a description was made of the most optimal situation (long term) of the sub activity topic, based on existing studies, policy and business interviews. To limit the scope somewhat a timeline of approximately 10 years was used for the designation "long term". Taking a greenfield perspective (lacking the constraints of today) was encouraged.

6.1 Where do we want to be in 10 years?

The results of the DIWA activity 2 sub-activities show a drive to reach the maturity level "connected" within 10 years including in some cases even maturity level "intelligent".



DIWA Maturity Model; Source: DIWA project

In the upcoming decade it is envisioned that EuRIS will have established itself as the default digital information platform/data space for IWT with respect to real-time and forecasted fairway-, infrastructure-, traffic and transport information, covering the entire European fairway network relevant for IWT [2.2, 2.3, 2.4]. Harmonised digital services will have expanded to a service catalogue bringing IWT on a par with the other transport modes and supports the modal shift towards IWT[2.4, 2.5].

By then EuRIS will fit into a common framework for multi modal data sharing, anchored in EU policy, that brings the transport modes together and accelerates cooperation with other relevant sectors across Europe. A competent and sufficiently mandated coordinating body will use this framework as the guiding instrument for all future digital initiatives related to transport [2.5].

Standardised service integration and data exchange with other modalities and logistic service providers will have reduced the administrative burden for vessel operators and logistic service providers. Data provided once can be shared digitally with all relevant stakeholders in a secure and GDPR compliant way [2.2, 2.3, 2.4]. Ports will be the digital connection nodes between modalities [2.3].

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Increased safety of navigation is reached by more sophisticated navigational information and the reduction of the administrative burden so vessel operators can focus on sailing [2.4]

Thus, reaching the “connected” and “intelligent” level will have enabled the transition to synchro modality on a technical level, supported by policy measures [2.2, 2.4, 2.5]

Although fully autonomous vessels are not expected to be a sizeable part of the inland fleet yet in 2032, highly automated vessels with reduced crew and/or remotely operated vessels will be a regular part of the inland waterway traffic. The legal and regulatory basis for this level of automation will be established for the entire EU region. Vessels and infrastructure will be able to coordinate their intentions digitally via standardised interfaces moving towards cooperative self-organised traffic management [2.1, 2.2, 2.3, 2.4]. Fairway Authorities will be able to facilitate a mixed fleet, from traditional operated ships, remotely controlled ships to fully autonomous ships [2.1, 2.4]

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7 Roadmap

7.1 Introduction

Investigation of the current opportunities, obstacles and state of the topics within the DIWA Activity 2 Sub Activities, combined with the envisioned developments and future state in 2032 has resulted in a collection of recommendations and topics to be addressed by DIWA Activities 3, 4 and 5.

The overall and integrated roadmap, including the recommendations and actions from DIWA Activity 2, 3 and 4 will be drafted in DIWA Activity 5. This chapter will group the recommendations into categories and provide a first assessment of the expected timeline.

7.2 Grouping recommendations

Recommendations and proposed actions in different DIWA 2 sub-activities often contribute to similar (business) goals or benefits. Therefore the following categories are proposed for grouping recommendations and actions:

1. Expansion of data & service provision towards vessel operators and other logistics stakeholders
   (i.e. recommendations from 2.1, 2.2, 2.3, 2.4 and 2.5 regarding extra data & services for vessel operators including service portfolio)

2. Raising reliability of fairway authority data provision
   (i.e. recommendations from 2.1, 2.2, 2.3, 2.4 and 2.5 regarding quality of data & services e.g. ETA forecasts)

3. Expanding data exchange between authorities
   (i.e. recommendations from 2.2, 2.3, 2.4 and 2.5 regarding report only once issues)

4. Digital interconnection of modalities
   (i.e. recommendations from 2.2, 2.3 and 2.5 regarding data exchange with Logistic service providers)

5. Process changes & improvements supporting digitalisation
   (i.e. activities aimed at fostering adoption of new services, cooperation, user support)

The recommendations have been categorised in the following table. Some recommendations may occur multiple times (different origin or applicable to multiple categories).

