DIWA Report

Sub-Activity 2.2. Synchro-Modality

Opportunities to support synchromodal developments in Europe

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Management Summary

This Management Summary provides an overview of the results and conclusions of the research for the DIWA project Sub-Activity 2.2 Synchro Modality. The objective of this Sub-Activity 2.2 was to *describe the recent, current and possible future business developments regarding Synchromodality (see also Paragraph 1.3 for more details on Synchromodality) in five European countries with a focus on:*

- *The synchromodal transport services, including the information processes and requirements related to inland waterway [1]transport, freight transport (rail and road) and logistics, which are currently in a development phase.*
- *The consequences of the increasing use of synchromodal transport services for the data and information needs of private and public stakeholders in inland waterway transport*.

Logistics service providers in Europe want to identify the most suitable inland transport mode for their clients (e.g. manufacturers, retailers, wholesalers) in all situations. Road transport is often the default transport mode, because road transport is easy to plan and execute. But over longer distances, both rail and inland waterway transport are often cheaper and more sustainable than road transport. Synchromodal planning can provide a solution, because in this case the logistics service provider can plan the use of all three transport modes next to each other for suitable transport orders of clients. However, logistics services providers can have trouble to implement synchromodal planning of inland waterway transport because they need information on the status of inland waterway transport infrastructure and real time traffic. This was not always readily available in the past, and the DIWA project wants to provide opportunities for logistics service providers to obtain data on inland waterway infrastructure and traffic in a structured way. The DIWA project focuses on the situation in five EU countries: Austria, Belgium, France, Germany and the Netherlands.

The logistics service provider needs to receive and exchange data with several public and private parties in the supply chain to be able to achieve synchromodal planning. In this Deliverable, the focus is on the current and future opportunities for these logistics service providers to obtain this information. The fairway authorities in each of the five countries play a major role as a data provider, while these fairway authorities also cooperate to provide integrated inland waterway data and information on an European level.

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] Note: In this Deliverable, inland waterway transport and barge transport are used as two interchangeable terms, having the same meaning.

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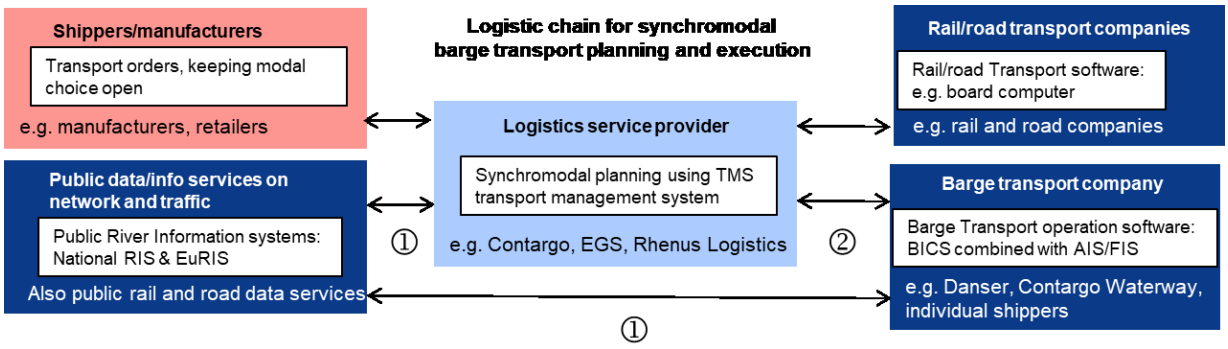
Figure S.1 Examples of data exchange needed for synchromodal transport planning and execution in inland transport



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

The public authorities in the five European countries involved (The Netherlands, Belgium, France, Germany and Austria) have all a national RIS (River Information Services) as a digital IT information service available which can supply data needed to do optimal synchromodal planning. Next to these national RIS digital IT services, a pan-European EuRIS digital IT service has been developed to provide integrated European inland waterway data. Also other inland waterway information services are available in these countries, like e.g. the IT data information services of seaports.

In this report, an analysis has been made how the data from especially the national and European RIS digital IT-information services can be used by logistics service providers to improve synchromodal planning. Based on these potential improvements, the ambitions for a European roadmap for facilitating synchromodal transport has been developed. These ambitions focus on the development of the inland waterways data exchange services on a national and European level (the RIS, other national IT information services like Connekt2Shore and BlueWave, and the European EuRIS), and the possible connections with other inland waterway data services. The roadmap ambition for the years up to 2030 on a European level is presented in the European roadmap ambitions in the figure below. These ambitions for the roadmap is divided in two parts:

- The upper part of figure S.2 below shows the actions required from the public authorities to facilitate the use of digital data information services in inland waterway transport .
- The lower part of the roadmap ambitions figure presents the current and future required focus of the fairway authorities to facilitate an extended and smooth digital exchange of data and information between companies and fairway authorities involved in inland waterway transport.

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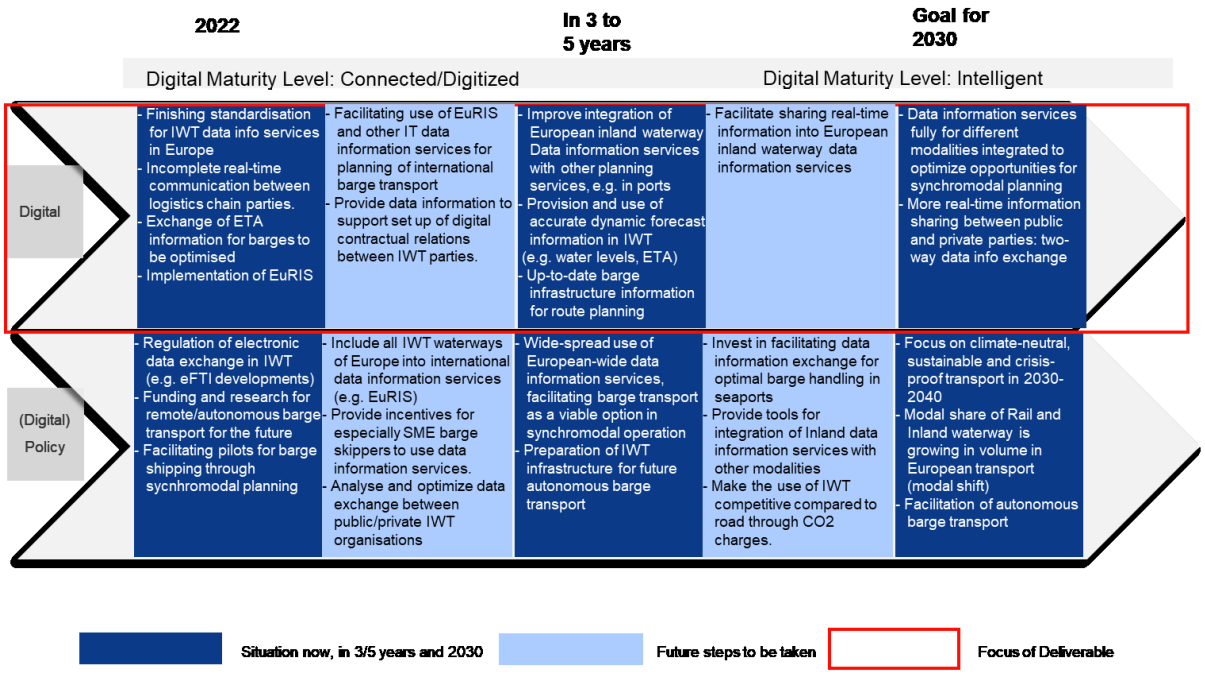
Figure S.2 Roadmap ambitions for further development of the inland waterways public data information services exchange[2]



The figure above shows that 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. When more Europe-wide data about inland waterway infrastructure and traffic is available, inland waterway transport can be planned in the same way as road and rail transport by a service provider although good knowledge and capabilities are needed to plan transport intermodal. As inland waterway transport is generally speaking the cheapest transport mode in regions where rivers and canals are available, the expectation is that the use of inland waterway transport will grow in volume.

The necessary data can partly be provided through inland waterway data information services from fairway authorities, like the national inland waterway data information services and the European EuRIS. By improving the digitalization of information in inland waterway transport, the opportunity for logistics service providers to implement synchromodal planning will increase. However, the analysis above has shown that also specific inland waterway data is sometimes already provided but is not yet used by logistics service providers. In both cases, European frontrunners among barge operators and logistics service providers can play a leading role in using all available inland waterway information services to increase the use of freight transport by inland waterways. This can be done through two scenarios:

1. the base scenario: public authorities will supply the inland waterway data information services to private companies, it is up to them to use the data elements provided.
2. the growth scenario: public authorities will act more pro-actively: they will not only supply the waterway data information services, but also actively market this service

[2] At the moment of publishing the report the impact of the FTI regulation was not fully clear

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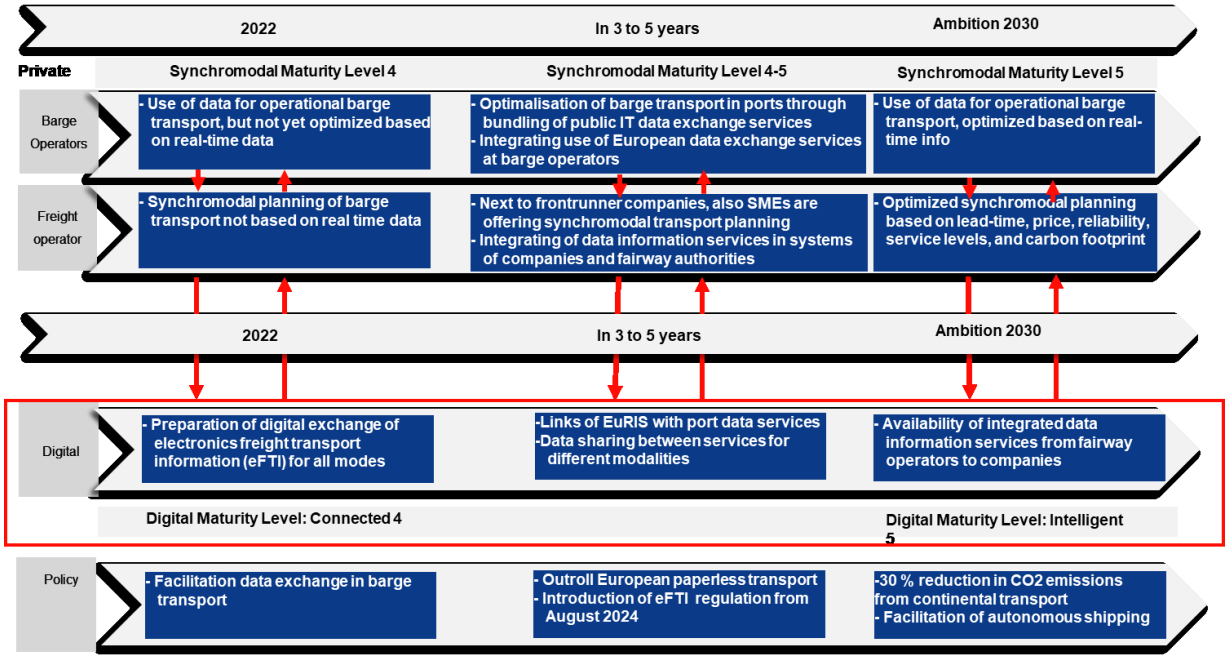
among the target group of private companies. This target group consists of larger companies as well as SMEs (Small and Medium sized Enterprises). Public authorities can even adopt the policy to reward private companies who extensively use available inland waterway data information services with specific treatment in reserving overnight berth spaces, etc. In this growth scenario

In the road map figure below, the opportunities for logistics services providers and barge operators to use public inland waterway data information services to reach maturity in synchromodal planning and operations in the growth scenario (2) are shown. This roadmap shows the possible future development of synchromodal planning at logistics service providers up to 2030, and the role that national and European data services from fairway and other authorities can play. The future development is expressed in the maturity level in synchromodal planning. Next to this growth scenario (2), the fairway authorities can also choose to follow the basic scenario (1) and have a slower pace in the developments, so that the results mentioned will be realized later, in 2035 or even 2040 instead of 2030. More details on the maturity level in synchromodal planning and operations can be found in paragraph 4.1 of this Deliverable.

Figure S.3 European roadmap for growth in synchromodal maturity at logistics service providers



The following 3 research questions have been addressed in the research:

Question 1: What are the vulnerabilities in the inland waterway network and services, and where can digital communication help to find solutions to these vulnerabilities? What are opportunities for digital functionalities and communication from public authorities to private parties?

The vulnerabilities are in fact that the logistics service providers report that they have insufficient data available to set up reliable synchromodal planning. The most important data elements that are only partly available are mentioned in the figure below. This can be solved in two ways: (1) developing the capabilities of the national RIS and European EuRIS to provide more specific data on these issues, according to the roadmaps presented, and (2) helping logistics service providers to recognize specific data elements that are already available through the data information services.

Figure S.4 Missing or partly available data elements for synchromodal planning of inland waterway transport in Europe

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

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

Question 2: Which synchromodal services can grow in the next ten years in the five countries, and how can the waterway management authorities contribute?

Especially inland waterway container transport has the most synchromodal growth potential in the next ten years. Almost all inland waterway container transport in the European Union is in and between the five selected countries. Germany is by far the country with the highest volume of long distance road freight in containers that has modal shift potential, followed by France.

Table S.1 Modal shift potential of long-distance road freight in containers – tonne, in 2019

Country	x1,000 tonnes of long-distance road freight in containers that have modal shift potential	Percentage of total road transport of containers
Austria	0,344	2.4%
Belgium	3,007	12.5%
France	8,811	18.5%
Germany	36,115	8.0%
Netherlands	3,180	3.2%
Other EU-28 countries	39,942	8.2%

Source: Eurostat 2021 (Modal_shift_potential_of_long-distance_road_transport_of_containers,_2017-2019_(thousand_tonnes).png (681×740) (europa.eu))

Austria has limited opportunities to shift more road container cargo to inland waterway freight transport, but this is due to the fact that maritime containers are seldom used in Austria. For

Austria, other road cargo not transported in containers could be transported by inland waterway if the business case for inland waterway services would be positive.

Question 3: What can be improved as it comes to digital services in logistics hubs where modalities interconnect? How can waterway management authorities cooperate transnationally to improve synchromodal opportunities?

The improvements can come in two ways, depending on the fact whether data elements are already available in the data services on fairway authorities:

(1) When data is not yet available: developing the capabilities of the national RIS and European EuRIS to provide more specific data on these issues, according to the roadmaps presented, and
(2) When data is already available: helping logistics service providers to recognize specific data elements that are already available through the data information services

The possible future opportunities to help logistics service providers when data is not yet available is already shown in figure S.2: Roadmap ambitions for further development of digitalization of inland waterway public data exchange services. These further developments are focused on:

- Facilitating the interoperability of the national RIS and EuRIS with other public inland waterway data services, like the data information services of sea ports. Connekt4e. The fairway authorities and port authorities have to cooperate in every involved country to make progress, so that for example data is connected about overnight berths and shore power in both seaports and inland waterways. The first cooperation steps have already been made in the COMEX-RIS and DIWA projects, and can be developed further in the coming years.
- The interoperability with other national IT information platform services in inland waterway transport like Connekt2Shore for berth and shore power reservations and BlueWave for inland shipping with reduced waiting times during the trip.
- The interoperability with information services from private companies, like the deep sea terminals. The combination of data elements from selected public and private sources can help logistics service providers to further optimize synchromodal planning. In this way, the current delays in handling inland waterway container ships in Northwestern European could be lessened.

The opportunities when data is already available are clear. In this case, a pro-active marketing campaign can help to inform the logistics service providers that the data they require to plan synchromodal transports is already partly available and could be used.

Chapter 1 Objective of the project

1.1 Background and objective of the project

Inland-waterway transport (IWT) plays a substantial role in the transportation of goods in European countries with waterway infrastructure. The use of inland waterway transport can offer several benefits: large volumes can be transported in one trip, it can be safer and more environmentally friendly than road transport, and the use of inland waterway transport can free up road and rail infrastructure capacity for goods transport. Inland waterway transport also results in less CO2 emissions per ton of product moved compared to road transport, so increased use of inland waterway transport will contribute to the 'Fit for 55' program initiative of the European Commission.

The objective of the European DIWA project is *to facilitate the increased use of inland waterway transport in Europe by further digitization of communication between private and public parties.* The ambition is to further integrate the use of the modality inland waterway transport with barges into Europe's logistics TEN-T transport network. In the DIWA project, public and private partners from The Netherlands, Belgium, France, Germany and Austria are participating to reach the objective of the project. The project is focusing on improving the use of IT-technologies and information services (in a broad scope) for more efficient digital communication between the public and private parties in the inland waterway transport in these five countries, and thus facilitating the setup and use of synchromodal transport.

According to the report 'Digital Inland Waterway Area. Towards a Digital Inland Waterway Area and Digital Multimodal Nodes' (TNO, October 2017), *Synchromodality* is the efficient and sustainable strategic, tactic and operational planning of shipments and transport operations. In practice, this is done by a logistics service provider, which is using different transport modes next to each other in a flexible way. The logistics service providers works together with barge, road and/or rail operators to offer synchromodal services to the clients. "Synchromodal transport is based on real-time availability of logistics services, operational transport data (e.g., the location of trucks or barges and their available capacities) and operational data on infrastructure (e.g., expected delays)." By sharing this data digitally in the transport chain, private stakeholders can optimize their transport operations and make more sustainable choices."

In the same report, the potential risk of a reduced competitiveness of Inland waterway transport is mentioned. The explanation for this risk of reduced competitiveness is as follows. Shippers and logistics service providers use synchromodal planning concepts in practice. This implies continuously choosing the right modality and transport service based on actual logistics needs, service availability, cost-, time- and (in some cases) environmental

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constraints – taking into account real-time conditions of the infrastructure (e.g., delays). Inland waterway transport can only be part of such synchromodal planning concepts if barge[3] operators are able and willing to share the required data for such concepts with other private and public operators.

The DIWA project focuses on facilitating inland waterway services in Europe, now and in the future. "Within the context of *Digital by Default*, the data exchange for an efficient and effective synchromodal approach should be facilitated." The optimal use of inland shipping requires recent and detailed information on the availability of the waterway infrastructure and planning of the most efficient use of the waterway infrastructure. A necessary condition is that standard (information) interfaces within the various transport modes road, rail and inland waterway are put in place and their interoperability across modes is assured.

1.2 Description of sub-task 2.2 in DIWA project

The Sub-Activity 2.2 *Synchro Modality* is part of Activity 2 *Business Developments* of the DIWA project Work Plan. The objective of this Sub-Activity 2.2 Synchro Modality is to *describe the recent, current and possible future business developments regarding Synchromodality in five European countries with a focus on:*

- *The synchromodal transport services, including the information processes and requirements related to inland waterway traffic, transport and logistics, which are currently in a development phase.*
- *The consequences of the increasing use of synchromodal transport services for the data and information needs of private and public stakeholders in inland waterway transport*.

Logistics service provider in Europe want to find the most suitable inland transport mode for their clients (e.g. manufacturers, retailers, wholesalers) in all situations. Road transport is often the default transport mode, because road transport is easy to plan and execute. When looking at transports over longer distances, both rail and inland waterway transport are often cheaper and more sustainable than road transport. Synchromodal planning can provide a solution, because in this case the logistics service provider can plan the use of all three transport modes next to each other for suitable transport orders of clients. However, logistics services providers can have trouble to do synchromodale planning of inland waterway transport because they need information on inland waterway transport infrastructure and traffic, This was not always readily available in the past, and the DIWA project wants to provide opportunities for logistics service providers to obtain data on inland waterway infrastructure and traffic in a structured way. The DIWA project focuses on the situation in five EU countries: Austria, Belgium, France, Germany and the Netherlands.

[3] Note: In this Deliverable, inland waterway transport and barge transport are used as two interchangeable terms, having the same meaning.

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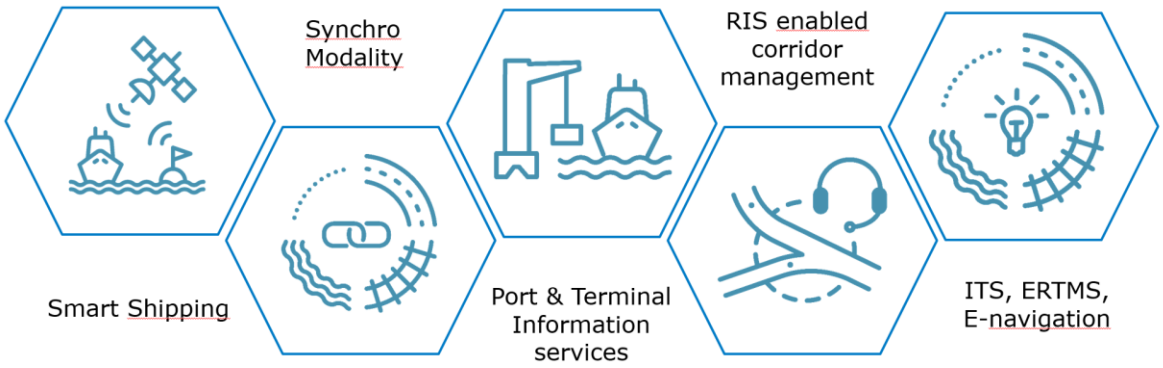
The logistics service provider need to receive and exchange data with several public and private parties in the logistics chain to be able to achieve synchromodal planning. In this Deliverable, the focus is on the current and future opportunities for these logistics service providers to obtain this information. The fairway authorities in each of the five countries plays a major role as a data provider, while the fairway authorities also cooperate to provide integrated inland waterway data and information on an European level.

In Activity 2 Business Developments of the DIWA project, five separate sub-tasks are identified. The other four sub-tasks next to 2.2 Synchro Modality are:

2.1 Smart shipping: The objective is to describe the business developments regarding Smart Shipping with a focus on the services, information processes and information requirements related to traffic, transport and logistics that are in a development phase. The consequences of these activities for data and information needs has been mapped.
2.3 Port and Terminal information service: The objective of this Sub Activity is to describe the business developments regarding port and terminal Information Systems with a focus on The services, information processes and information requirements related to traffic, transport and logistics that are in a development phase. The consequences of these activities for data and information needs has been mapped.
2.4 RIS enabled corridor management: The objective of this Sub Activity is to describe the business developments regarding RIS enabled Corridor Management, with focus on: The services, information processes and information requirements related to traffic, transport and logistics that are in a development phase. The consequences of these activities for data and information needs has been mapped.
2.5 ITS, ERTMS, E-navigation: The objective of this Sub Activity is to describe the business developments regarding ITS, ERTMS, e-Nav, with focus on: The services, information processes and information requirements related to traffic, transport and logistics that are in development phase and are relevant to IWT The consequences of these activities for data and information needs has been mapped.

The figure below gives an overview of these sub-tasks in DIWA Activity 2 Business Developments.

Figure 1.1 Five Sub-tasks within DIWA Activity 2 Business Developments



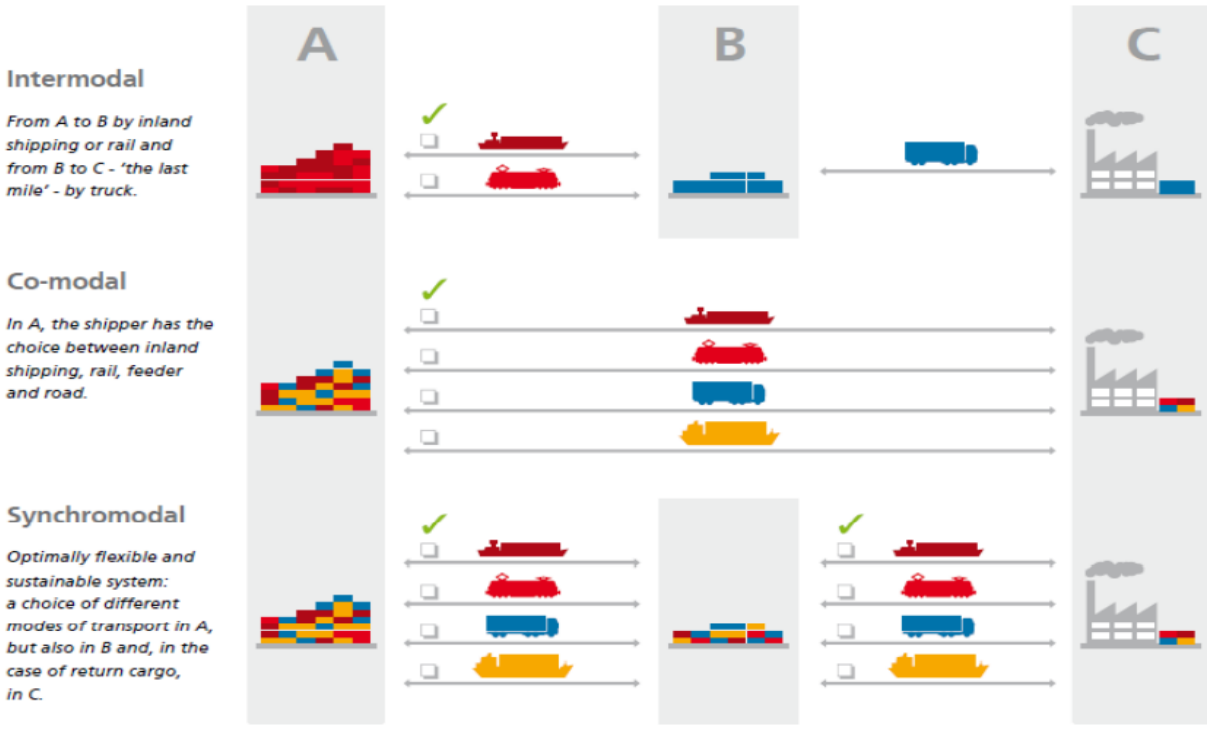
For the research in this sub-task there has been regular contact with the project leader of these sub-activities, and concept results have been exchanged in order to help each other to reach the objectives of the sub tasks.

1.3 Synchromodal transport characteristics

In Europe, we have intermodal and co-modal transport, in which barge and rail transport is used as a main mode of transport from A to B:

- Intermodal transport concerns the transport of unitized loads (often containers or continental loading unit) from A to B, using rail or barge transport for the major part of the distance. Often, the pre- and/or final transport is done by road. Private companies have set up a network of intermodal barge and rail services in Europe, which is available for use by their clients
- Co-modal transport concerns the transport of loads from A to B using only one transport mode, selected from a number of possibilities. Often these loads are bulk transports.

Figure 1.2 Transportation concepts: intermodal, co-modal and synchromodal

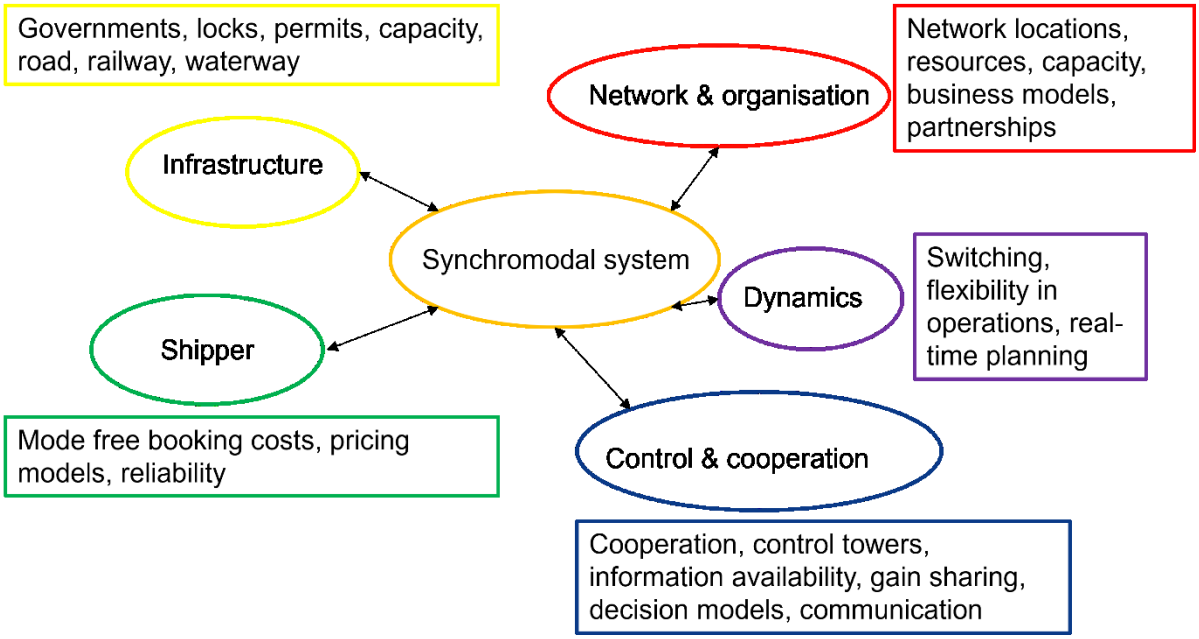


Source : European Container terminal, 2011

In practice, the volume of intermodal transport services in Europe is growing at a slow rate, while the logistics sustainability ambition of the European Commission and the Member States for the next 10 years is substantial, as indicated among others in the Fit for 55 programme. Therefore, the concept of synchromodal transport has been developed in order to increase the growth in the use of barge and rail transport in Europe, and achieve a modal shift. The figure below shows the concept of synchromodality compared to other multi-modal transportation concepts. In the end, synchromodality is a concept that has evolved and different definitions have been given in the past years. Eventually, it leads to the increased combined use of intermodal transport, using a more proactive approach and promoting freight transportation in a sustainable way.

According to Behdani, Fan, Wiegmans, & Zuidwijk (2014) synchromodal transport planning is an integrated view of planning and use of different transport modes to provide flexibility in handling transport demand from clients. They further state that this is a general agreement on what the concept of synchromodal transport planning encompasses. Another definition that is used in Van Riessen, Negenborn, Dekker, & Lodewijks (2013) for synchromodality is that synchromodal transport is intermodal planning with the possibility of real-time switching between the different transport modes. The focus lies on real-time decisions concerning the transport modes. Aspects concerning synchromodality are free mode choice, sustainability, costs, and quality. Sustainability can be expressed in, for example, the reduction of carbon dioxide emissions. Quality can be measured in several ways, for example, throughput time or service level agreements (Vinke, 2016). The figure below shows the characteristics of freight transportation for an optimal synchromodal system, that can provide robustness in offering to utilize different transport modes when there is a calamity in the use of transport infrastructure. E.g. when due to adverse winter weather road transport can not be used, inland waterway transport can be a substitute because the necessary data is available to plan and execute inland waterway operations.

Figure 1.3 Characteristics of a robust synchromodal transport planning and operation system



Source: BCI, edited and based on the MoS way, 2017

For each of the characteristics in the figure above, the key components are described. The components that are part of the characteristics can be described as part of portal systems, data (providing and sharing), starting partnerships, or investing in infrastructure. Eventually, for optimal use of the network and capacity, all five characteristics must be (partially) met. The table below shows some of the responsible stakeholder(s) for each characteristic.

Table 1.1 Five main characteristics of synchromodal transport

The five characteristics of synchromodal transport	Components	Involved parties and their tasks:
Infrastructure	Governments	Public parties: Supply, maintenance, renovations, expansions of the infrastructure. Providing permits, grants, regulations, and laws
	Locks	
	Permits	
	Capacity	
	Road-infrastructure	
	Railways	
	Waterways	
Shippers (clients)	Mode free booking costs	Private parties: stabilizing and combining individual information services to integrated information services between modalities.
	Pricing models	
	Reliability	
Control & Cooperation	Cooperation	Private & Public parties: sharing and communication of relevant real-time data.
	Control Towers	
	Information availability	
	Gainsharing decision models	
	Communication	
Dynamic	Switching	Private parties: The willingness to use more inland waterway transport will grow when the
	Flexibility in operations	
	Real-time planning	

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The five characteristics of synchromodal transport	Components	Involved parties and their tasks:
		planning of barge transport is resilient because real-time data is available
Network & organization	Network locations	Private and public parties: Combining the networks and enthusiast companies to look into possibilities for combined data information services.
	Resources	
	Capacity	
	Business models	
	Partnerships	

1.4 Synchromodal barge planning in practice

The use of synchromodality in practice is depending on the capability of the logistics service provider to plan the use of all three transport modes in the same way. When the logistics service provider has this capability, the use of barge, rail and road transport can be compared to each other based on a level playing field. This will improve the use and volumes of rail and barge transport, and therefore the facilitation of synchromodal transport planning can facilitate modal shift in Europe.

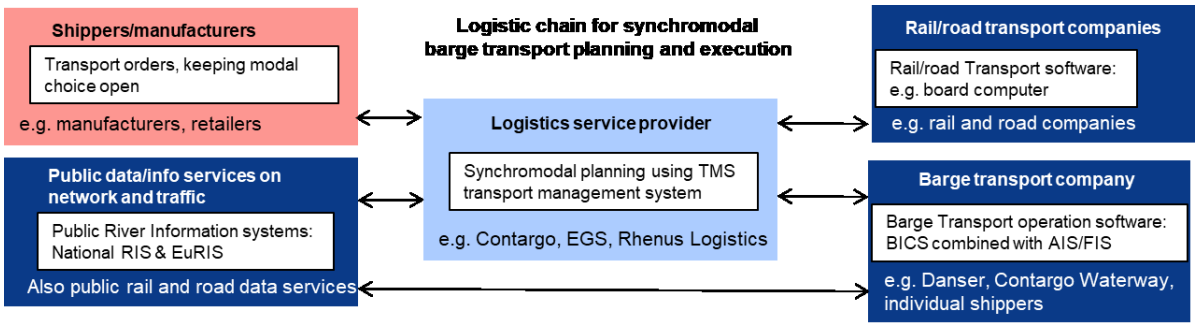
In the DIWA project, the focus is on facilitating barge transport in Europe through further digitization of communication between private and public parties. Therefore, in this Deliverable the focus will be on synchromodal planning to facilitate barge transport. The focus is on container barge transport throughout the report, because this is the most common type of transport for synchromodality.

The logistics service providers need to receive and exchange data with several public and private parties in the logistics chain to achieve synchromodal planning. These parties are:

- clients (manufacturers, retailers or other client who give the transport order)
- barge operators (operators carrying out barge transport)
- rail/road operators (not in scope for this Sub Task 2.2)
- public administrations, such as fairway authorities and inspection agencies (e.g. police, inspection, customs)

The data exchanges between these public and private parties to facilitate synchromodal planning are summarized in the figure below.

Figure 1.4 Data exchange needed for synchromodal transport planning



The public authorities in the five countries The Netherlands, Belgium, France, Germany and Austria each have a national RIS (River Information Services) digital information service available which can supply data needed to do optimodal synchromodal planning. Next to these national RIS digital information services, the European EuRIS digital information service has been developed to provide integrated European fairway data. In this Deliverable, an analysis will be made how the data from national and European RIS digital information services can be used by logistics service providers to improve synchromodal planning. Also, a Road Map will be set up to show how these national and European RIS digital IT-information services can develop to support synchromodal planning capabilities in the years up to 2030. This will result in a modal shift from road to rail and barge transport.

1.5 Overview of chapters in this Deliverable

For this DIWA Sub Task 2.2 Synchro-Modality, both desk research and interviews with relevant private and public parties have been carried out. Meetings that have been organised:

- Start November 2021: Kick-off workshop at general DIWA Meeting
- Dec 2021-Jan 2022: Individual interviews with participating public authorities from 5 EU countries
- Jan-March 2022: Individual interviews with market parties: both logistics service providers and barge operators
- Jan/March 2022: Workshops with participating public authorities from 5 EU countries

The results of the interviews can be found in the Annexes.

This Deliverable contains the following chapters in which the results for DIWA Sub Task 2.2 Synchro Modality have been depicted.

- Analysis of the current and future developments for the role of inland waterway transport in the synchromodal services of operators in five countries. This information can be found in summarized form in chapter 2, while additional information can be found in the Annexes.

- Assess the role that inland waterway authorities could play for the further digital transition of inland waterway transport in Europe in the period 2022-2032. This information can be found in chapters 2 and 3.
- Define and analyse the integral and harmonized service, information and data requirements in each of the five countries needed for the next steps in the digital transition of Inland Waterways transport to facilitate synchromodality. This information can be found in chapters 3 and 4.
- Deliver a road map on the opportunities of synchromodality for the increased use of inland waterway transport in the future for each of the five involved countries, with a focus on the support that public authorities can offer by digitalization of communication with inland waterway operators concerning the Masterplan Digitalization of Inland Waterway. This information can be found in chapter 5.

Buck Consultants International (BCI) has undertaken four steps to fill in these activities:

Step 1 Overview of current/future use of synchromodal transport services in five countries

The first step was to make a complete overview (based on published documents/desk research) concerning the current and (possible) future use of inland waterway transport as part of synchromodal transport services, and its challenges and opportunities in the five countries. This included an analysis of modal shift trends and opportunities, and the current and (possible) future use of inland waterway transport as part of synchromodal services offered by operators in the countries Austria, Belgium, France, Germany and the Netherlands. Also, an overview of policies concerning digitalization of inland waterway transport operations in the 5 countries has been made, with a focus on the digitalization of the communication between public authorities and inland waterway market parties. The current and (possible) future use of inland waterway transport as part of synchromodal transport services will be in different stages of development in the five countries. This has been taken into account, and for every one of the five countries, the specific national situation has been mapped.

Step 2 Inventory of opportunities for inland waterway authorities to support synchromodal transport through digitalization

The second step was to create an overview for each of the five countries of:

- The concrete and funded plans to increase the use of inland waterways per participating EU member state.
- The interests and needs of the logistic sector/service providers to increase the level of synchromodal services including inland waterway shipping next to rail and road transport.
- The current levels of digitalization of inland waterway shipping, both in the communications between private parties as well as the communication between private parties and public authorities in the five participating countries.

To gain input for this overview per country, we have held several DIWA workshops with the member state representatives, and we have held additional individual interviews with member state representatives (1 per country). Next to this input from DIWA project partners, we have

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held interviews with a total maximum of 5 inland waterway market parties that are active in the field of synchromodal transport in the member states involved (for example European Gateway Services, H. Essers, Danser France, etc.)

In this inventory, the focus has been on a description of the digital services that are offered by the waterway management authorities to private organisations. These services include communicating static and dynamic info about inland waterway use (e.g., actual navigation and depth info), data and information about the use and real-time traffic information (sailing and travel times). The point of view will be from the waterway management authorities.

An example of these digital services is COMEX. 15 Partners from 13 European countries have joined forces to realize the common goal (2016-2021) to implement harmonized Corridor Management by providing all required RIS (River Information Services) information to the users by one single point of access. Using a joint and harmonized approach, the partners aim to increase the quality and availability of fairway, traffic and transport information services as well as an augmentation in efficiency, sustainability, and safety of inland navigation and thus optimizing traffic and transport processes. There will be one European fairway information portal with digital data services by inland waterway authorities that can be used in the logistic/synchro modal chain. The services are threefold:

- Static information about the fairway and the infrastructure and their features.
- Dynamic information on waterways: e.g., water depths and bridge clearances.
- Dynamic traffic information: e.g., waiting times, berth occupation, and ETA.

We have looked into the ways the data requested for synchromodal transport relates to the data that will be incorporated in COMEX and can be combined. The issue to be addressed in these steps 2 is how digitization can support inland waterway transport organizations and logistics service providers in offering synchromodal transport. The following questions have been addressed and will be answered in the last chapter:

- Question 1: What are the vulnerabilities in the inland waterway network and services, and where can digital communication help to find solutions to these vulnerabilities? What are opportunities for digital functionalities and communication from public authorities to private parties?
- Question 2: Which synchromodal services can grow in the next ten years in the five countries, and how can the waterway management authorities contribute?
- Question 3: What can be improved as it comes to digital services in logistics hubs where modalities interconnect? How can waterway management authorities cooperate transnationally to improve synchromodal opportunities?

Step 3 Benchmark of differences in offered digital services for inland waterway transport per country

In the third step, a benchmark of the digital services offered by the waterway management authorities in the respective countries (from a user's perspective) has been made. In this benchmark, we have taken into account the maturity level of synchromodal transport in each of the five countries, analysed the differences and learning opportunities. For this step, BCI

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has used the synchromodal maturity model that has been developed by BCI, TNO and Fontys as an analysis tool.

In the benchmark, the current state of digital services of public authorities, which can support synchromodal transport in the various countries, has been assessed along with broader KPIs that relate to reliability, travel times and waiting times for inland waterway transport. For each country, a dashboard with the results of the benchmark has been set up. The dashboard contains results for input (a.o. the number of data messages and users (to be) exchanged), output (a.o. the amount of time (to be) saved in data operations) and outcome (a.o. (future expected) improved level of use inland waterway transport). Also, we have formulated which (digital) tools can be implemented to increase the level of synchromodal transport in the individual countries as well as for the whole system of five countries.

Step 4 Compile a road map for improved and harmonized use of digital services to support synchromodal transport in five countries.

In this fourth and last step, a road map for improved and harmonized use of digital services to support synchromodal transport in the five countries has been compiled. This road map will focus on a path towards synchromodal transport in each of the five countries. These road map paths for improved and harmonized use of digital services in inland waterway transport in Europe can be different per country, based on the possibilities and developments in each of the five countries.

The objectives of the roadmap are:

- Painting a dot on the horizon for 2030 on the improved and harmonized use of digital services in inland waterway transport to support synchromodal transport for two scenarios in five countries.
- A description of the road map with actions on a path towards 2030 concerning the development of these digital services from public authorities to market parties to enhance and improve inland waterway transport operations.
- As assessment of the potential of inland waterway transport in the mix of continental modalities next to rail and road transport.

The road map should be able to handle two development scenarios up to 2030:

1. the base scenario: public authorities will supply the inland waterway data information services to private companies, it is up to them to use the data elements provided.
2. the growth scenario: public authorities will act more pro-actively: they will not only supply the waterway data information services, but also actively market this service among the target group of private companies. This target group consists of larger companies as well as SMEs (Small and Medium sized Enterprises). Public authorities can even adopt the policy to reward private companies who extensively use available inland waterway data information services with specific treatment in reserving overnight berth spaces, etc. In this growth scenario

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Chapter 2 Opportunities of barge transport per country

In this second chapter, an overview of the current status of the volume and use of inland waterway transport in each of the five countries (Austria, Belgium, France, Germany and the Netherlands) will be given. The current situation, bottlenecks and opportunities for future developments in each country will be identified. For this chapter, quantitative and qualitative data were obtained through desk research and interviews with public and private organisations. More specific information per country can be found in the annex of this report.

2.1 Volume of Inland waterways container transport

Next to rail and road transport inland waterway transport is one of the main freight transport modes for containers. Therefore, an analysis has been made of the current and potential growth in Europe in barge transport. As already mentioned, the focus is on container transport throughout the report because this is the most common type of transport for synchromodality. Nevertheless, the efforts made to support synchromodal transport are alsoe useful for other cargo types, since these services increase transparency of inland waterway transport in the whole supply chain.

The five countries in scope in the DIWA project account for over 99% of all container in-land waterways transport in the EU-28, measured in thousands of TEU-kilometres. The Netherlands and Germany have by far the highest volume share, as shown in table 2.1. For Belgium, the volume in tonkm might be somewhat misleading, because the port of Antwerp is very close to the Dutch border. Measured in TEU-kilometres can therefore lead to an underrepresentation. For instance, while sailing from Antwerp to the German Ruhr Area, most kilometres are sailed through Dutch waters. Also, in Austria only a limited number of container barge transport in tonkm has been taken place.