Category	Recommendation	Origin
Expansion of data & service provision towards vessel operators and logistic service providers		
	Need for insight in the levels of support for automated navigation (ISAD). Give automated systems and their operator's guidance on the "readiness" of the waterway network for (further) automation.	2.1 (3)[2]
	Need for reliable connection on the waterway – especially on critical sections	2.1 (8)
	Need for agreement of a common language to share information between users (like C-ITS) on the road following the work of CESNI.	2.1 (9)
	Need for increase in system to system communication – sharing data not by voice but with digital messages.	2.1 (11)
	Facilitating use of EuRIS and other IT data Information services for planning of international barge transport	2.2
	Include all IWT waterways of Europe into international data information services (e.g. EuRIS)	2.2
	Facilitate sharing real time information into European inland waterway data information services	2.2
	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	2.3
	Provide AIS coverage and ensure mobile internet coverage on all navigable inland waterways used for commercial transport of cargo	2.3
	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	2.3
	Increase accessibility of services and data for users of EuRIS	2.4
	Enhanced traffic management	2.4
	Enhanced electronic reporting within IWT	2.4
	Enhanced corridor management services	2.4
	Elaborate on a translation service between Inland and Maritime reporting systems e.g. automated exchange of ETD/RTA information.	2.5 (rec 7)
	Process automatic alerts in case of incident or man over board.	2.5 (rec 20)

[2] E.g. Meaning the third recommendation from sub activity 2.1. See the individual report for more details.

	Extend the geographical coverage of EuRIS with all waterways suitable for commercial IWT i.e. beyond corridors. (	2.5 (rec 24)
	For voyage and cargo information, extend current information catalogue with a service to provide path offer & path request.	2.5 (rec 27)
	For voyage and cargo related information, extend current information catalogue with a service to provide re-routing (pre-arranged paths and reserve capacity in case of temporary capacity restrictions).	2.5 (rec 28)
	For traffic related information, extend current information catalogue with a service to provide pro-active alerts.	2.5 (rec 29)
	For traffic related information, extend current information catalogue with a service to provide overview of affected vehicles.	2.5 (rec 30)
	For traffic related information, extend current information catalogue with a service to communicate with affected vehicles.	2.5 (rec 31)
	For traffic related information, extend current information catalogue with a service to provide easy feedback on discrepancies between provided data traffic information and the real-life updates or even initiate the abnormal state.	2.5 (rec 32)
	Introduce pilotage services for autonomous vessels. For instance, to provide assistance at locks/berths that are not yet fully compatible with fully autonomous vessels.	2.5 (rec 36)
	Introduce tug services for autonomous vessels e.g. through an extended LockAcces message.. For instance, to provide assistance at locks/berths that are not yet fully compatible with fully autonomous vessels. This would however require a standardized physical interface between the tugs and the autonomous vessels.	2.5 (rec 37)
	Provide a service to make tidal projections available that are based on astronomical tide.	2.5 (rec 37)
Raising reliability of fairway authority data provision		
	Increase the quality of the data by investing in quality of existing data instead of a focus on sharing new types of data. A solution might be to build a digital twin of the waterway with the possibility for users to add or suggested changes.	2.1 (1)
	Need for more clarity on the quality (meta data) of existing data. This allows users to verify on critical functional parameters.	2.1 (2)
	Need for harmonised data	2.1 (12)
	Enhanced traffic management by providing relevant information to the traffic managers	2.4
	Enhanced electronic reporting within IWT by interconnecting existing electronic reporting systems to foster “reporting only once with single entering of data”	2.4
	Enhanced corridor management services considering the needs and requirements of the users	2.4