Table 2.1 Volume of Inland waterways transport of containers, 2015 and 2018

	2015 (x1,000 TEU-km)	2018 (x1,000 TEU-km)	Share empty containers in 2018
Austria	575	1,225	100%
Belgium	107,051	94,026	72.2%
France	89,806	84,129	25.5%
Germany	688,407	659,394	31.3%
Netherlands	744,974	722,892	34.7%

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Other EU countries	2,776	2,937	

Source: Eurostat 2019

Within the five countries, there is a large difference in the transport of empty containers per country. As stated in table 2.1 Austria has a share of 100% empty containers, Belgium is second with 72.2%.

Also, the top-9 of international loading-unloading barge transport consists of links between the four countries Belgium, France, Germany and the Netherlands. The top-10 of European country flows for inland waterways transport of containers in 2019 are presented in table 2.2 The main relations of transport measured in thousands of TEU-kilometres are between Germany and Belgium, Netherlands and Germany and Netherlands and Belgium. These 3 relations accounted for 94.7% of the total TEU-km in Europe for containers.

Table 2.2 Top-10 international country flows for inland waterways transport of containers in 2019

Loading country	Unloading country	Total (x1,000 TEU-km)	Share on total (%)
Germany	Belgium	244,438	24.2
Netherlands	Germany	225,405	22.3
Germany	Netherlands	164,560	16.3
Belgium	Germany	114,808	11.4
Netherlands	Belgium	64,123	6.3
France	Belgium	52,745	5.2
Belgium	Netherlands	42,625	4.2
France	Netherlands	26,718	2.6
Netherlands	France	25,483	2.5
Netherlands	Switzerland	15,012	1.5
Other routes		35,134	3.5

Source: Eurostat 2020

Eurostat has also developed a methodology to indicate the modal shift potential of long-distance road freight in containers. This analysis shows – in absolute tonnes and for 2019 – that first Germany and second France have the highest potential to shift volumes in containers from road to other modalities. As a percentage of total freight, the potential is highest in France and Belgium (see table 2.3).

Table 2.3 Modal shift potential of long-distance road freight in containers – tonne, in 2019

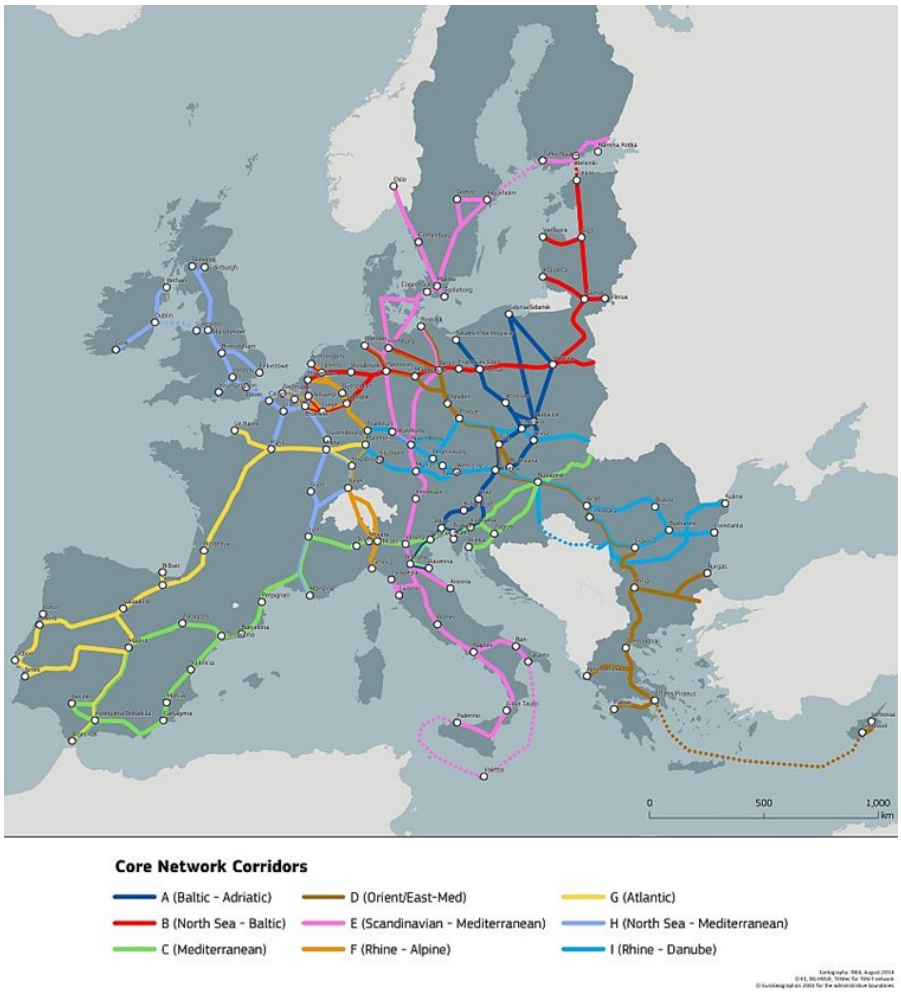
Country	x1,000 tonnes of long-distance road freight in containers that have modal shift potential	Percentage of total freight
Austria	0,344	2.4%
Belgium	3,007	12.5%
France	8,811	18.5%
Germany	36,115	8.0%
Netherlands	3,180	3.2%
Other EU-28 countries	39,942	8.2%

Source: Eurostat 2021

The conclusion is that almost all inland waterway container transport in the European Union is in and between the five selected countries. Belgium, Germany and the Netherlands are by far the countries with the highest volume of barge transport in tonkm. All five countries also have opportunities to shift more road cargo to inland waterway freight transport. The potential for France and Belgium is the highest. Austria has limited opportunities to shift more road container cargo to inland waterway freight transport, but this is due to the fact that maritime containers are seldom used in Austria. For Austria, other road cargo not transported in containers could be transported by inland waterway if the business case for inland waterway services would be positive.

The European Union focuses on making transport in Europe more effective and sustainable through the Trans-European Transport Network (TEN-T). The TEN-T consists of two network layers. The first is the Core Network, which includes the most important connections and has to be completed in 2030. Figure 2.1 shows the nine Core Network Corridors. The second layer is the Comprehensive Network, which covers all European regions and is to be completed by 2050. For this research, the Core Network Corridors are the most important (European Commission, 2022).

Figure 2.1 TEN-T Core Network Corridors



Source: European Commission, 2022

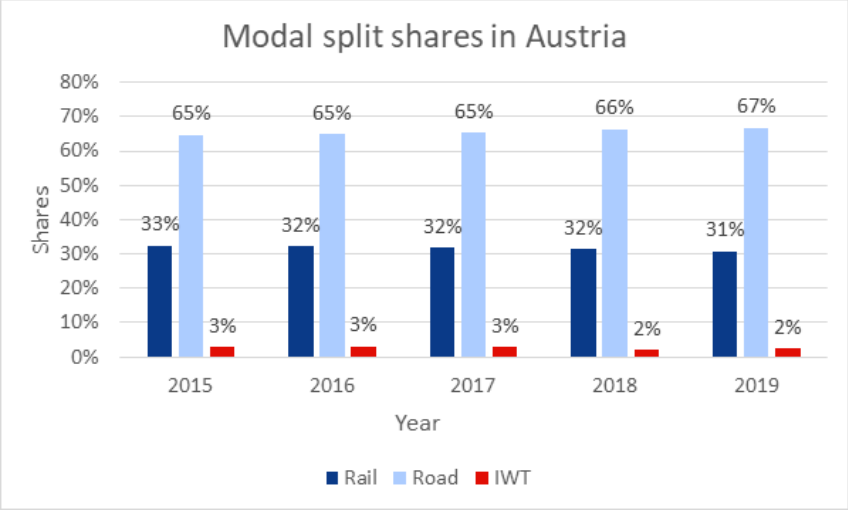
The TEN-T policy addresses the implementation and development of a Europe-wide network of railway lines, roads, inland waterways, maritime shipping routes, ports, airports, and railroad terminals. The ultimate objective is to close gaps, remove bottlenecks and technical barriers, as well as to strengthen social, economic, and territorial cohesion in the EU. Besides the physical infrastructure, the TEN-T policy supports the application of innovation, new technologies and digital solutions to all modes of transport. The objective is improved use of infrastructure, the reduced environmental impact of transport, enhanced energy efficiency and increased safety (European Commission, 2022).

2.2 Inland Waterway Transport in Austria

Current use of freight transport modes

In Austria, inland waterway transport has a small share in freight transport. In the inland waterway modality is only used for 2% to 3% of the total freight transportation of goods in the last years, as shown in figure 2.2. At the moment there is no regular container transport available in the country. Currently, containers are only shipped on demand. However, for rail, Austria is connected to a regular shuttle service. It is well known that Austria has a strong rail network and due to geographical reasons, most freight is transported by rail or road (Source: R. Schwarz, personal communication, 23 December 2021).

Figure 2.2 Modal split of freight transport in Austria, 2015-2019



Source: Eurostat, 2021

For the inland waterways in Austria, the most important waterway that crosses several nearby countries is the River Danube. The river Danube has a high potential for the transport of freight via inland waterways. However, at this moment only 10% of its potential is used. This

is because the Danube has various bottlenecks, both in the eastwards (downstream) and westwards (upstream) direction

Table 2.4 Bottlenecks and strengths for barge transport in Austria

Bottlenecks Westbound direction	Bottlenecks Eastbound direction	Strengths
• Water depths in Germany between Straubing and Vilshofen. • Low bridge clearance. • Only for smaller-sized infrastructure (waterway UN/ECE class VI and smaller). • Long transit times to ARA sea ports because of numerous locks on the Danube, the Main, and the Main-Danube Canal. • Fast rail connections (overnight) and high frequencies to all Austrian Container Terminals.	• Physical infrastructural bottlenecks. • Limited container volume. • Blockages not announced on time. • Administration.	• Waterway link from Northwest to the southeast • Strong rail network due to geographical reasons • Container terminals available

Summary of government Policy on intermodal transport

Rail freight transport and waterways are core components of a sustainable Austrian and European freight transport system due to their inherent advantages. Punctuality, reliability, planning capacity and speed of rail freight need to continue to increase, primarily in international rail freight transport. Austria wants rail and inland navigation to become primary com-ponents of climate-neutral supply chains by 2040. For the modal split in freight transport, Austria is mostly focusing on rail transport. For Austria, the rail share of the modal split must be increased to 40 percent (equivalent to some 35 billion tonne-kilometres) with the right European collaboration. Austria alone can only achieve a moderate increase (34%) (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, 2021).

Digitalization is an important aspect to achieve the goals of Austria. Digitalizing modes of transport and their interfaces should make transport capacity and multimodal supply chains more efficient. Technologies will be developed that will be consistent nationwide and internationally to facilitate access to and use of the rail and waterway systems (booking and usage information services) (Federal Ministry for Climate Action, Environment, Energy, Mobility, In-novation and Technology,2021).

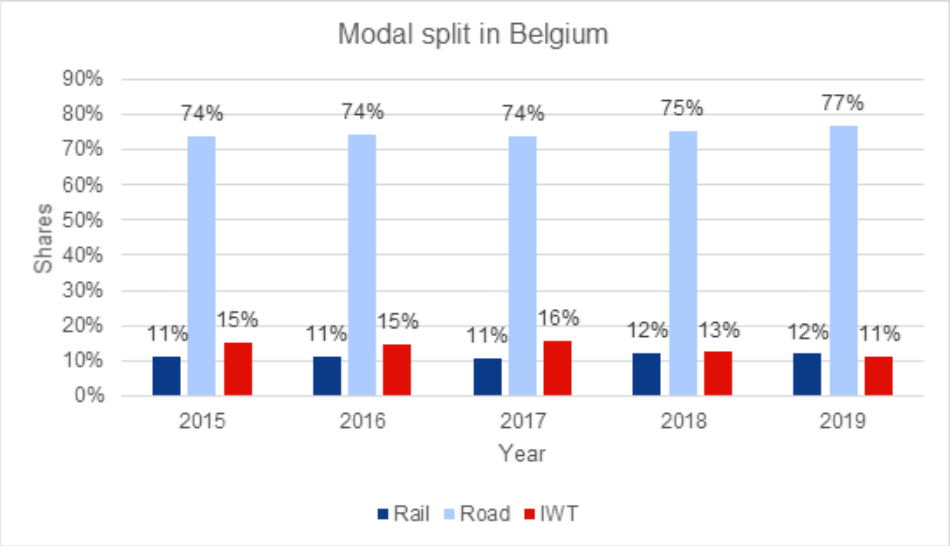
Austria has national funding schemes offered for the transport of containers via rail and inland waterways. Fundings are for the amendment of ships for intermodal transport: “Investitionsförderprogramm Kombinierter Verkehr”. But also funding for additional ports superstructure like cranes: “Terminalförderprogramm”. In parallel, there are additional funding schemes existing to increase digitalization in logistics operations: “Logistikförderprogramm”. As well as increasing the environmental performance of the company: “Klima aktiv”. Next to these studies are funded to increase intermodal transport, inland waterway and digitalization.

2.3 Inland Waterway Transport in Belgium

Current use of freight transport modes

As shown in figure 2.6, the modality road has a relatively high share of 75% over the past five years compared to the modal split shares of rail and road. In Belgium, the modalities rail and inland waterways have similar shares around 10-15% each. Both inland waterway and rail transport are valid alternatives for (inter-)national freight transport, although the share of road transport in the modal shift has risen slowly in 2015-2019. The share of rail transport is growing marginally, mainly because new train shuttle services to other destination in Europe and Asia are developed. The growth has been slow, because the cost of freight transportation by train on medium-sized distances is still high compared to road transport. These costs include the operational costs, the first and last-mile costs, and the handling costs (Van Leijen, 2019). The share of inland waterway transport has decreased because the waterway network is limited: barge is mainly used on the waterways in the Flemish part of Belgium where the terrain is mainly flat and from the port of Antwerp (which is very close to the Dutch border) to The Netherlands and Germany.

Figure 2.3 Modal split shares in Belgium in 2015-2019



Source: Eurostat, 2021

The use of inland waterway transport is well established in the whole of Belgium, but in 2015-2019 a decline in the modal split has been observed. In order to release the potential for growth of inland waterway transport in Flanders and Wallonia a number of bottlenecks have to be addressed.

Table 2.5 Bottlenecks and strengths for barge transport in Belgium

Bottlenecks	Strengths
• High costs for transporting by train and inland waterway transport. • Digital infrastructure of Flanders and Wallonia is not equally developed. • Disjoint network because Flanders and Wallonia have only recently joined forces • Barge transport concentrated in Flanders. • Problems with handling in seaports.	• Geographically strong position with large ports (Ports of Antwerp, Bruges, North Sea Port) • An extensive inland waterway network. • Flanders, Wallonia, France, and Europe are collaborating and funding for the waterway connection between the Seine and the Schelde canal.

Government Policy on intermodal transport

With the document 'Visie goederenvervoer Vlaanderen' the Flemish government wants to give some direction to freight transport in Flanders. To stimulate the modal shift from road to rail and inland shipping, Flanders already implemented kilometre charge for trucks. Next to the kilometre charge for road transport, De Vlaamse Waterweg nv (DVW) started the DigiWave program to support innovation in the inland shipping industry. With this program, De Vlaamse Waterweg nv wants to stimulate the modal shift from road to inland waterways, since the potential of the waterway is being used less and less (De Vlaamse Waterweg nv, 2021). This programme has three pillars, i.e. Smart Shipping, Smart Logistics and Smart Administration. To help the future of autonomous barge shipping, the Smart Shipping pillar works on four topics:

- Smart vessels: vessels with the minimal form of automation on board.
- Smart infrastructure: waterway infrastructure is highly automated and operated remotely. Interaction between infrastructure and vessels takes place digitally to guide traffic as safely as possible.
- Smart data: data sharing that strives to be a smart, smooth and flexible process in which all communication between the government and the user of the waterway is digitalized and takes place according to internationally standardized procedures.
- Smart regulation: supports innovation and future-oriented initiatives.

While within Smart Shipping DVW is mainly acting as a facilitator, within Smart Logistics and Amsinistration DWV is besides a facilitator also active as a developer and architect for future proof government solution, i.e. for traffic management and an administrative no-stop-shop.

Flanders has the ambition to become a green, low-carbon society. For sustainable freight transport, this means that improvements must be made on efficient network nodes and an efficient organization to achieve multimodality and synchromodality. Digitalization is one of the important elements (Flemish government: Policy area Mobility & Public Works, 2020).

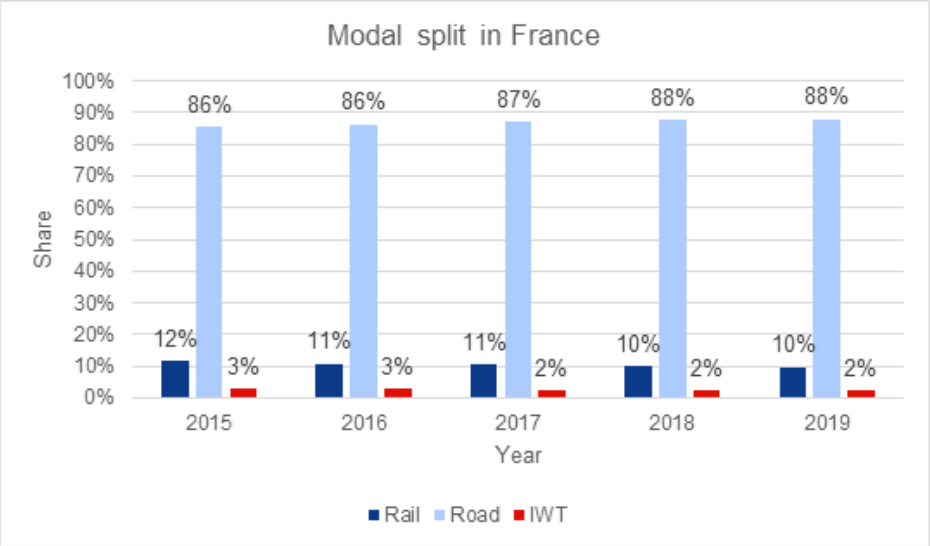
Since Belgium is divided into three departments of Flanders, Wallonia and Brussels the above-mentioned government policies only apply for Flanders. Nevertheless, Flanders is the frontrunner and the representative entity of the inland waterways for the DIWA subtask 2.2 Synchromodality for Belgium.

2.4 Inland Waterway Transport in France

Current use of freight transport modes

As shown in figure 2.14, in France the most common modality for freight transport has been by road for the past five years. One of the possible reasons, that the mode road is dominant is due to the operative way of working in France. Another reason for the high share of road modality is due to the huge road network France has to offer. Moreover, in France, different large manufacturing industries are located and the roads are known for the most European-wide international freight transport (Santander, 2021).

Figure 2.4 Modal split shares in France



Source: Eurostat, 2021

Throughout the years, the share of rail in France has been decreasing enormously compared to the modal split share of 26% in 1984. An important reason for the relatively low freight rail modal split share is due to the lack of good quality links between the ports and rail in hinterland areas. Also, the complete French rail network exists at this moment as disjoint pieces instead of an integrated rail network. Therefore, the costs of using rail for transport do not outweigh the costs of freight transportation by road. To take advantage of rail's scale economies, increased rail freight should be realised (Railweb, 2020). The bottlenecks and strengths for France are listed in the table below.

Table 2.6 Bottlenecks and strengths for barge transport in Belgium

Bottlenecks	Strengths
• Shortage on ships. • High handling costs. • Disjoint network.	• Flanders, Wallonia, France, and Europe are collaborating and funding for the waterway connection between the Seine and the Schelde canal.

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Bottlenecks	Strengths
• For geographical reasons, inland waterway transport is limited to the North of France.	• Modal split for IWT in North of France 10-20%. • Strong road network due to geographical reasons.

Government Policy on intermodal transport

In the Clean Mobility Development Strategy, the French government presents the guidelines and actions planned for the periods 2019-2023 and 2024-2028, to meet with France's objectives and commitments in the fight against global warming and achieving lower energy consumption. One of the actions is "Promoting modal shift and freight transport towards river routes and railways and improving efficiency." The French government wants to do this by streamlining urban logistics by taking them into account in planning documents and by overseeing the activity of digital information services. Also, by developing mass modes for freight by increasing in-vestments in mass transport infrastructure (railways, river routes, and ports).

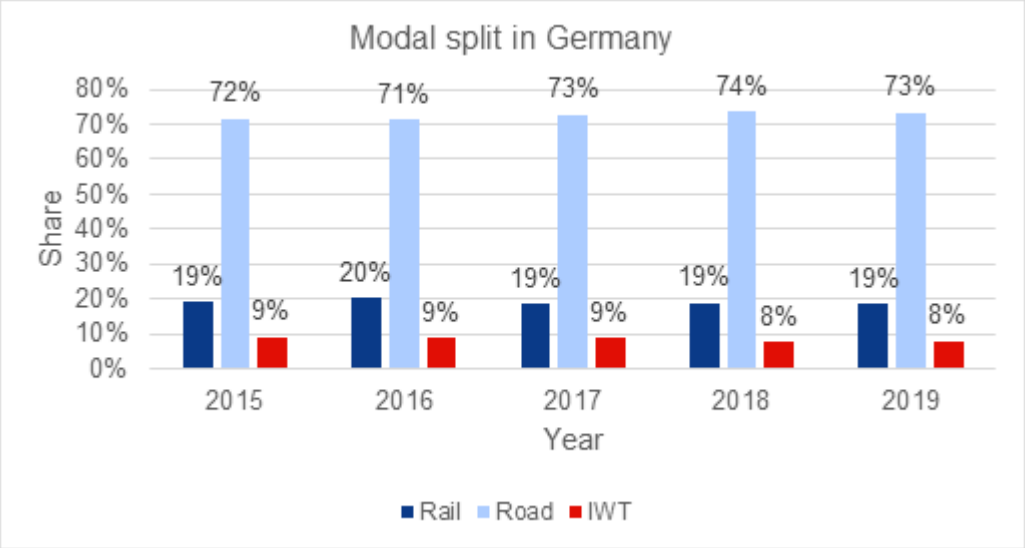
French policies for the development of infrastructure and service operations (notable freight) should be connected to those in other European countries. This includes the establishment of European freight corridors, support for port freight policies, development of projects in partnership with the EU, and the mobilization of European funds. The public policy must evolve to improve the competitiveness of maritime entry ports and their terrestrial access routes, and effective management of the explosion in final distribution flow rates Ministère de la Transition écologique et solitaire (2020).

2.5 Inland Waterway Transport in Germany

Current use of freight transport modes

As shown in figure 2.21, the modality of road has a relatively high share of 70%. The distribution of the different modalities has not been changed, throughout the past five years. The inland waterway of the Rhine-Main-Danube Channel, which crosses in total ten countries (8 countries in the European Union) is the most important European inland water transport route (NEWADA duo project consortium, 2016). For Germany, the Rhine is the most important and largest river, it connects the large seaports with the hinterland of Europe.

Figure 2.5 Modal split shares in Germany



Source: Eurostat, 2021

According to the Federal Ministry of Transport and Digital Infrastructure (personal communication, February 9, 2022), there is still room to increase the share of inland waterway transport in Germany. However, there are bottlenecks that have to be overcome, mostly concerning the physical infrastructure.

Table 2.7 Bottlenecks and strengths for barge transport in Germany

Bottlenecks	Strengths
• Water depths (low water levels are still decreasing since 2018) also result in higher costs. Lack of maintenance of locks, bridges • High administrative costs. Strong road network due to geographical reasons.	• Connected to many corridors and countries. • Large international logistic companies are from Germany.

Government Policy on intermodal transport

The Federal Republic of Germany states in the Inland Waterway Transport Masterplan (2019) that digitalization has established itself predominately for the road and rail modes in recent years. In the future, inland waterway transport users are to be able to obtain up-to-date infrastructure data for route planning (e.g., fairway depth, number of locks, opening hours of the locks, etc.) from a one-stop-shop. The cross-border flow of registration data is also planned. In the future, inland waterway skippers can share data with relevance for their customers, such as the ship's position, the arrival time, journey and cargo data, with their logistics partners via a protected system. At the same time, a legal framework is to be established which allows for uniform digital car-go documentation throughout the EU. Digitalization offers great opportunities for optimizing and automating this exchange of

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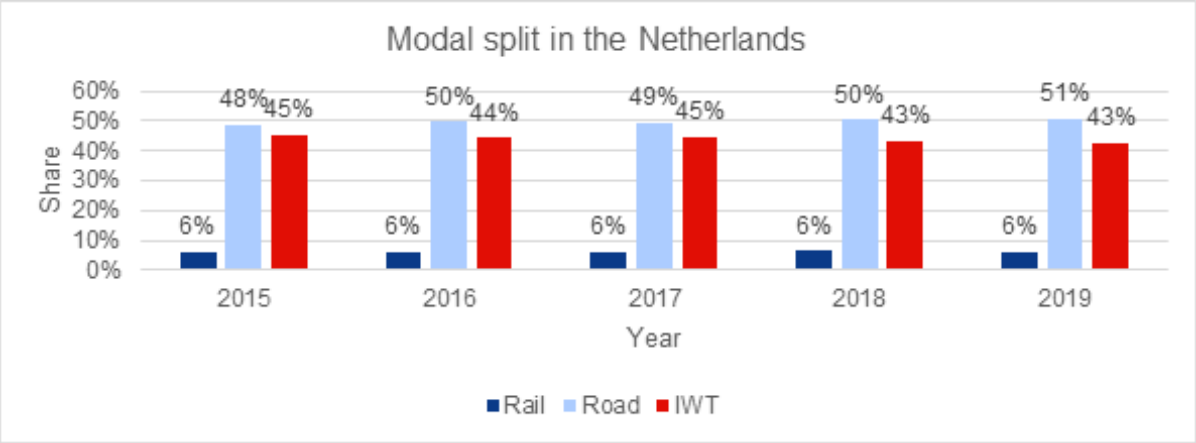
information and thus enhancing the efficiency of transport operations (Federal Ministry of Transport and Digital Infrastructure, 2019).

2.6 Inland Waterway Transport in The Netherlands

Current use of freight transport modes

Compared to the other aforementioned countries, the Netherlands has a relatively strong position of freight transportation via inland waterways. Looking at the past five years, from 2015 to 2019, the Netherlands held an inland waterway modal split share of nearly 43%. Compared to the rest of Europe, the Netherlands has the densest network of inland waterways.

Figure 2.6 Modal split shares in The Netherlands



Source: Eurostat, 2021

Also in the Netherlands, there is an opportunity to increase the use of inland waterway transport, although the share of inland waterway transport has been decreasing in the past five years. This is due to the fact that inland waterway transport to and from ports is experiencing bottlenecks in barge operations. The handling of barges in ports sometimes has delays, and this makes the business case of using inland waterway transport harder for specific clients.

Table 2.8 Bottlenecks and strengths for barge transport in the Netherlands

Bottlenecks	Strengths
• Problems with handling in seaports. • Long waiting times at locks and bridges.	• Geographically strong position with a large port (Rotterdam). • An extensive inland waterway network. • Transportation costs of inland waterways are low.

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Government Policy on intermodal transport

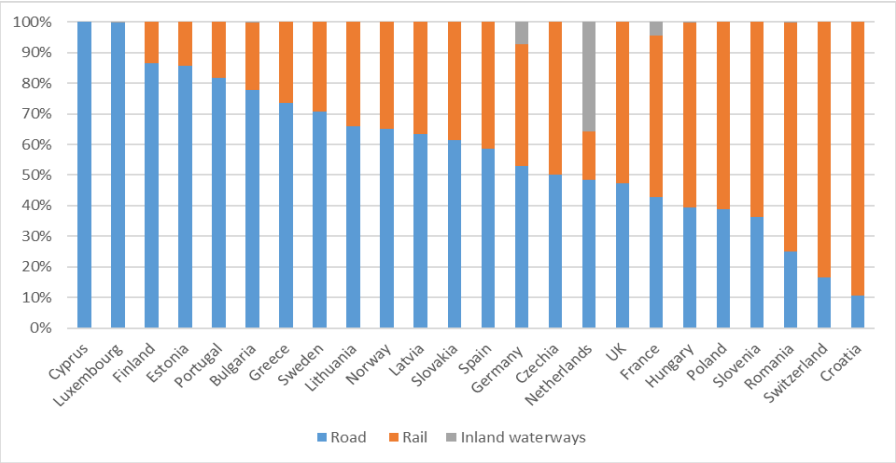
To make the Netherlands more competitive in logistics, the Ministry of Infrastructure and Water Management (I&W) has an agenda for a robust, efficient, and sustainable transport system. Digitization promotes the possibility to make easier use of multiple transport modalities within a logistics chain. In short, digitization improves the efficiency, speed, and reliability of the logistics process. However, companies and governments are still not benefiting enough from the opportunities offered by the digitization of freight transport and logistics systems. Due to fragmented legislation and the lack of a common digital language, the government has not yet been able to provide a digital infrastructure. To achieve a working system of digital exchange of logistics information the Ministry of Infrastructure and Water Management has drawn up the Digital Transport Strategy (DTS). With the DTS, the ministry is focusing on a digital transport policy that has four milestones (Ministry of Infrastructure and Water Management, 2019):

- The realization of paperless transport.
- The development of digital collaboration between governments.
- The development and reinforcement of a future-proof basic data infrastructure to enable seamless transport by road, rail, air, inland shipping, and sea shipping.
- Structural - smart mobility - innovations and large-scale applications.

2.7 Opportunities for increased inland waterway transport in Europe

The previous paragraphs show that there are many bottlenecks, strengths, and policies for inland waterway use. All five countries want to become more sustainable in freight transport, and the use of inland waterway transport can still be expanded.

Figure 2.7 *Modal split container transport in EU (tonkm) (Eurostat, 2019), Note: Belgium/Austria not included*



The main barriers for growth of barge transport in the five European countries are:

(1) lack of physical opportunities in using infrastructure/ships,
(2) hard to reach economic business case for barge transport,
(3) complexity of inland waterway planning/performance for container transport

In order to tackle these barriers, national and EU authorities are carrying out policies to facilitate growth of inland waterway transport. The DIWA project focuses on lowering barrier (3), through among others, national public digital inland waterway River Information Service (RIS) and the European EuRIS information service.

To achieve this the authorities in the involved countries all implemented specific governmental policies. All five countries recognize that rail and inland waterway transport are one of the components for a sustainable European freight transport system. However, some countries prefer rail over inland waterway transport and the other way around. As stated before this is due to geographical factors but also due to bottlenecks in rivers that hinder the development of inland waterway transport. The digital aspect of sustainable freight transport is for all five countries about harmonized data ex-change, data sharing between data information services, and paperless transport. The countries are investing individually in digitalizing their freight transport. Improvements have already been made by developing information services and paperless transport, this will be described later. However, the goal is to make all the digital information services in Europe work as one.

The bottlenecks have to be overcome by the different countries to stimulate inland waterway transport. The strengths show what the countries are capable of, which need to be used to increase the share of inland waterways. Solving the bottlenecks will ensure the turning point for inland waterway transport. Table 2.9 below summarises these physical bottlenecks and their strengths.

Table 2.9 Physical bottlenecks and strengths for inland waterway transport in the five countries

	Bottlenecks	Strengths
Austria	Westbound direction: • Water depths between Straubing-Vilshofen (Germany)	• Waterway link from Northwest to the southeast

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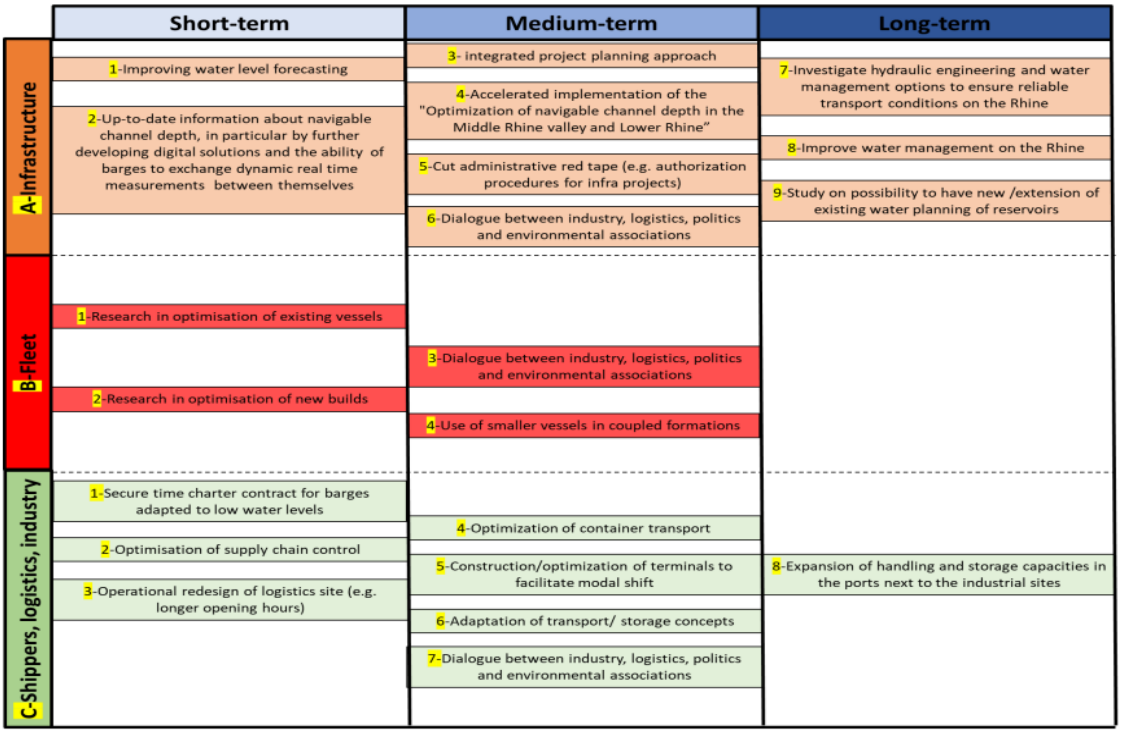
	Bottlenecks	Strengths
	• Low bridge clearance, smaller-sized infrastructure • Rail is faster and cheaper Eastbound direction: • Container market volume is low • Blockages not announced on time • Administration (no harmonizing forms)	• Strong rail network due to geographical reasons • Container terminals available
Belgium	• High costs for transporting by train and inland waterway transport. • Digital infrastructure of Flanders and Wallonia is not equally developed. • Disjoint network because Flanders and Wallonia have only recently joined forces. • Barge transport concentrated in Flanders. • Problems with handling in seaports.	• Geographically strong position with large ports and an extensive inland waterway network. • Flanders, Wallonia, France, and Europe are collaborating and funding for the waterway connection between the Seine and the Schelde canal.
France	• Shortage on ships. • High handling costs. • Disjoint network. • For geographical reasons, IWT is limited to the North of France.	• Flanders, Wallonia, France, and Europe are collaborating and funding for the waterway connection between the Seine and the Schelde canal. • Modal split for IWT in North of France 10-20%. • Strong road network due to geographical reasons.
Germany	• Water depths (low water levels are still decreasing since 2018) also result in higher costs. • Lack of maintenance of locks, bridges • High administrative costs. • Strong road network due to geographical reasons.	• Connected to many corridors and countries. • Large international logistic companies are from Germany.
The Netherlands	• Problems with handling in seaports. • Long waiting times at locks and bridges.	• Geographically strong position with a large port (Rotterdam). • An extensive inland waterway network. • Transportation costs of inland waterways are low.

Fort several countries the bottlenecks include low water levels. The CCNR (2021) defined solutions for low water levels on the Rhine (see figure below). For the short term, the solutions include up-to-date information and optimalisation of processes. For the long-term, it includes large changes from the industry, for example, investigation for hydraulic engineering, the extension of existing water planning, and expansion of handling and storage capacities. These solutions can also be implemented on other rivers.

Figure 2.8 Overview of solutions for low-water levels on the Rhine



Source: CCNR, 2021

Chapter 3 Digitalization in inland waterway transport

3.1 Added value of Digitalization in inland waterways

Digitalizing the inland waterways is fundamental for the competitiveness of the mode compared to the other modalities. Different challenges are defined by the European parties to tackle the challenges and create solutions with the private and public companies (Fumuso, 2021). The main challenges that have to be faced are:

1 Inefficient navigation and traffic management
2 Inefficient integration of inland waterways transport in logistics processes
3 The high administrative burden for complying with legislation

The River Information Services (RIS) in each of the five European countries has been developed with continuous and controlled data sharing in mind, which is a key requirement for many new digital solutions. However, several underlying challenges can be discussed for the development of new digital tools for the inland waterways sector:

- There are several legal and commercial bottlenecks for sharing data, such as availability on barges maintenance work on locks or congestion on the road.
- The IT setup of barge operators is not always capable of continuous interaction with third parties yet.
- The Inlands Waterway Transport sector is limited in size and fragmented, making it difficult to achieve economies of scale for new solutions.
- The lack of an overall framework for electronic reporting covering different purposes makes it difficult to address the administrative burden. Connecting the national systems with the European systems could support for an overall framework.

Digitalization in freight consists of the automation of manual processes to deliver information faster, more accurately, more added value for external clients, and also internal efficiencies within organizations. The literature and different published reports on digitalization, the added value in the freight transport especially, for inland waterways is researched. To digitalize the inland waterways, different stakeholders are involved, who provide and use data in inland waterways. The distinction in parties is based on the inland waterways customers, inland waterways service providers (shipper/receiver, logistics service provider), the skippers, and departments from the public sector. An overview of the IT systems used and the involved stakeholder in the value chain in inland waterways is shown in Figure 3.1 This figure is based

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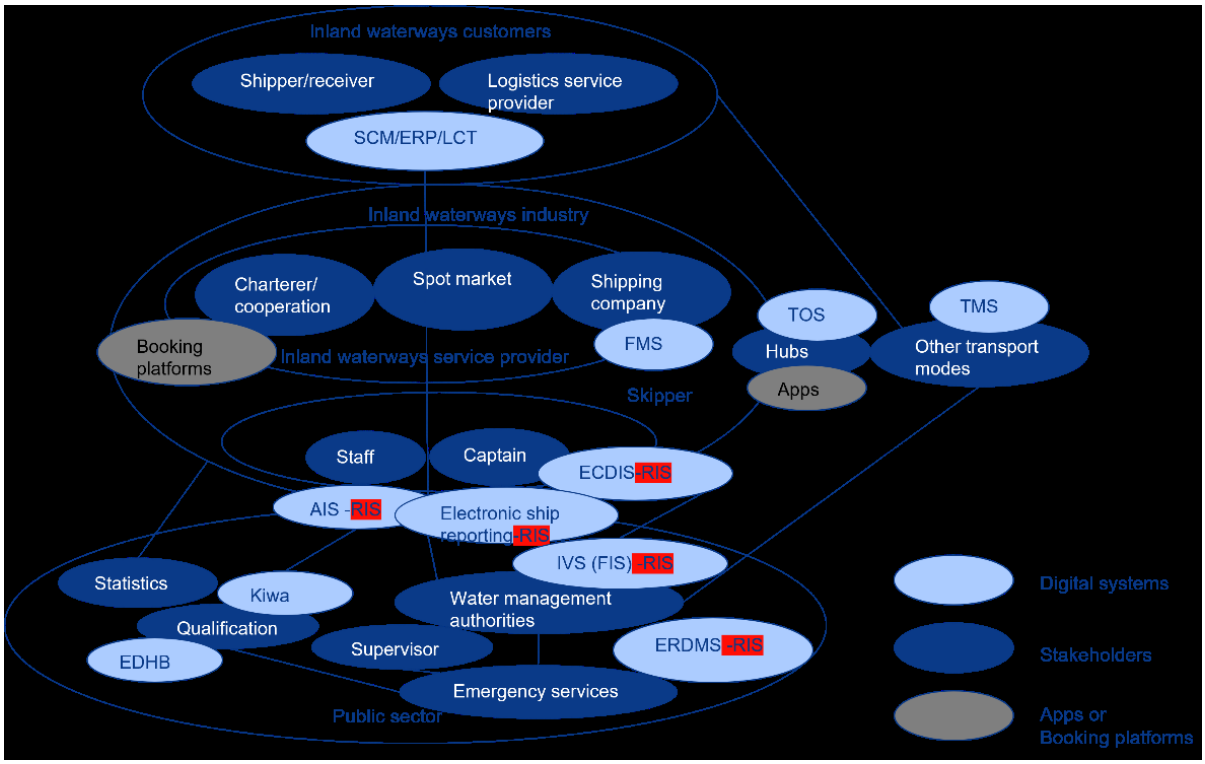
on the report from TNO (2020), and the relevant parts of the national RIS are mentioned specifically.

Figure 3.1 Relevant public and private IT information services in the value chain of inland waterways



Source: TNO,2020

Based on figure 3.1 the different digital IT information services of public and private stakeholders can be described in more detail in table 3.1. The data exchange between the different IT information services is between public and private parties.

Table 3.1 IT systems elaborated with the value chain of inland waterways

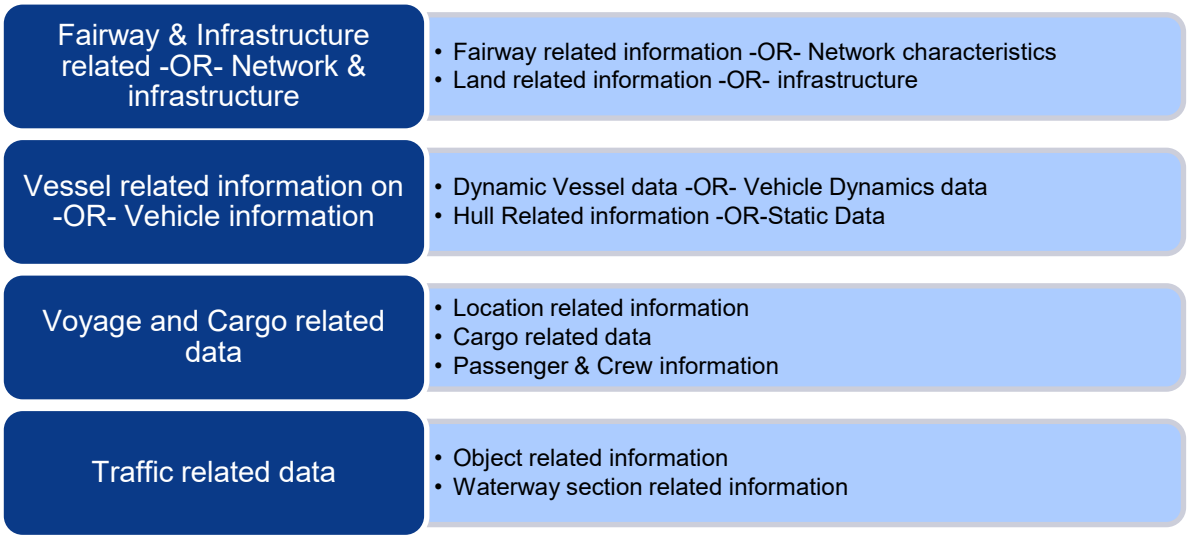
Digital system	Explanation of the system	Stakeholder-group	Stakeholder-specific
SCM	Supply Chain Management	Inland waterways customers	Shippers
ERP	Enterprise Resource Planning		Shippers
LCT	Logistics Control Tower		Logistics service provider
FMS	Fleet Management System	Inland waterways service provider	Shipping companies and inland waterway cooperation
TMS	Transport Management system (system for loading information)	All transport modes	Inland waterways, rail and truck operators
TOS	Terminal operating systems	Hubs/terminals	Used by (large) terminals
ECDIS (RIS)	Navigation system with the digital maps of the waterways	Skipper	Staff/ captain & Water management authorities
FIS (RIS)	Fairways Information system, information portal with data regarding the water levels and streams from the water management		Staff/ captain & Water management authorities

Digital system	Explanation of the system	Stakeholder-group	Stakeholder-specific
	authorities,including temporary fairway traffic limitations..		
Electronic ship reporting (RIS)	Reporting for arrival- and departure from the waterways		Staff/captain
AIS (RIS)	Automation Identification system, for the type of freight (for dangerous and non-dangerous freight), insights in locations, direction and speed of the vessels fleets. This is private data, as in some cases the skippers have their barges as their residence place.		Staff/captain
ERDMS (RIS)	European Reference Data Management System, an information portal with reference codes, dangerous goods coding and location codes. No detailed information about locks and bridges is available. Also, information on the country codes is based on international standards.	Public sector	Water management authorities
EDHB	European Hull Database, European system for certificates and permits		Qualification
Kiwa	National register with certificates of the crew and permits of the fleets.		Qualification

Source: TNO,2020

As elaborated in the table above, different IT systems are used before, during and after the use of the inland waterways. The focus is on the data supply and exchange improvements between the private parties and the Water Management authorities for the optimization of logistics processes. A European integral system, EuRIS is developed and implemented in the European countries in 2022 to publish information of the inland waterways .