	Enhance predictability of IWT by means of reliable voyage calculations based on actual and accurate data (and potentially also based on predicted information)	2.4
	Check the physical transport composition (length, depth, cargo, convoy,…) whether this corresponds with the digital transport composition.	2.5 (rec 18)
	For network and infrastructure information, extend the current information catalogue with a service to give easy feedback on discrepancies between provided data and real-life situation.	2.5 (rec 26)
Expanding data exchange between authorities		
	Enhanced electronic reporting within IWT	2.3, 2.4
	Invest in facilitating data information exchange for optimal barge handling in seaports	2.2
	Involve the ports and port terminals to increase the number of berths covered in operational systems.	2.5 (rec 35)
	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	2.3
Digital interconnection of modalities		
	Invest in facilitating data information exchange for optimal barge handling in seaports	2.2
	Provide tools for inland data information services with other modalities	2.2
	Develop a vision for future integration of fairway/port/PCS platforms with complete coverage of a corridor including connecting to the 'Maritime Connective platform'	2.3
	Multimodal integration of information systems and services to foster synchro modal data exchange	2.4
	Harmonised multimodal CM services to extend the scope of services beyond the limits of a specific transport mode	2.4
	Involve the ports and port terminals to increase the number of berths covered in operational systems.	2.5 (rec 35)
Process changes & improvements supporting digitalisation		
	Need for a governance structure that allows for safe (cyber secure) communication and making sure that all privacy aspects taken care of (like e.g. iSHARE).	2.1 (10)
	Need for coordination on the way in which a cooperative network should work.	2.1 (13)
	Provide data information to support set up of digital contractual relations between IWT parties	2.2
	Provide incentives for especially SME barge skippers to use data information services	2.2
	Analyse and optimise data exchange between public/private IWT organisations	2.2
	Make the use of IWT competitive compared through road trough CO2 charges	2.2

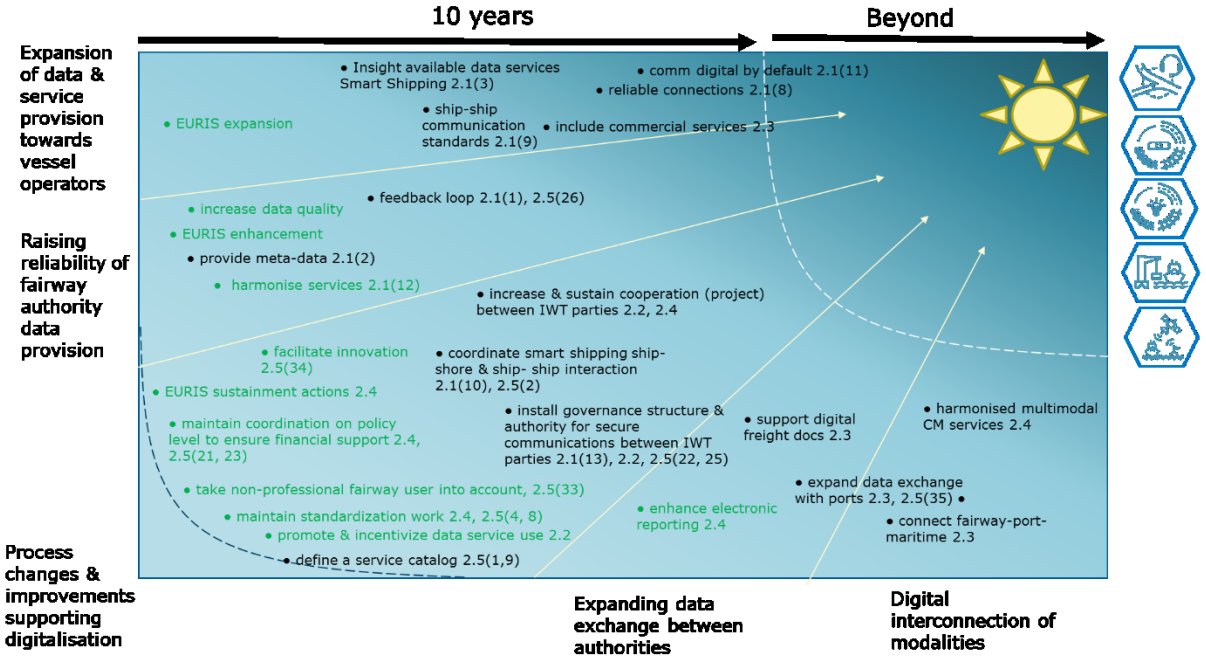
	operational start and sustainable operation of the EuRIS and CEERIS systems	2.4
	Identify and document open issues and priority developments to be realised for EuRIS and CEERIS after the end of RIS COMEX	2.4
	Submit a project application for a follow-up project of RIS COMEX into the 2nd CEF2 Call in order to ensure financial support for the further development of RIS Corridor Management	2.4
	Besides the fact that RIS COMEX and its planned follow-up project(s) will play a major role in the further development of RIS Corridor Management, it is obvious that there are specific issues identified which do not fall under the responsibility of the fairway authorities providing the related RIS Corridor services. Therefore, it will be important to specifically identify open issues, actions, potential developments, etc. which would have to be realised by other organisations and initiatives and to share the findings with responsible parties and initiate the necessary actions	2.4
	Identify relevant other initiatives and ensure appropriate cooperation and coordination in order to utilise synergies in the further development of RIS Corridor Management and to maximise the benefits for the stakeholders	2.4
	Continue international harmonised cooperation, ideally in common projects	2.4
	Maintain and communicate the big picture of RIS Corridor Management (overview of systems and services, open issues and gaps, planned future developments, etc) in order to optimise coordination and cooperation among related organisations and initiatives as well as for planning of future projects and initiatives	2.4
	Keep close contact with the users and stakeholders of RIS Corridor Management	2.4
	Monitor the identified and potential future benefits towards their realisation and set appropriate measures	2.4
	Keep an eye on the identified and potential future risks and challenges, set preventive actions and draft reactive measures for those risks	2.4
	Continuously maintain the identified and future requirements to further develop RIS Corridor Management and to reach the envisioned benefits and initiate appropriate actions to tackle them	2.4
	Maintain coordination on the level of policy makers in order to ensure financial support for the further harmonised development and operation of River Information in Europe	2.4
	Making the same mistake as in the RIS Directive evaluation should be avoided by defining and monitoring the KPI's, including the right causality	2.5
	Take the operational services in PIANC extended with the services of RIS COMEX as the baseline for a service catalogue.	2.5 (rec 1)