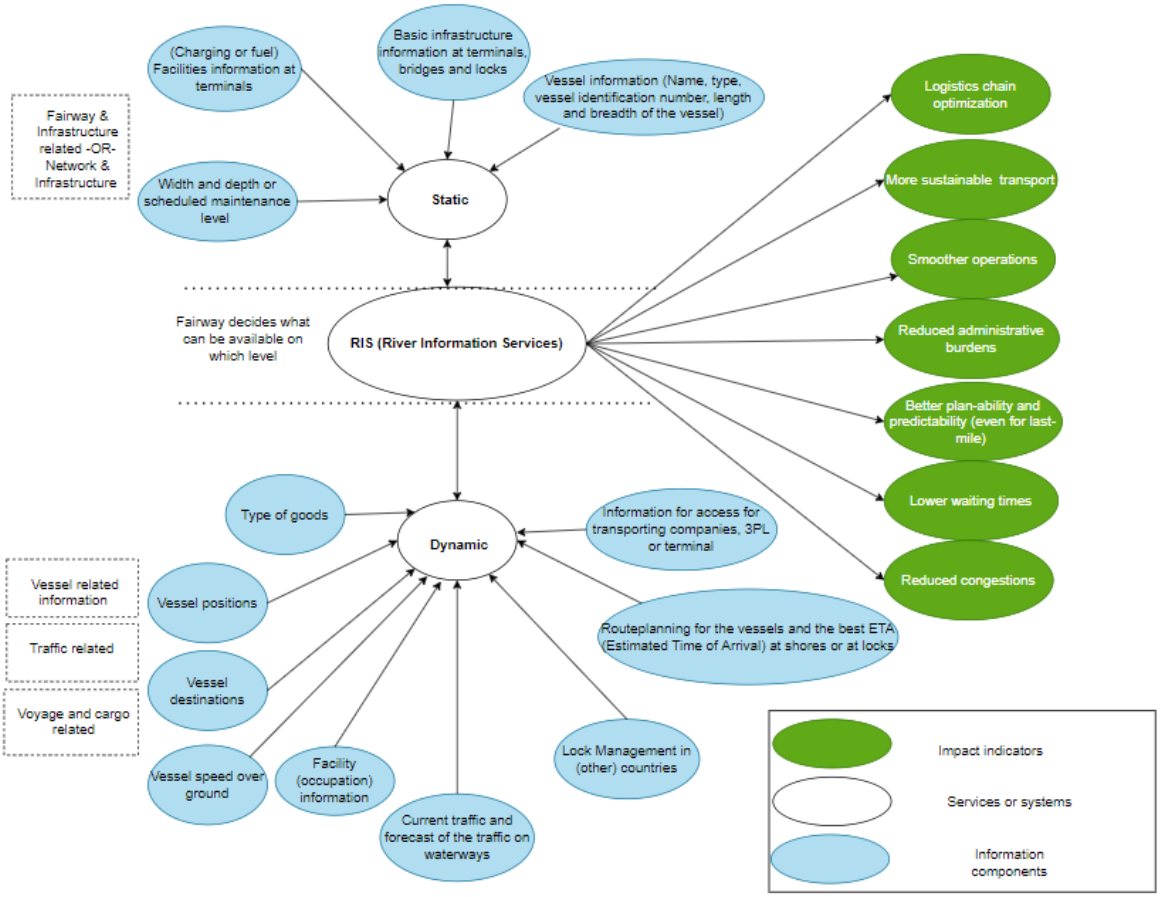
Figure 3.2 Level and information from the levels



In the DIWA project subtask 2.5, a matrix has been developed with the required information components by the public (waterway) authorities of the DIWA partners. The information provided by the RIS system can be assigned to four different levels as shown in figure 3.2 The second level presents the information category on a more detailed level.

The RIS system of the public authorities is used by both the barge operators and the Water Management authorities to exchange data related to different information components. The input for the data and the level of information shows that there is a difference between static and dynamic data. To optimize and maximize the output of the value chain of inland waterways, the information components are digitally shared (see figure 3.3). The digitalization of inland waterways transport can result in optimization of barge transport, more sustainable freight transportation, smoother logistics operations, reduced administrative burdens, better planning ability, and reduced congestions. Lastly, if the information is optimally shared the last-mile connections with transport companies lead to reduced waiting times and possibly lower origin-destination costs. This increases the modal shift towards the use of inland waterways (RIS-COMEX, 2019).

Figure 3.3 Visualization of dynamic and static information exchange in inland waterway transport

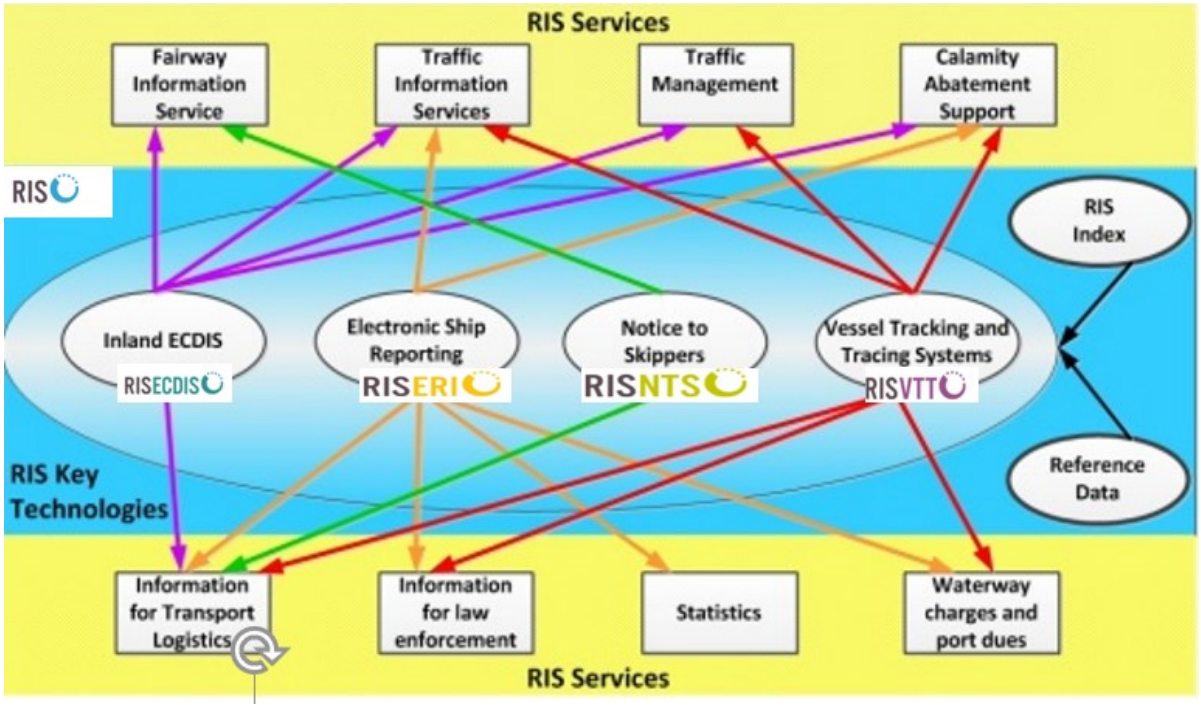


Source: BCI, based on RIS-COMEX, 2019

3.2 Digital systems and standards in the European Union

In the European Union, different digital information services for inland waterway transport are developed by fairway authorities and used in each country. The European RIS-COMEX (River Information Services COrridor Management EXecution) project is set up to work works towards flawless integration of information services on an European level. This project aims to improve the information flow between inland waterways and across intra-European borders, and wants to increase the efficiency of waterborne transportation and logistics in Europe. Furthermore, with the accessibility of static and dynamic information, advanced and real-time route navigations are created (Innovative Navigation, 2020). There are many national RIS Systems and within RIS COMEX the EuRIS System is developed which gathers all relevant data from the national RIS Systems and provides the Date and specific Services as Single Point of Access to the Users. The 'RIS' reference in the figure refers to the different national RIS systems. These national RIS systems include four technologies, which provide data to different parties in the freight transport chain in standardized formats defined by the European PIANC, and currently maintained by the CESNI as shown in figure 3.4.

Figure 3.4 Overview on RIS Key-Technologies and Categories of RIS Services



Source: ALSIC, 2022

In order to set up an pan-European data exchange Information service, the following four technologies are integrated in the EuRIS information service. The data can be exchanged to the portals of private parties in the freight transport chain:

1 Inland Electronic Navigational Chart (RIS-ECDIS)
- FIS – Fairway information services
- ITL – Information for transport Logistics
  a Voyage planning
  b Transport management
  c Inter-modal port and terminal management
  d Cargo and fleet management
- TI – Traffic Information
  – Tactical traffic information (TTI)
  – Strategic traffic information (STI)
- TM – Traffic Management
- CAS – Calamity abatement support

2 Electronic Reporting International (RIS-ERI)
- TI – Traffic Information
  – Tactical traffic information (TTI)
  – Strategic traffic information (STI)
- CAS – Calamity abatement support
- ITL – Information for transport Logistics
  a Voyage planning
  b Transport management
  c Inter-modal port and terminal management
  d Cargo and fleet management
- ILE - Information for law enforcement
- ST - Statistics
- CHD – Waterway charges and harbour dues

3 Notices to Skippers (RIS-NtS)
- FIS – Fairway information services
- ITL – Information for transport Logistics
  a Voyage planning
  b Transport management
  c Inter-modal port and terminal management
  d Cargo and fleet management

4 Vessel Tracking and Tracing (RIS-VTT)
- TI – Traffic Information
  – Tactical traffic information (TTI)
  – Strategic traffic information (STI)
- TM – Traffic Management
  – Local traffic management (vessel traffic services – VTS)
  – Lock and bridge management (LBM)
  – Traffic planning (TP)

- CAS – Calamity abatement support
- ITL – Information for transport Logistics
  a Voyage planning
  b Transport management
  c Inter-modal port and terminal management
  d Cargo and fleet management
- ILE - Information for law enforcement
- CHD – Waterway charges and harbour dues

The exchange of data is partly based on the fact that the vessels have mandatory pieces of data exchange equipment on board, such as the Inland ECDIS Chart display and Inland AIS transponder (Innovative Navigation, 2020). Data exchange that is in line with the European RIS standards is necessary to facilitate international inland waterway transport for the following reasons:

- Inland navigation does not stop at the borders of countries.
- The different RIS systems reach their full benefit only when they are harmonized.
- Suppliers of equipment will only produce hardware and software for RIS once generally applicable standards have been defined.

From the European Union, the TEN-T policy aims to create sets of requirements that digital infrastructure must comply with, including safety, quality for highly performing transport, and alignment with environmental objectives (European Commission, 2021).

Lastly, for the European inland waterways, the implementation of EuRIS system is aimed for 2022. This is the extended edition of VisuRIS, implemented in Flanders. In this system, thirteen European countries are connected and it allows more countries to join in the future. The EuRIS collects data from the connected countries, such as the infrastructure information, vessel locations, locks information, and terminal facilities. This information service provides all data in a harmonized way in one information service instead of finding information on different locations and information services. Moreover, it also introduces new services especially for logistics service providers as: Estimated Time of Arrivals (ETA), route planners, etc. It is an overarching system, that provides insights information for different parties in the logistics chain. In the following subsections, for each country, the current and future levels of digitalization in inland waterways are discussed. Also, the country-specific policies will be elaborated. This information is acquired by having interviews with the representative party of the ministry of each country.

3.3 Inland waterway digital information services in Austria

The freight transportation via the Danube rivers counted for nearly 8.3 million tonnes in 2020. However, the inland waterways and the barge operators face different bottlenecks,

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concerning infrastructure, unannounced maintenances, and the harmonization towards digitalization. Especially, the administration processes require steps towards digitalization. Currently, the administration is performed via form-filling, while the objective is to harmonize forms, like arrival- and departure reports or passenger lists. To reduce travel times and harmonize the different forms of languages, the use of CEERIS (Central & Eastern European Electronic Reporting Information System) is stimulated. This is a joint electronic system with eight countries, from Austria downstream the Danube and to the Czech Republic. In this system, the forms are included, customized routes are available for the specific transport, and the possibilities of connecting to ports and other authorities.

By collecting and sharing the administrative information in the portal, it is accessible for companies and authorities. Basically, there are two main user groups:

- Reporting Parties (Skippers, Fleet managers) who enter the required data to create and submit the required voyage reports based on predefined reporting requirements.
- Receiving Authorities will receive the customized voyage reports according to the relevant laws and regulations.

Furthermore, the Reporting Parties can share their cargo- and voyage data (reports) also with partners along the logistics chain.

EuRIS is a joint effort of 13 European countries within the RIS COMEX project and Austria delivers, from the national RIS system called DoRIS, data to EuRIS (same is valid for all 13 countries). Just like some other European countries, Austria aims to implement EuRIS as the digital system for the inland waterways. However, before this information service could be widely implemented, different challenges were encountered, such as technical, organizational, legal, and financial complexities. Most of the challenges are finished, while some of the struggles are in their final phases. The objective is to have both systems EuRIS and CEERIS operational from March/April 2022 in short phases nationwide.

Austria will provide national data, regarding the infrastructure and facilities in the EuRIS. The data will be visible for other European countries of the system. Moreover, for the barge operators, it would be possible to optimally plan the routes, by taking the available information of this route into consideration. This electronic reporting system CEERIS enables Repüorting parties to fulfil their reporting obligation for inland waterway transports by creating and submitting voyage reports in an efficient way (single entering of data and reporting only once). CEERIS will then create the individual reports for the Receiving Authorities and transfers them in the configured means (CEERIS portal dashboard, e-Mail, via APIs).

Lastly, in Austria, the digital information services are in the beginning phase and are not widely implemented or used in the country. At the moment, the information is not always (real-time) available. And due to form-filling of administration, the travel times are too long. The collection of data, better collaboration, and data-sharing should be increased between public and private parties. But also between the operators of different modalities. Especially rail and inland waterway transport is environmentally friendly and can transport large amounts of containers. They are suitable for the increasing demand for intermodal transport services. To make use of the advantage of both modes of transport better cooperation is needed.

3.4 Inland waterway digital information services in Belgium

Belgium, and especially the Flemish waterways are innovating and stimulating toward digitalization of freight transport. The three regions of Belgium (Flanders, Brussel, and Wallonia) used, up to a few months ago, their own digital inland waterway system. In Flanders and Brussel, the VisuRIS (VisuRIS - Start) is now used for data capturing and planning for the internal (lock and bridges information and management) and external activities. VisuRIS provides information regarding the network infrastructure, the terminal facilities, locks and bridges information, accessibility for planning routes, and signing up when the inland skippers arrive at Belgian waterways. In the future, the Walloon region is exploring the possibilities to integrate and implement the VisuRIS system for operational uses. However, this will go in phases and take time, before this is all completely integrated with the other regions and the digital systems.

VisuRIS includes a package, of different services, which optimizes the transport and traffic flow in inland waterways. Using the RIS improves the safety and efficiency of the inland waterways. Moreover, the data exchange is between the skippers, waterways, and ports, which leads to a standardized way of communicating. More integrated traffic management is possible due to sharing transport and logistics statistics. This form of integration and data exchange increases the vulnerability of transportation via the inland waterways. Due to the unstandardised 'languages' of the different and multiple systems, the shippers tend to choose truck transport more often. A solution for this issue is the VisuRIS information service that should lead to standard data exchange between waterways and chain parties, with only a sign-up of the (inland) skipper on the digital information service. This leads to accurate and on-time information of the network for possible route planning and terminal arrival (P. Creemers, personal communication, December 20, 2021). VisuRIS combines and processes the European CESNI standards as described in the section of the digital information services in the European Union (see section 3.2).

The Flemish waterways are working closely with the ports because the ports use their own information systems. These systems include the processes of the port, clients of the ports, and digital communications. Research is performed on the digital notifications, once the inland skippers arrive in Flemish waterways, they can be further divided into the available and involved ports. However, the inland skippers have still the option to traditionally sign up at the ports, via mobile phone, or the physical offices. Digitally signing up is not mandatory at this moment (Q1, 2022). Therefore, communicating and sharing information about the arriving skippers is still partially traditionally performed. Also, if the information is not shared digitally, only the last part of the voyage will be shared with the remaining locks and bridges. On the contrary, if the information is shared digitally the complete voyage is shared with all locks and bridges allowing an optimal traffic planning. By sharing the information digitally the steps for further actions could be taken in an earlier phase (P. Creemers, personal communication, December 20, 2021).

Currently, research is performed regarding the expansion and implementation of big data sharing information services between the waterways and the ports. The challenge is to what extent the data can be shared (T. van Parys, personal communication, December 20, 2021). Lastly, interoperable digital information services for synchromodality are currently in the research phase. For every modality, digital information services are in use, but are not mandatory yet or not completely implemented throughout the country. For synchromodality, the data-sharing between the modalities and availability of accurate data-sharing information services between public and private parties is essential.

3.5 Inland waterway digital information services in France

Voies navigables de France (VNF) is the French navigation authority in charge of managing the majority of France's inland waterways network and their associated facilities – dams, locks, towpaths, lock-keepers houses, and other structures. VNF is also responsible for the development of commercial and leisure inland navigation.

The management of the aforementioned factors is found in the RIS (River Information Services) in France, and it focuses on the safe and efficient inland navigation of the barges rather than optimizing logistics chains. Different (mandatory) portals are installed for the barge operators along the rivers in France based on the AIS (Automation Identification System). Through these portals, the involved stakeholders can communicate and anticipate the arrival of barges at the locks, bridges, or terminals.

However, the use of the RIS system is not sufficient enough, to collect and share data for optimizing logistics services. Therefore, the French government is looking into other digital information services or applications that can providegive data about the cargo system, cargo reports, berth origin, destinations, and the type of (hazardous) goods. These can be compared with the Dutch BICS (Binnenvaart Informatie en Communicatie Systeem), which operates as a digital information service for the skippers, freight forwarders, barge operators, and reduces administrative burdens. Other information services are reviewed, that could be implemented in the French waterways, such as the Dutch information service iBarge. The ambition of the government is to implement a new security system, based on blockchain technology.

Other projects, which are running in France are based on the Internet of Things (IoT), which is the interconnection via the internet of computing devices embedded in objects (e.g. along the rivers, in the locks, at the bridges, in the barges, and the seaports or terminals) to send and receive data. Moreover, VNF, signed a partnership with the rail-network management, to research the possibilities for exchanging static and dynamic data of inland waterways. This project is labelled as the 'green freight,' it is started to provide decision-makers, public parties,

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or barge operators to choose the optimal decision for logistics performance or future investments.

Lastly, integrated digital information services for synchromodality are currently in the research or experimenting phase. Digital information services based on blockchain or IoT are widely tested and different projects will start to increase data-sharing and perform the best logistics performance.

3.6 Inland waterway digital information services in Germany

The Federal Ministry of Transport and Digital Infrastructure will take measures in the short- and medium-term to address the digital challenges for inland waterway transportation.

In freight transportation, reliability and on-schedule delivery are the key indicators, for the decision-making choice for the mode of transport. Inland waterway transport operators are therefore highly interested in increasing the reliability of locking operations. The Federal Waterway and Shipping Administration's electronic waterway information service (ELWIS) makes available data on the accessibility and operating hours of the locks on inland waterways. The reliability of locking operations is to continue to improve. The ELWIS is the current operative RIS system, which is used in the German inland waterways.

The Federal Waterways and Shipping Administration informs and supports shipping to facilitate smooth and safe transport operations on the waterways. To this end, the traffic service centres of the Federal Waterways and Shipping Administration are in direct contact with shipping with the help of the Automatic Identification System (AIS). AIS and radar stations receive traffic data and transmit them to the traffic service centres. The Federal Waterways and Shipping Administration installs and operates shore-side AIS infrastructure. To increase safety in inland waterway transport, AIS coverage of the waterways of network categories A, B, and C is aimed for. The Federal Waterways and Shipping Administration is currently making it available to the users' electronic waterway charts for inland waterways of category IV and higher. Inland waterways of categories I to III have not been recorded in electronic waterway charts. Thus, it will be possible to create overviews for all the different types of vessels in inland waterways.

The Federal Waterways and Shipping Administration's electronic waterway information service (ELWIS) already makes available comprehensive information for inland waterway transport. In particular, it is possible to retrieve water levels and traffic information as well as waterway infrastructure information and traffic statistics. An expansion of water body information to include, for instance, information on current velocity and a shorter and longer-term water level forecast (currently: four-day up to ten days water level Inland Waterway Transport Masterplan Control Centre forecast) could significantly facilitate the journey duration planning of the users (T. Aretz, personal communication, February 8, 2022).

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In the event of emergencies and accidents, the National Reporting and Information System for Inland Waterway Transport of the Federal Waterways and Shipping Administration (Na-MIB), which was set up in 2010, provides the responsible rescue services with the information they require. In the case of such events, the respective traffic control centres of the Federal Waterways and Shipping Administration simultaneously inform the inland waterway crews about the condition of the waterways in the area. The electronic reporting of container vessels and inland tank vessels on the Rhine is already mandatory. The expansion of Na-MIB to all waterways enhances the safety and efficiency of the traffic on the waterways. This is the system, which is originated from the RIS-Electronic Ship Reporting technologies.

For the future, the Federal Republic of Germany is supporting the concepts of autonomous navigation. These innovations could brace the inland waterway transport mode compared to other transport modes. Different research and pilot projects are performed in different innovation fields to launch on suitable waterways. New processes in the field of automated and connected navigation – including autonomous navigation – can help the inland waterway transport industry to operate at an optimum level and to enhance the competitiveness of inland waterway transport. In addition to uninterrupted broadband communication, large amounts of data have to be made available on digital information services for this purpose. There are already various research and development projects that deal with automated and connected navigation. To do practice-oriented research in these innovative fields, digital test beds have to be created on suitable waterways.

In all the measurements, the Federal Ministry of Transport and Digital Infrastructure has a facilitating, supporting, and funding role towards the system information, or investments for the future. Also, providing the instruments for the new technologies and developments for the testing fields in Germany. Parallel, it is crucial that the physical and digital infrastructure for autonomous navigation is adjusted for these innovations, to be smooth in operation.

The Federal Republic of Germany is heavily involved in the EuRIS project, as it has an interest due to the TEN-T corridors that cross in Germany. Also, the project should provide digital information for the skippers that cross by Germany, to other destinations in Europe. The members of the involved countries of the respective TEN-T corridors ensure the exchange of data for navigation, traffic management, and logistics planning across borders.

Another issue, which is faced and tackled by Germany and the EU is the legal framework for uniform digital cargo documentation for cross-border transport. Digitalization offers great opportunities for optimizing and automating this exchange of information and thus enhancing the efficiency of transport operations. Attached to the legal framework, in a few cases, the IT systems for electronic transport information and data exchange for business are unconnected. The EU Commission seeks to address these problems with the proposal for a Directive on the harmonisation of electronic transport information (Federal Ministry of Transport and Digital Infrastructure, 2019).

3.7 Inland waterway digital information services in the Netherlands

The Netherlands is performing research and testing the digital information services with its resources to improve the use of the digital information services in the Netherlands. The systems used by the inland skippers and the water management authorities are, the vaarweginfo.nl and BICS (Binnenvaart Informatie- en Communicatie Systeem) (Quist, 2021). The vaarweginfo.nl is the Fairway Information Services (FIS) portal of the Netherlands, which shows the following information:

- Notifications to the skippers.
- Information as of the time windows, and sizes of the bridges, locks, and the draught of the waterways.
- Water levels, discharge, and heights of the locks.
- Seasonal information, concerning ice maps and water notifications.
- Electronic Navigational charts.

The BICS system is facilitating mandatory and voluntary electronic reporting (of cargo and origin-destination) to fairway authorities. Reporting of statistics is an additional secondary feature”

Furthermore, different private and public initiatives are researching, testing, and using different digital information services for the inland waterways. The type of data and the exchange of the data on the information services are based on the owner of the information services. The digital information services, which are built up or operated from the commercial parties, such as the ports, or inland terminals, use the data more towards planning for labour, (un)loading of the freight, and the planning for the reach stackers or transhipments to the hinterland. Examples of the information services used in the Netherlands are, Portbase, PortXchange, or Nextlogic.

In addition, there are also data information services from private parties, like Connect4Shore and BlueWave. Connect4Shore provides various nautical services to skippers. The services provided are shore power, drinking water, payment of transit, mooring fees and waste processing. Skippers can easily start and stop their transaction with their mobile phone via the app, website or IVR. All costs are charged monthly on one clear invoice. Blue Wave Connecting provides real-time data on opened bridges and available berths in ports. Information that allows skippers and road users to better plan their journey and arrival, with less nuisance and annoyance and without unnecessary fuel consumption and exhaust emissions. Blue Wave offers this data for a large number of regions in the Netherlands and is expanding these services further and further across the country.

The administrative process in the inland waterways of the Netherlands is widely digitalized and is paperless. These processes were implemented after the digital transition in maritime transport. The RIS systems that are used, are mostly exchanging data between the skippers/shippers and the waterway management authorities. Furthermore, commercial

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information services are taking advantage of the lack of exchange of data between third parties. Therefore, private parties are innovating and developing applications for third parties to ease freight transportation. On the contrary, the large number of applications developed creates confusion and the overview is often lost. Currently, the main transport objective of freight transportation is transitioned to an economic objective. Now, the objective is transitioned with an economic objective, and scaling up systems or creating standards are not performed. This leads that supply chain for the freight transportation for origin and destination are not optimized (R. van Bockel, February 1, 2022).

On a Dutch or European level, it is shown that the standards for inland waterways are not harmonized. Every country and even inland terminals in the country have their demands or rules. The barge operators experience a lack of trust for providing data, which could endanger their privacy.

Concerning synchromodal transport, the EuRIS project offers opportunities to ex-change data cross-borders in a standardized and harmonized format. However, the EuRIS is only designed from the perspective of the skippers/shippers and waterway management authorities and not from transport modes. To create more synchromodal transport an independent system or information service is desired, which needs to have the objective of transporting freight from origin to destination. Instead of individual parties and information services that offer separate services. So, the current digital systems are for operational uses on the waterways, but for more tactical and strategical levels and integration with public authorities, shippers and Logistics service providers EuRIS is an potential initiative(R, van Bockel, February 1, 2022). EuRIS is the public portal for waterway information, and is the harmonized system within Europe.

3.8 Inland waterway digital information services in Europe

The information and interviews of the waterway management authorities and the commercial freight forwarders of each of the countries show that the extent of digitalization differs per region and per country. Each country and even the private companies use their systems for planning, labour, (un)loading at ports or inland terminals.

Table 3.3 Overview of national RIS in the five involved countries

County	National RIS
The Netherlands	Vaarweginfo, BICS
Belgium	VisuRIS
France	VisuRIS
Austria	CEERIS
Germany	ELWIS

Therefore the following conclusions can be drawn:

- The implementation of standards are not harmonized throughout the European countries, which causes room for misinterpretation. Harmonizing the same interpretation of the RIS standards of data cross-border is critical, to optimise the barge transport mode. EuRIS offers the opportunities to tackle the bottlenecks by harmonizing the standards into one information service.
- It is shown that the links to the other planning systems are not integrated into the system and that EuRIS is only designed from the inland waterway transport perspective. However, other users can access the information at EuRIS. Next to this, other information services are individually used by the parties in the chain, such as systems for the ports, or planning tools of other transport modes.
- An overview of the five involved countries concerning digitalization is shown in table 3.2 The connection to which extent the digitalization and synchromodal transport are developed is further elaborated in chapter 5.

Table 3.3 Overview with the bottlenecks and strengths concerning the current digital infrastructure

	Bottlenecks	Strengths
Austria	• The harmonization of digitalization • Form registration is insufficiently organized, with the adjacent countries. • Hurdles for nationwide implementation, due to technical financial, legal, and organizational issues.	• Austria developed harmonizing forms for countries connected to the Danube. • Austria is also among the 13 European countries who together developed and are operating the systems EuRIS and CEERIS (Central & Eastern European Electronic Reporting Information System).
Belgium	• Forms registrations by arrival and departure are performed physically, instead of digitally. • The implementation of IT-related software executed in small steps, through the states, Flanders-Wallonia-Brussels • Only Flanders takes an active role in the implementation project EuRIS	• The origin of the VisuRIS is from Belgium, which is used as the basis for the EuRIS system • Working with full forces towards the mobility policy for 2030 • Working closely with ports, to share and integrate data and create interoperable (portal) systems (opportunity to scale up 1). • Researching possibilities for digital notifications for inland skippers, arrival at Flemish waterways
France	• Digitalization only focuses on safe and efficient inland navigation of the barges.	• Looking into multimodal approaches to the digital transformation to boost the modal shift. • Experimenting with new technology and looking for partnerships with rail modality. • Researching into a information service with block-chain technology or IoT (Internet of Things) and possibilities to combine information services with rail management (opportunity to scale up 2)
Germany	• Germany and the EU, the legal framework for uniform digital cargo documentation for cross-border transport is a bottleneck. • The IT systems for electronic transport information and data exchange for business are unconnected. The EU Commission seeks to address these problems with the proposal for a Directive on the harmonisation of electronic transport information.	• ELWIS takes up to 10 days the water levels forecast, will be an add-in in the EuRIS project • Since September 2021 electronic shipping documents via eCMR are legally accepted in Germany. • With eCMR EU Member States use the same digital information service for shipping documents which reduces administrative costs. (opportunity to scale up 3)

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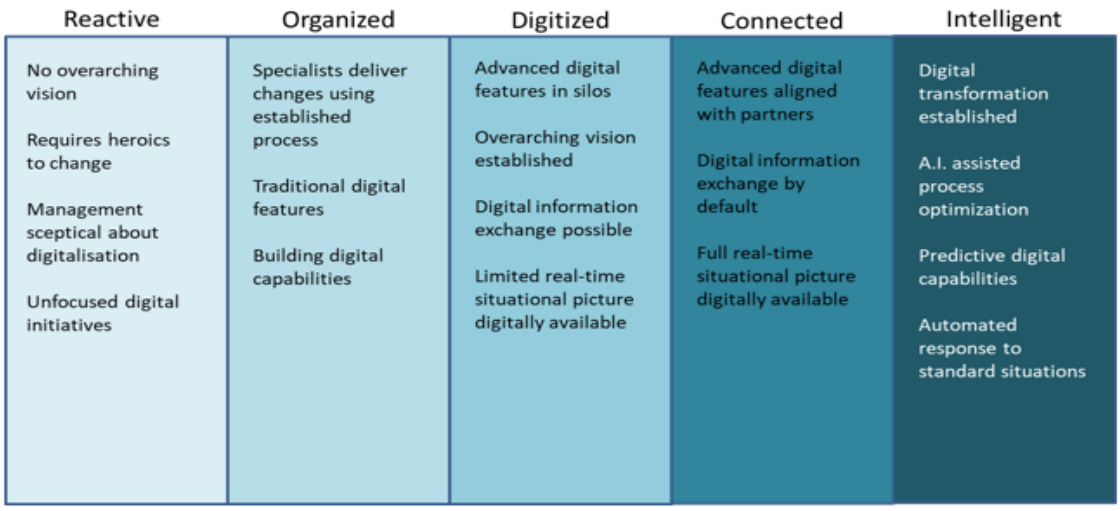
	Bottlenecks	Strengths
The Netherlands	• Individual IT information services instead of combined, collective and integrated information service • Information is available, but the overview is often lost. Or it is not always easy findable for the parties. • The existence of certain information is not always in knowledge of parties.	• Most of the enrolment and arriving on Dutch waterways is performed digitally. • Paperless transition in inland waterways. • Less administrative burden

3.9 Assessing the maturity of inland waterway digital information services

From the DIWA partners, the digitalization of inland waterways is divided into five different levels. These five levels shows the initiatives, and mindset towards digitalization in inland waterway transport (see figure 3.5).

Figure 3.5 The DIWA Maturity model



For each country, with the information resulting from desk research and interviews the assessment for the five countries is made. The information and assessment is divided into three main components, the information flows administration, future opportunities and ambitions and research/ test fields.

Figure 3.6 Assessment of maturity of public IT inland waterway information services in different countries

	France	Germany	Austria	Belgium	The Netherlands
Information flows administration	Focus on Digital form-filling, largely performed non-digitally.	Focus on Digital form-filling, largely performed non-digitally.	Administrative processes digitized. East-European countries lack digitalization	Focus on digital form-filling but not mandatory, partly performed non-digitally.	The administration processes are widely digitalized. Results on less administrative burden.
Future opportunities and ambitions	Focus on use of different digital platforms for planning purposes such as iBarge.	Expansion of NaMIB (Electronic Reporting System) to all waterways enhances safety and efficiency of barge traffic. System is developed from the RIS-Electronic Ship Reporting technologies.	Use of CEERIS is stimulated with neighbouring countries Implementation of EuRIS is performed in phases.	Flanders and Wallonia are working separately. Flanders is ahead, further implementation of VisuRIS en EuRIS in Wallonia and Brussels.	Nextlogic usage in the inland waterways, for real-time tracking of vessels for the transhipment of containers in the port of Rotterdam.
Research/ test fields	Experimenting with connected sensors on bridges and locks (IoT) and data storage in blockchain environment.	Test fields in autonomous and connected navigation	Focus on solving lack-of real-time information availability for private organisation.	Digital platforms offer real-time planning and modal shift. Front runner in use of automated barging	Researching and testing autonomous ships (TU Delft), together with Flanders

Chapter 4 Assessment of synchromodal freight transport

4.1 Explanation of synchromodal maturity model

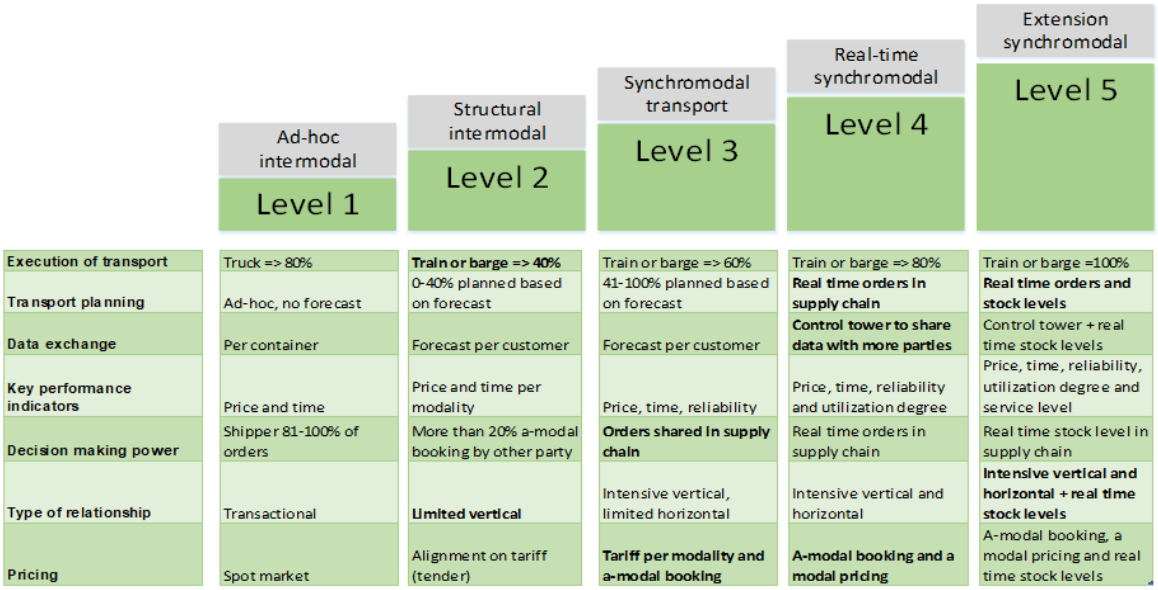
The synchromodal maturity model has been developed by Alons-Hoen, Somers and Van Duin (2019) and can be applied to different levels of operations of transport. The synchromodal maturity model helps to define the level towards synchromodality for companies/private organisations in the five researched countries, such as the frontrunner companies. The maturity model consists of five levels:

1 Ad-hoc intermodal transport
2 Structural intermodal transport
3 Synchromodal transport
4 Synchromodal transport with real-time planning and capacity
5 Extension synchromodal transport

Key components in the Synchromodal Maturity Model are (Alons-Hoen, Somers and Van Duin, 2019):

- Transport execution: how transport is executed (e.g. by Truck, Train, and/or Barge).
- Transport planning: how transport is planned (planning horizon, and granularity).
- Data exchange: the data requirements for correct execution of the planning.
- Key performance indicators: how feedback is given about the performance of the operational processes.
- Decision-making power: which stakeholder can decide how and when the transport is executed.
- Type of relationship: degree of horizontal and vertical collaboration in the supply chain.
- Pricing: how the tariffs are set and how payment takes place.

Figure 4.1 Synchromodal Maturity model



Source: Alons-Hoen, Somers and Van Duin, 2019

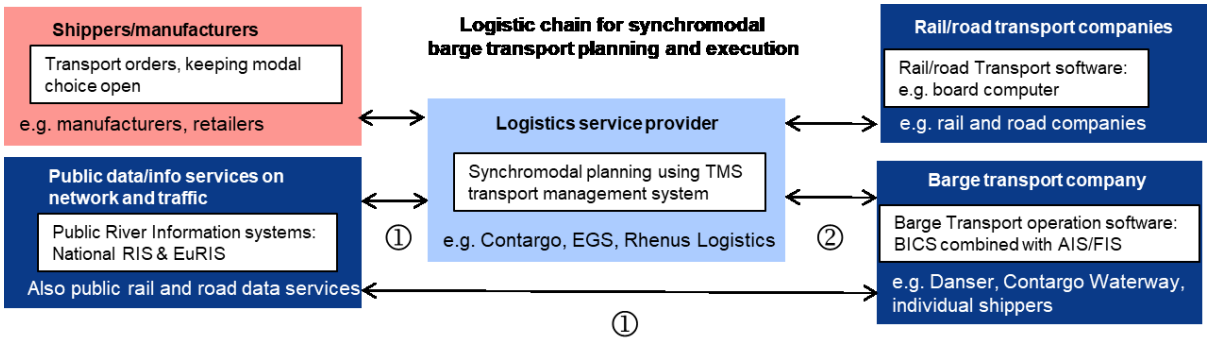
As shown in figure 4.1, the different levels of synchromodal transportation and the performance transport indicators are shown. The following transitions are observed when the levels are shifted (Alons-Hoen, Somers and Van Duin, 2019):

- Transport execution: starting at level 2 most transport is intermodal transport (rail or barge), and road transport is only used in case of exceptions.
- Transport planning: starting at level 2 the shippers make upfront reservations of capacity based on a forecast. Starting at level 4 real-time information about transport orders is shared and planned accordingly. In level 5 stock information is shared real-time for the logistics service provider for transport planning.
- Data exchange: for levels 2 and 3 a forecast is shared between the skippers and the logistics service provider. Real-time information on transport orders is necessary from level 4 to fill the control tower. Additionally, real-time stock information is needed in the control tower at level 5. This real-time data includes traffic flows, type of cargo, estimated time of arrival, (un)planned maintenance, waiting times (on locks), multiple route options, synchronized forecast on water depths and weather conditions.
- Key performance indicators: reliability is added to the performance indicators at level 3. Utilization is added as a KPI for the service providers. Also service level becomes an important KPI for shipper and logistics service providers at level 5.
- Decision-making power: starting at level 3 the shipper books his transport a-modal, giving the orchestrator the freedom to plan and execute the transport optimally. Real-time information for booking is added at level 4. At level 5, the logistics orchestrator plans the arrival and/or departure time of transport based on real-time inventory levels.
- Type of relationship: starting a level 2 vertical collaboration in the chain is required. At level 4 intensive horizontal collaboration between logistics service providers and operators is required to fully benefit from synchromodal transport.

- Pricing: at level 2 prices are agreed upon by tariff and are quoted per modality. In level 3 prices are estimated up front and adjusted afterward based on actual usage of modalities. Starting at level 4 an integral price is defined for a trajectory with an average lead time.

In operational practice, the examples of data exchanges between these public and private parties to facilitate synchromodal planning are summarized in the figure below. In the interviews, the following data elements were mentioned as missing or incomplete by companies.

Figure 4.2 Examples of Data exchange needed for synchromodal transport planning and execution in inland transport



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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

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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

However, in practice most of the mentioned data elements are available from the data information services of European fairway authorities. This implies that it is not well known that these data elements are already available, and that the awareness of companies about improvements in the data information services of European fairway authorities has to grow. The mentioned data elements in the figure above include:

1. Data elements communicated between private and public data information services, to be used for planning synchromodal transport services. The logistics service providers exchange and use data from/to public national RIS and European EuRIS to plan synchromodal transport.
2. Data elements communicated between private data information services, to be used for planning synchromodal transport services. The logistics service providers exchange data with barge operators (and road/rail operators) to plan synchromodal transport.

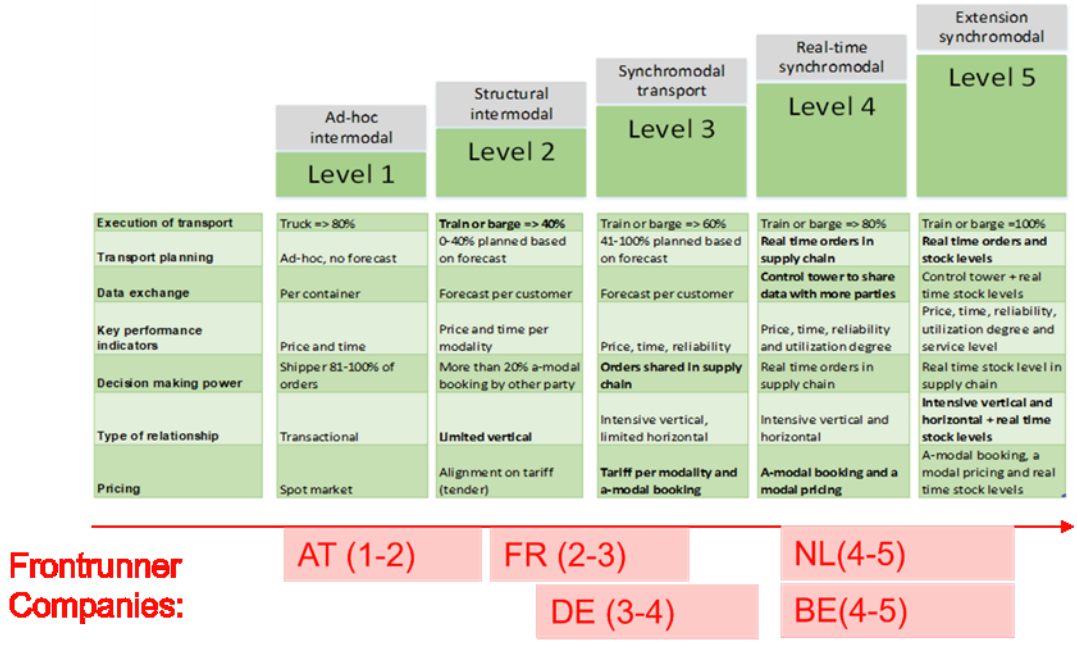
The conclusion from the analysis of data elements to be exchanged include:

- LSPs and barge operators are still missing data from fairway authorities that can help them using synchromodal planning. Companies are looking for dynamic traffic and lock opening times in order to reduce waiting times in barge transport (needed to be competitive).
- However, most of these data elements are already available to them in the national RIS and EuRIS data information services of European fairway authorities
- Companies are also looking for links between capabilities of national RIS and EuRIS data information services and port IT information services in main seaports in order to find solutions for seaport barge planning.