	Define communication profiles for the different operational and technical services.	2.5 (rec 2)
	Investigate the potential of the digital twin of a vessel as explained in the Universal Hydrographic Data Model (S-100) opened by the IHO.	2.5 (rec 4)
	Develop a service catalogue on Activity 2 level to fulfil the requirements, defined within the different Sub-Activities, to cover all the business developments in IWT.	2.5 (rec 9)
	Start the testing and development phase for S-401 (the IWT counterpart/extension of S-101).	2.5 (rec 8)
	Keep supporting the worldwide approach of River Information Services within the global official organisations.	2.5 (rec 21)
	Install a governance body to guard harmonisation and developments in the field of automated vessels i.a. the hard infrastructure.	2.5 (rec 22)
	Keep supporting DTLF with insights from IWT in the framework of synchromodal transport.	2.5 (rec 23)
	Install a system authority or equal governance at EU level to guard harmonisation and developments in the field of operational services and systems e.g. ERA in ERTMS, IMO in e-Navigation. In case of legal obligations proper enforcement is necessary.	2.5 (rec 25)
	Take into account the non-professional users for a smooth traffic management.	2.5 (rec 33)
	Facilitate developments from innovative companies (with a level playing field) which create value for IWT.	2.5 (rec 34)

In addition to the above categories, recommendations and actions to be addressed within the DIWA activities 3, 4, 5 and 6 were identified. These are collected in a separate document for use by the (sub) activity leaders.

7.3 Timeline

A first assessment of the recommended actions have indicated a place on the timeline according to their estimated urgency/complexity. In order not to "overload" the picture, some recommended actions have been summarised using a general encompassing term. Where applicable a reference to the sub-activity and action point is mentioned. Items in **green** signify an ongoing effort across the entire timeline.



8 Appendices/Annex

Report Business developments Sub Activity 2.1 Smart Shipping, project team DIWA
Report Business developments Sub Activity 2.2 Synchro modality, project team DIWA
Report Business developments Sub Activity 2.3 Port and terminal information services, project team DIWA
Report Business developments Sub Activity 2.4 RIS enabled corridor management, project team DIWA
Report Business developments Sub Activity 2.5 ITS, ERTMS, E-Navigation, project team DIWA

Masterplan DIWA content and framework document 2.0, Project team DIWA, 10-02-2021