4.2 Synchromodal Maturity assessment per country

In the research for this project, information is collected from all five countries regarding inland waterway transport, digitalization and synchromodality. This paragraph is based on desk research and interviews from chapters two and three. The focus is mainly on inland waterway transport, however, rail and road are also taken into account for each country because synchromodal transport involves the flexible use of all three transport modes next to each other. What can be concluded is that public and private parties have different views at synchromodality and use this at a different level. The public authorities have a facilitating role in providing the means for synchromodal transport, and on the other side the private organisations perform the synchromodal transport. From an expert view, frontrunner companies from the five countries can be divided into the Synchromodal Maturity Modal as shown in figure 4.3. This is done with qualitative data. It must be said that 100% barge and train at level 5 is not feasible. The first and last part of the route needs to be done by road at most of the times.

Figure 4.3 Synchromodal Maturity Model assessment expert view



In a benchmark, the current state of digital services of public authorities, which can support synchromodal transport in the various countries, has been assessed along with broader KPIs that relate to reliability, travel times and waiting times for inland waterway transport. For each country, the results of the benchmark are available and are listed in figure 4.4.

Figure 4.4 Synchromodal Maturity Model assessment expert view

Benchmarking the current use of synchromodal planning	Ease of using inland container waterway transport	Availability of relevant data services from authorities	Level of synchromodal planning	Potential for synchromodal planning	Main Barriers to solve
Austria	-	++	-	++	Set up of container barge services
Belgium	++	++	++	+	Convincing clients to use synchromodal transport
France	0	+	0	+	Set up of synchromodal planning
Germany	+	+	+	++	Effective use of inland waterway infrastructure (locks)
Netherlands	++	++	++	+	Convincing clients to use synchromodal transport

The results of the benchmark are summarized per country below.

Assessment of synchromodal transport in Austria

For both the frontrunner companies in Austria, their synchromodal maturity level is level 1: Ad-hoc intermodal. One of the reasons is that Austria has no scheduled container inland waterway services, only for rail. Inland waterway transport is sporadically used in the case of peaks, and bulk or empty containers have to be transported. This also results in the fact that no modal shifts are be made during the voyage. The logistics service operators in Austria are still in the first steps of implementing synchromodal transport. The use of inland waterways has a large potential for development, and main inland waterway operators like Rhenus Logistics could take the first steps in developing synchromodal transport services in the next years. However, companies are also very dependent on the wishes of the customer. More cooperation is needed for synchromodal transport, not only between shipping companies but also between rail and inland waterway operators. When the share of barge and rail increases, the Synchromodal Maturity Level also increases. This also applies to an increase in scheduled routes for the barge.

The benchmark for the current use of synchromodal planning in Austria:

- Ease of using inland container waterway transport: the score is -, using inland waterway container transport in Austria is difficult because currently there are no regular services for loaded container waterway transport;

- Availability of relevant data services from authorities: the score is ++, because the Austrian fairway authorities have relatively well-developed inland waterway data services and are also involved in EuRIS;
- Level of synchromodal planning: the score is -, because the lack of inland waterway container services makes to difficult to develop synchromodal planning capabilities;
- Potential for synchromodal planning: the score is ++, because potential to develop synchromodal planning capabilities are high. But the economic business case of inland waterway containers services first has to be developed;
- Main Barriers to solve: the set up of regular inland waterway container services on the Danube.

Assessment of synchromodal transport in Belgium

For the frontrunner companies in Belgium, the Synchromodal Maturity Modal is level 3: synchromodal transport. This is because operators in Belgium are combining the use of road, rail, and inland waterways more often. However, the share of rail and inland waterways has not increased in the last years. To push the modal shift, the cost of rail should be reduced. Especially, the transhipment, handling, and operational costs lead to higher differences. Part of these costs could be financed by government subsidies. Only when road transport is more expensive than rail and inland waterway the modal shift will take place. Belgium also has a large number of inland waterway operators. It must be said that at this moment, when looking at the Synchromodal Maturity Modal, Belgium can be split in two. Flanders, with the port of Antwerp, has a synchromodality level of 3. For Wallonia, the Maturity Level is at level 1 to 2.

By equally developing Flanders and Wallonia on physical and digital infrastructure the Synchromodal Maturity Level will increase to level 4. The use of the Seine-Schelde canal will also increase the use of inland waterway transport in Wallonia. For the Synchromodal Maturity Model to increase for private parties, it is important to also include smaller and medium-sized companies. They could be included by providing information and means for synchromodal transport of freight transport. Only then a broad synchromodal network can be realised.

The benchmark for the current use of synchromodal planning in Belgium:
- Ease of using inland container waterway transport: the score is ++, using inland waterway container transport in Belgium is very easy because there are numerous loaded container waterway transport shuttles services per week, especially in Flanders;
- Availability of relevant data services from authorities: the score is ++, because especially the Flemish fairway authorities are one of the leaders in Europe concerning the development of innovative inland waterway data services and are also involved in EuRIS;
- Level of synchromodal planning: the score is ++, because the numerous inland waterway container services provides a stimulus to develop synchromodal planning capabilities;
- Potential for synchromodal planning: the score is +, because the potential to develop synchromodal planning capabilities has already partly been realised. The challenge is to facilitate SME's to develop synchromodal planning capabilities;

- Main Barriers to solve: Logistics service providers have developed Synchromodal planning capabilities, the main challenge is to convince clients (manufacturers, retailers, wholesalers) to use inland waterway instead of road transport.

Assessment of synchromodal transport in France

Large inland waterway operators are already operating in France. However, these operators do not offer synchromodality on a large scale. Because of this France can be placed on level 1 of the Synchromodal Maturity Model. Opportunities lay in the fact that these international operators cover multiple European countries which makes it easier to implement synchromodality. Because the Northern and Eastern parts of France are using inland waterways, this gives France opportunities to switch between modalities. Large shippers are also interested in the concept of synchromodality. However, medium and smaller-sized companies are less interested to invest their energy and time in synchromodality (E. Flipo, personal communication, December 23, 2021).

The use of the Seine-Schelde canal will increase the use of inland waterway transport and also increase the Synchromodal Maturity Level because France will be part of a larger inland waterway network. When the physical infrastructure is improved this will also stimulate the aspect of key performance indicators. It will be more reliable, the travel times will be faster and the utilization degree will improve. Since medium and smaller-sized companies are less interested in synchromodality it is important to include these companies for improving the Synchromodal Maturity Level for private companies. This can be done by providing funding for using digital systems. Only when small and medium-sized companies collaborate with the frontrunners, the small and medium-sized companies can use the remaining capacity of the trains or barges. By gaining insight in the capacities of other transport modes, it is possible for logistics service provider to make an optimal real-time synchromodal planning. So, it is possible to switch to other modes, due to maintenance of infrastructure or bad weather conditions, or other external factors (J. Baudy, March 8, 2022).

The benchmark for the current use of synchromodal planning in France:
- Ease of using inland container waterway transport: the score is 0, using inland waterway container transport in France is only possible in certain parts of the country and the economic feasibility is a challenge due to smaller waterways in some parts of the country
- Availability of relevant data services from authorities: the score is +, because the fairway authorities are following the leaders in Europe concerning the development of innovative inland waterway data services and are also involved in EuRIS;
- Level of synchromodal planning: the score is 0, because logistics service providers are still beginning to develop synchromodal planning capabilities;
- Potential for synchromodal planning: the score is +, because the potential to develop synchromodal planning capabilities has already been realised at a few frontrunners. The challenge is to facilitate more logistics service providers to develop synchromodal planning capabilities;
- Main Barriers to solve: Logistics service providers have not yet developed Synchromodal planning capabilities, the main challenge is to facilitate and stimulate the set up synchromodal planning.

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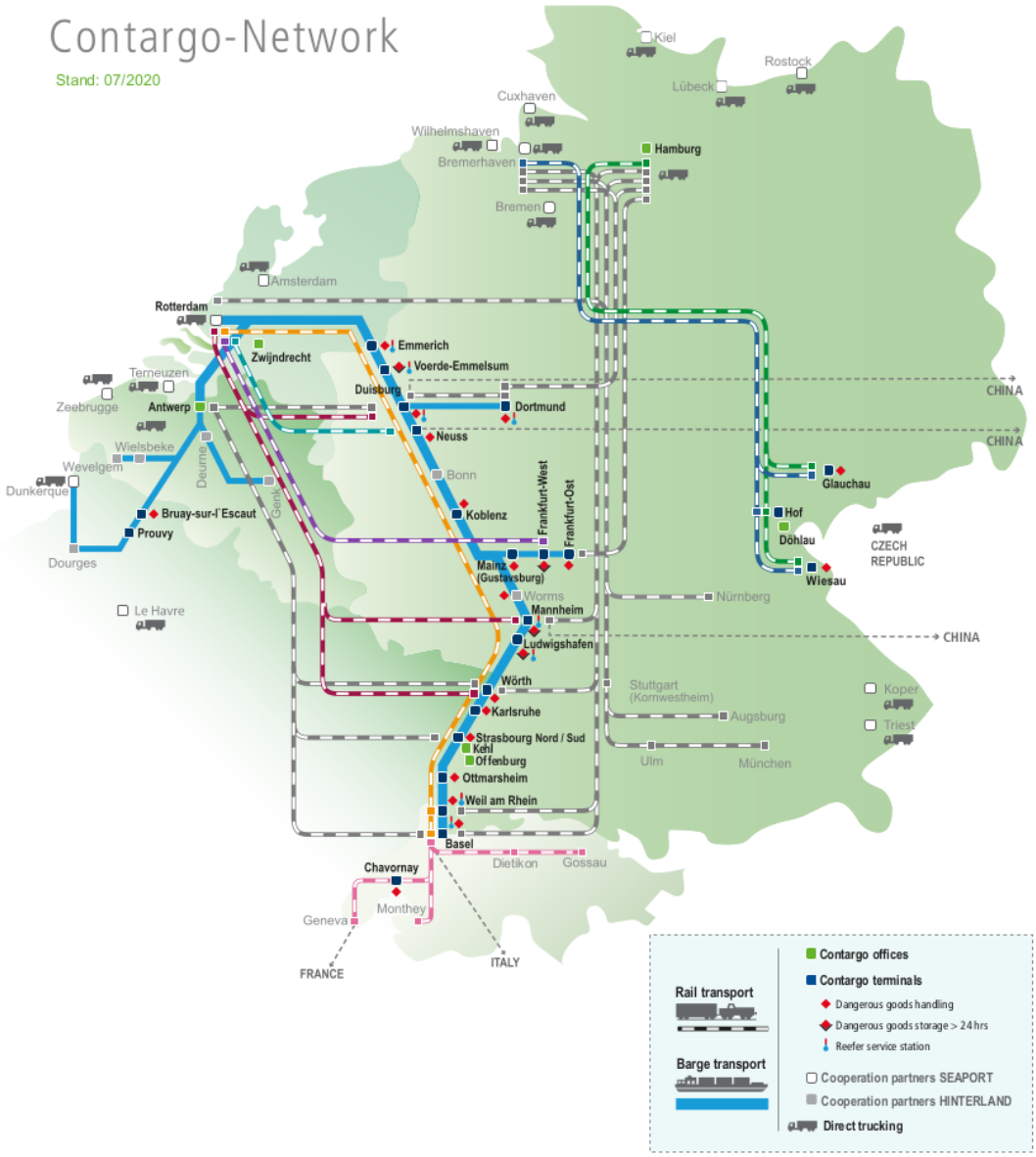
Assessment of synchromodal transport in Germany

Some large companies in Germany like Contargo are using synchromodality. This results in a Synchromodality Maturity Level 3. Germany is heavily interested in EuRIS and other European projects for digitalization. The Synchromodal Maturity Level for the government is 2.

Germany is covered by multiple corridors and has access to multiple inland waterways. However, still, a large part of the transportation is done by road. Even though Germany has large international logistic companies, they do not all use the inland waterways. (Frontrunner) private freight forwarders and shippers have options to transport freight in a synchromodal way, because of the economies of scale. Therefore, they have the option to offer transport sustainably to the shippers. On the other hand, small and medium-sized freight forwarders do not have the same options and often only offer trucks as the modality. When companies collaborate, the small and medium-sized companies can use the remained capacities on the trains or barges. This also applies to Austria, Belgium, France and The Netherlands. Also, the lack of maintenance work limits the use of inland waterways. The public authorities should contribute by supporting and providing good infrastructure. Different tests and pilots are performed with autonomous barges, but it lacks the needed infrastructure to operate smoothly. For instance, by implementing autonomously operated locks or smart ports it could be possible that freight has the option to be delivered overnight (T. Ambra, personal communication, February 10, 2022). The autonomous locks are considered to be completely autonomous and will be closed and opened by sensors, and digital data exchanges. It is visioned that no manual actions are required. These are ideas to stimulate the use of inland waterways, not only for Germany but also for Austria, Belgium, France and The Netherlands.

Contargo is a large logistic operator that is located in Germany, The Netherlands, France, and Switzerland. The core activities include barge lines with fixed routes and schedules connecting the inland terminals on the Rhine and Main with the western seaports (Antwerp-Rotterdam-Amsterdam). Contargo also provides intermodal and synchromodal transport services, with the logistic network of rail, barge, and road. The modes can be used interchangeably and are an extension to the inland waterway connections of Contargo (Contargo, 2021). The network of Contargo is shown in the figure below.

Figure 4.5 Synchromodal Network map of Contargo



Source: Contargo, 2021

Opportunities for Germany lay in their policy. Germany set goals to achieve the digitalization of the transport industry. However, their policy is not so much focused on increasing the share of inland waterway transport, rather it focuses and invests in the expansion and digitalization of the rail sector. Keeping up with the maintenance on inland waterways can help to increase the share of inland waterway transport.

The benchmark for the current use of synchromodal planning in Germany:

- Ease of using inland container waterway transport: the score is +, using inland waterway container transport in Germany is possible in large parts of the country. The economic feasibility of inland waterway transport is clear on the larger waterways like the Rhine and Elbe, but more difficult for the smaller waterways in some parts of the country

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- Availability of relevant data services from authorities: the score is +, because the fairway authorities are following the leaders in Europe concerning the development of innovative inland waterway data services and are also involved in EuRIS;
- Level of synchromodal planning: the score is +, because logistics service providers are in general following activities in Belgium and the Netherlands in developing synchromodal planning capabilities, but there are frontrunners companies like Contargo;
- Potential for synchromodal planning: the score is ++, because the potential to develop synchromodal planning capabilities is large and has already been realised at a few frontrunners. The challenge is to facilitate more logistics service providers to develop synchromodal planning capabilities;
- Main Barriers to solve: The main challenge is the effective use of inland waterway infrastructure (locks) throughout the country, with a focus on the medium and smaller sized rivers and canals.

Assessment of synchromodal transport in The Netherlands

The Netherlands is the most mature country in Europe when it comes to inland waterway and synchromodality, together with Belgium. The level of The Netherlands in the Synchro-modal Maturity Model for frontrunner companies 4. The number of Dutch inland waterway operators that offer multimodal transport and synchromodality is higher than the other four countries mentioned above. Therefore, Dutch companies seem to be exploiting the benefits of this relatively new concept more. Inland waterway has a large share of the total transportation and multiple initiatives for synchromodality are already made. In the end, the concept of synchromodality found its origin in The Netherlands, based on a formulation of an innovation concept for inland transport by the Deep sea terminal organisation ECT in 2011.

European Gateway Service (EGS) is a Dutch company located in Rotterdam which is offering synchromodal service. It is a daughter company of ECT, a deep sea terminal in Rotterdam. Through EGS, ECT offers shipping lines, logistics service providers, and skippers an extensive network of highly frequent rail and inland barge services. These services directly connect the international terminals in Rotterdam with a growing number of strategically located inland terminals in the European market. From various modes of transport – rail, inland shipping, truck – the best option for that moment is selected. The connections for EGS are located in the Netherlands, Belgium, Germany, and Austria (see figure below) Some locations, like Vienna, Kehl and Amsterdam are operated by partner connections (European Gateway Service, 2021).

Figure 4.6 Network map European Gateway Service

Source: European Gateway Service, 2021

European Gateway Services mainly experiences challenges to improve synchromodality with the customer. Some customers do not want to hand over control. These types of customers largely determine the planning of their containers. This makes it difficult to apply synchromodality. Costumers should be made aware by companies and the government of the possibilities and benefits of synchromodality. (P. Zoeter, personal communication, January 27, 2022).

The benchmark for the current use of synchromodal planning in the Netherlands is only in minor details different from Belgium:

- Ease of using inland container waterway transport: the score is ++, using inland waterway container transport in the Netherlands is very easy because there are numerous loaded container waterway transport shuttles services per week;
- Availability of relevant data services from authorities: the score is ++, because the fairway authorities are one of the leaders in Europe concerning the development of innovative inland waterway data services and are also involved in EuRIS;
- Level of synchromodal planning: the score is ++, because the numerous inland waterway container services provides a stimulus to develop synchromodal planning capabilities;
- Potential for synchromodal planning: the score is +, because the potential to develop synchromodal planning capabilities has already partly been realised. The challenge is to facilitate SME's to develop synchromodal planning capabilities;

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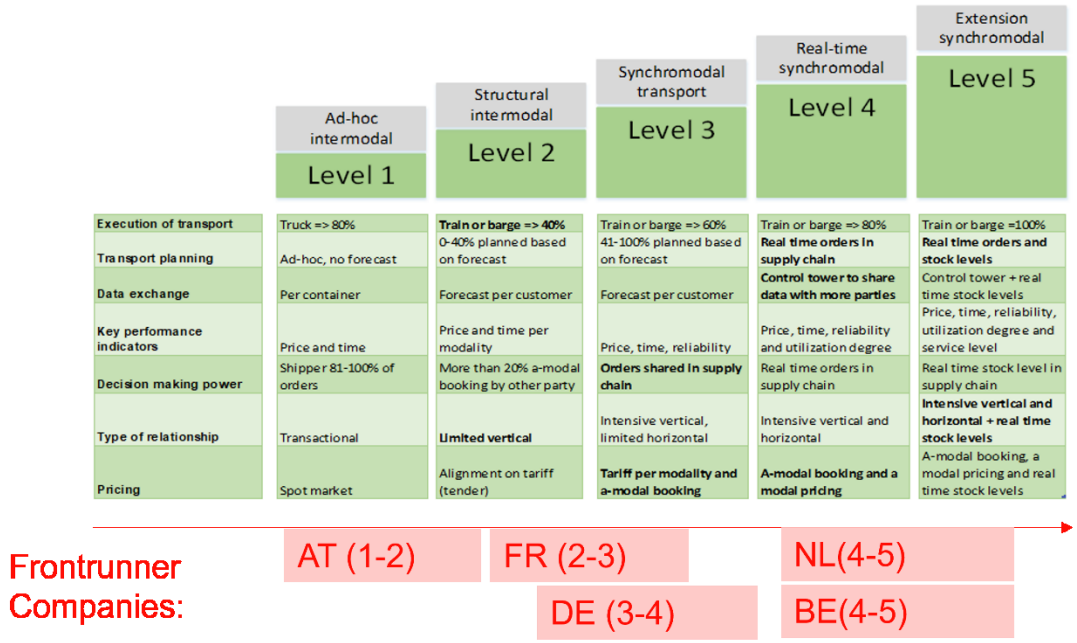
- Main Barriers to solve: Logistics service providers have developed Synchromodal planning capabilities, the main challenge is to convince clients (manufacturers, retailers, wholesalers) to use inland waterway instead of road transport.

4.3 Conclusion on synchromodal freight transport

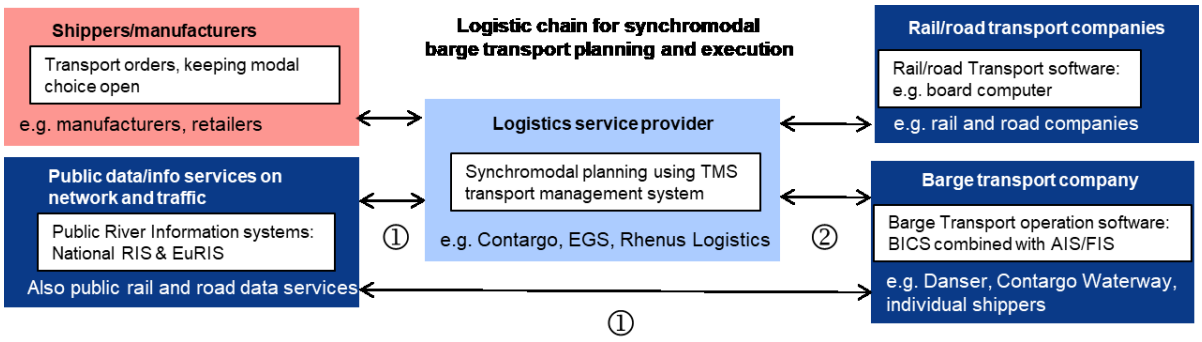
The conclusion of this analysis is that there is a difference in the Synchromodal Maturity Level per country, but also between government and frontrunner companies. The main differences are given in the figure below.

Figure 4.7 Synchromodal Maturity Model assessment expert view



Improvements for using synchromodality and all three transport modes are awareness of customers, physical infrastructure, and collaboration between frontrunner, small and medium-sized companies. The unawareness of customers limits companies to make their planning and to be flexible with the voyage. Also, the physical infrastructure, and especially lack of maintenance, limits the development of inland waterway transport, which is also part of the synchromodal concept. By developing autonomous locks, barges can be transported overnight. (Frontrunner) freight forwarders and shippers have options to transport freight in a synchromodal way, because of the economies of scale. Small and medium-sized freight forwarders do not have the same options, and often only offer trucks as the modality. When companies are collaborating small and medium-sized companies can use the remained capacities on the trains or barges. In the interviews, the following data elements were mentioned as missing or incomplete by companies.

Figure 4.8 Examples of Data exchange needed for synchromodal transport planning and execution in inland transport



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

However, in practice most of the mentioned data elements are available from the data information services of European fairway authorities. This implies that it is not well known that these data elements are already available, and that the awareness of companies about improvements in the data information services of European fairway authorities has to grow. The mentioned data elements in the figure above include:

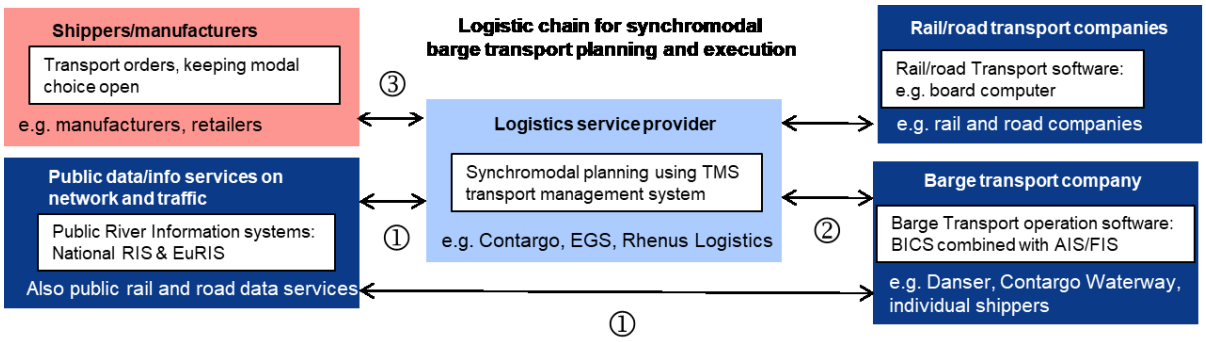
1. Data elements communicated between private and public data information services, to be used for planning synchromodal transport services. The logistics service providers exchange and use data from/to public national RIS and European EuRIS to plan synchromodal transport.
2. Data elements communicated between private data information services, to be used for planning synchromodal transport services. The logistics service providers exchange data with barge operators (and road/rail operators) to plan synchromodal transport.

Chapter 5 Roadmap for synchromodal transport

5.1 Future data exchange for synchromodal transport

In this paragraph, a road map is presented and elaborated for the development of data exchange capabilities between fairway and other authorities and companies (service providers and barge operators) to develop synchromodal planning capabilities at logistics service providers. The Road Map shows the opportunities to increase the use of data exchange services from authorities to increase the use of synchromodality in freight transport. The road map in figure 5.1 give the current situation in data exchange between fairway and other authorities and companies, the ambition in three up to five years, and the ambitions up to 2030. Also, the implications for achieving the desired steps are elaborated for the time period up to 2030.

Figure 5.1: Road map for the opportunities for data exchange between companies and authorities to develop synchromodal planning capabilities



Expected Development of data exchange flows	1. Data exchange between authorities and companies	2. Data exchange between service provider and barge operator	3. Data exchange between service provider and shipper (clients)
2022	-Use of national RIS, introduction of EuRIS	- availability of vessels/personnel	- transport orders/real time info on transport
in 3/4 years	'- links/integrated use of fairway and port authorities data exchange services	- optimal planning of future inland waterway transport	- service provider chooses inland waterway in synchromodal planning
vision for 2030	- steps towards facilitation of autonomous transport	- management use of autonomous vessels	- planning of autonomous vessels for

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The road map in the figure above shows the current and expected development in data exchange between fairway and other authorities and companies:

- In 2022 the use of data services from fairway authorities by service providers and barge operators will be improved with the availability of the EuRIS data information services next to the national RIS
- In 3 to 4 years, an integration of the data exchange services of fairway and sea port authorities can further improve data information exchange. Service providers then will have more integrated data available to plan future trips to and from sea ports.
- On to 2030 the development of autonomous shipping in inland waterway transport can take off. At the moment, autonomous inland waterway transport is already tested with 10 vessels in Belgium. Because autonomous inland waterway transport is both effective (less personnel needed) and cheap we except in the optimal scenario that autonomous vessel transport will start to develop in 3 to 4 years up to 2030.

The detailed information on the ambitions for the future and the needed steps are elaborated in the following paragraphs. The roadmaps are designed and based on the results of the previous chapters. The assessment of each country on the digitalization level is based on the DIWA Maturity Model (see figure 5.2).

Figure 5.2 The DIWA Maturity model

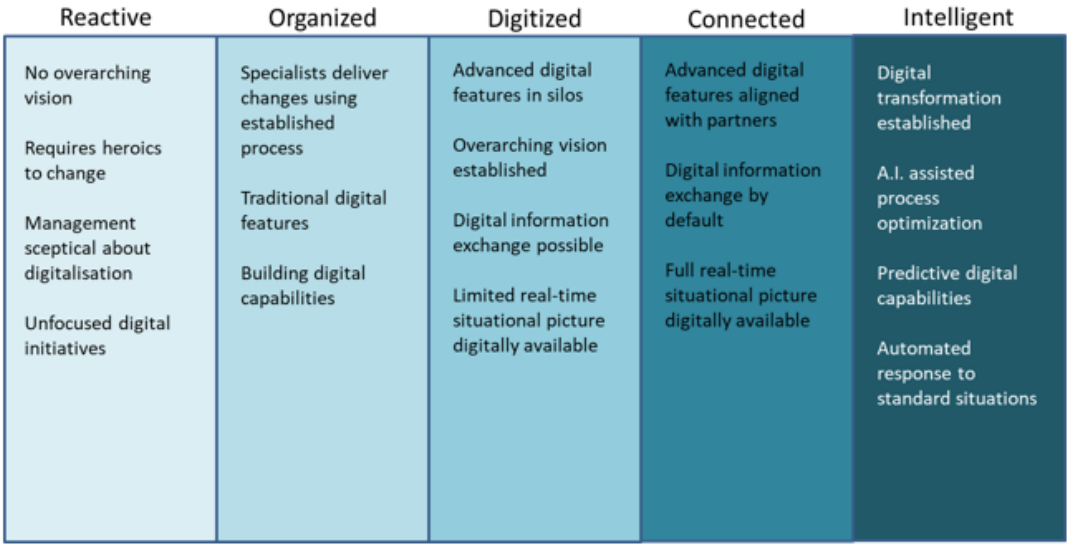

Figure 5.2 DIWA Maturity Model

The DIWA Maturity Model presents the possible different levels of digitalization on a European level and country-specific. Also, the results from chapter three are taken into account for complementing the different roadmaps. The current situation of each country is different, however for the upcoming three to five years, it is set to reach the level digitized to connected for all the European countries and eventually to the intelligent level in 2030. Moreover, the timeline of the roadmap is set on a ten-year ambition plan with the digital and (digital) policy components. The time scope of the roadmap covers the ambitions in the upcoming three to five years till up to 2030.It is only possible to reach synchromodality in

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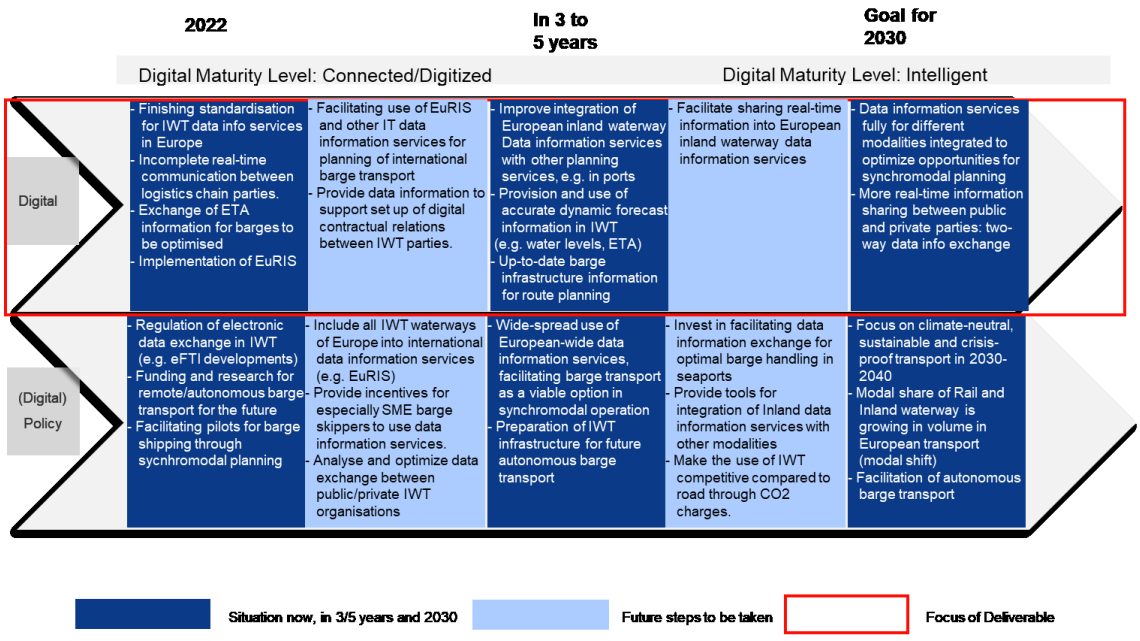
Europe by working together on an international level. That is the reason, that the goals are set up from three to five years from 2022. Because every country in Europe is at a different level at the Synchromodal and Digital Maturity Model, it is important to all reach a similar level in three to five years from 2022. From that point, European countries can work on an international level to reach full synchromodality by 2030. On the other hand, the scope on geographical level is scoped on TEN-T corridor levels for the first phase and eventually for all the waterways in Europe. Implementing the changes on the TEN-T corridor levels is possible due to the large freight transport volumes transported and the expected support from the DIWA partners. Once, the actions and adaptions are successfully implemented, the rollout can be expanded to all the European waterways.

5.2 Road Map public authorities to facilitate synchromodality

The European roadmap for facilitating synchromodal transport focuses on the ambitions for further development of digitalization of the inland waterways public data exchange information service (the RIS and EuRIS). The roadmap for the upcoming ten years on a European level is presented in the figure below. This figure presents an overview of the current situation in data exchange between fairway authorities and companies, the desired situation on the data information exchange in Inland waterways in the future and the possible actions to achieve a more digitalized inland waterway freight transport. In the following paragraphs, the policy instruments on a European level are described, and it is applicable for each country.

Figure 5.3 Road Map ambitions for further development of the inland waterways public data information services exchange



The EuRIS system is a single point of access for RIS Data and Services, so for the inland Waterway users and authorities. Next to EuRIS and national RIS, other data information services have to be used by logistics service providers to do synchromodal planning, e.g. the eFTI data exchange service. If all inland waterway parties would be involved in EuRIS and all of the inland waterway data services integrated, or interconnected, to EuRIS, logistics service providers would still need data from road and rail data information services to do synchromodal planning. This implies that EuRIS and all other Inland waterway data exchange services need to be interconnected with their pendants from the other transport modes in order to facilitate synchromodal planning and operation. In this respect the EuRIS system would be an important preparatory step to enable synchromodal transport planning in the future.

In three to four years, an integration of the data exchange services of fairway (national RIS, EuRIS and other data exchange services) and sea port authorities (e.g. in the major ports in Belgium, France, Germany and the Netherlands) can further improve data information exchange. Service providers then will have more integrated data available to plan future trips to and from sea ports. The integration of these data exchange services would open the possibility for service providers to receive relevant data for an optimal planning of inland waterway activities from door to port.

It is only possible to facilitate the growth of synchromodal transport by logistics service providers in Europe by working together on an international level. That is why objectives are set up in the Road Map from three to five years from 2022. Because every country in Europe is at a different level at the Synchromodal and Digital Maturity Model, it is important to improve the development of digitalization of the inland waterways public data exchange information service in the coming three to five years:. From that point, European countries can work on an international level to support full synchromodal planning and operation by 2030.
The goals that are set for three to five years are (based in the figure above)

- Digital level (development of RIS and EuRIS)
    - At least 50% of the IWT parties is able to use EuRIS daily
    - At least 50% of other IWT planning information services of Logistic Service Providers should be interoperable with EuRIS
    - Public authorities have the following data available in EuRIS:
        - Water depths
        - Waiting times at locks and bridges
        - Water flow
        - Berths availability
        - ETA
        - Maintenance
        - Daily lock planning

- (Digital) policy level for increased use of inland waterway transport:
    - Harmonized standards in the European countries
    - Stimulate the use of EuRIS in Europe with:

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        - Incentives
        - Privileges
        - Taxes
    - The first policy steps for using autonomous barge transport and infrastructure is made

The Actions for public authorities for further development digitalization of the inland waterways public data exchange information service in the next three to five years are the following:

- Digital level: For Europe to reach synchromodality in 2030 every country needs to reach the DIWA Maturity Level of Connected within three to five years from 2022 onwards. This includes:
    - Advanced digital features aligned with partners;
    - Digital information exchange by default;
    - Full real-time situational picture digitally available.

The public parties of the European countries need to include the data from different digital commercial and supply chain planning information services into European data information services from fairway authorities like EuRIS. Within three to five years, 50% of all data information services must be integrated into EuRIS. Preferably, when all the information is available in one place or if it is available and able to import for all stakeholder (with permission of the data owner(s)) to make decision steps towards synchromodality. From the private parties, there must be enough support. If this is not the case digitalization and synchromodality at a European level is unlikely to be successful. This means that 50% of the IWT private parties must use EuRIS on a daily basis. This can be done with policy measures described in 5.1. Within three to five years it is important to have certain real-time data available on a European level. The type of that is described above. At this moment this data is available, however, it is spread over different information services. This makes it difficult for all parties to use. With EuRIS all future information and forecasts are generated from the origin and destination, which should make it easier to calculate the ETA of barges. With the information of the ETA of the barges, an efficient impact could be realized in the barge chain.

(Digital) Policy level: For the next three to five years the European countries needs to facilitate EuRIS for all parties in the inland waterway transport industry. Currently, EuRIS is at the beginning phase and is not widely implemented or used in European countries. By promoting the EuRIS system more (potential) users will get to know this information service. Instruments to do this are incentives, privileges for users of EuRIS (e.g. less waiting time at locks), and policy for using EuRIS over the national RIS system. The most important thing is to make EuRIS available for everyone. EuRIS should not be limited to an exclusive part of the inland waterway transport industry.

To reach an international harmonized level of synchromodality, public parties from all European countries need to set up harmonized standards in the commercial and private information services of inland waterways . This means that public parties must agree on the type of data that will become available, which functionalities should be introduced, and what the ambitions are on a European level.

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Steps that will be made in the future are autonomous infrastructure and barge transport. Pilots have been started in, for example, Belgium and The Netherlands. However, it is not easy to implement these pilots in practice due to regulations. It is therefore important to start the process for changing the legislation for autonomous infrastructure and barge transport.

5.3 Road Map for private parties for implementing synchromodality

Private organizations, such as the barge operators and freight operators have a role in increasing the use of freight transport by inland waterways or rail. Currently, the selection of a transport modality is based on certain selection criteria of the shipper. The shipper discusses with the freight operator or logistics service provider, the possibilities to transport the freight from origin to destination (O-D) based on lead-time, price, reliability, service levels (e.g. refrigerated), and or carbon footprint. The modality planning is performed in a Transport Management System (TMS). In the very near future, when the freight operator is planning to perform the route via barges, the data from EuRIS can be used as input for the optimal route on the waterways. So, EuRIS has a role in the synchromodal planning of the barge transport and the first- and last-mile transport of container transport. In the upcoming years, sharing the (real-time) information from EuRIS supports the synchromodal planning of barge transport. So eventually, it is expected that the digitalization increases the barge transport reliability, compared to the current situation and the shippers are willing to transport more containers by barge. Other factors, that influence the modal choice of containers are the selection criteria, but also the conditions on the physical infrastructure (e.g. sufficient fleets, barge operators, maintained waterway infrastructure, etc.).

‚An analysis has been made how the data from especially the national and European RIS digital IT-information services can be used by logistics service providers to improve synchromodal planning. Based on these possible improvements, the ambitions for European roadmap for facilitating synchromodal transport has been formulated. These ambitions focus on the development of the inland waterways data exchange services on a national and European level (the RIS and EuRIS), and the possible connections with other inland and seaport waterway data services. The Road map ambition for the years up to 2030 on a European level is presented in the European Road Map ambitions in the figure below.

These ambitions for the Road Map is divided in two parts:

- The upper part of the Road Map ambitions presents the actions required from the public authorities to facilitate the use of digital data information services in inland waterway transport .
- The lower part of the Road Map ambitions presents the current and future required focus of the fairway authorities to facilitate an extended and smooth digital exchange of data and information between companies and fairway authorities in inland waterway transport.

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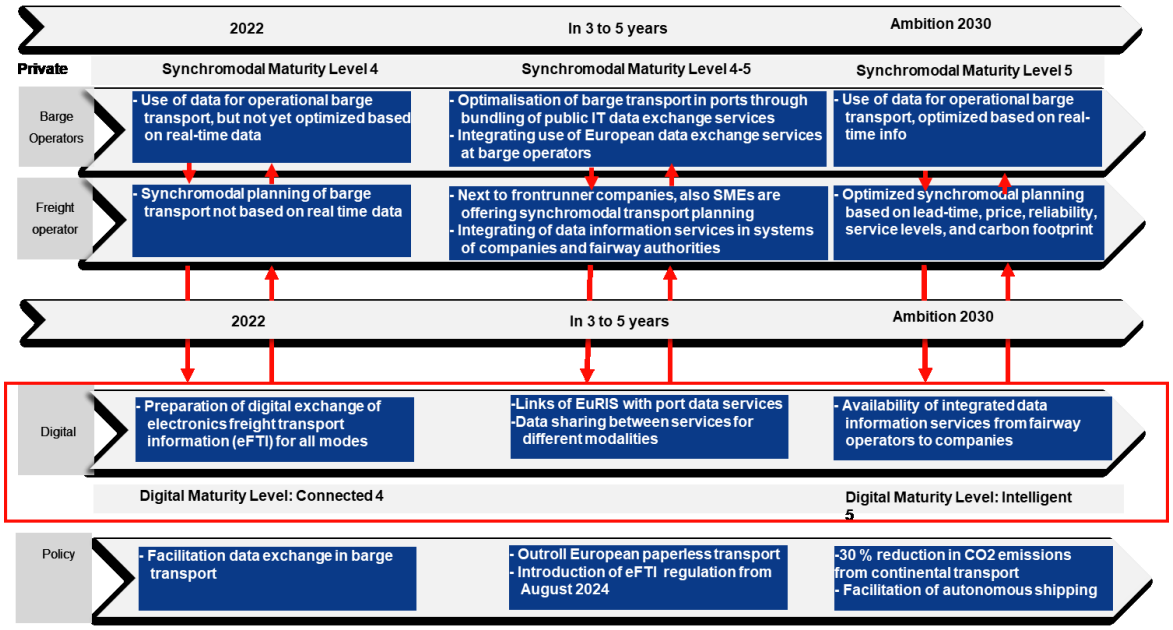
Figure 5.4 European Road Map for growth in synchromodal maturity at logistics service providers.



The necessary data can partly be provided through inland waterway data information services from fairway authorities, like the national inland waterway data information services and the European EuRIS. By improving the digitalization of information in inland waterway transport, the opportunity for logistics service providers to implement synchromodal planning will increase. However, the analysis above has shown that also specific inland waterway data is sometimes already provided but is not yet used by logistics service providers. In both cases, European frontrunners among barge operators and logistics service providers can play a leading role in using all available inland waterway information services to increase the use of freight transport by inland waterways. This can be done through two scenarios:

1. the base scenario: public authorities will supply the inland waterway data information services to private companies, it is up to them to use the data elements provided.
2. the growth scenario: public authorities will act more pro-actively: they will not only supply the waterway data information services, but also actively market this service among the target group of private companies. This target group consists of larger companies as well as SMEs (Small and Medium sized Enterprises). Public authorities can even adopt the policy to reward private companies who extensively use available inland waterway data information services with specific treatment in reserving overnight berth spaces, etc. In this growth scenario

For facilitating the increase of synchromodal transport in Europe, both private and public parties must work closely together and create connections between the different systems used in the IT chain. By advancing the digitalization in inland waterways, the synchromodality level of the country is expected to be increased. The following paragraphs per country elaborate on the difference in the development of digital information services.

Specific Road map characteristics for Austria

EuRIS and CEERIS are developed and brought into operation within the RIS COMEX project by several countries. The operational start is planned for June 2022. At this moment, Austria is just like some other European states starting to implement EuRIS and CEERIS as it is stated in the previous chapters. Countries that are connected to the Danube have unharmonized standards for forms and other elements. By using CEERIS and EuRIS the first steps to harmonization are made. The policy to promote inland waterway transport, digitalization, and synchromodality regulations are made, as stated in chapter 2 and Annex 1. To achieve more inland waterway transport, digitalization and synchromodality Austria has national funding schemes.

In Austria, electronic reporting on inland waterway transport is supported by the national DoRIS Portal since around 2009. In some other Danube countries the administration is still being performed via form-filling. The objective for international inland waterway transport n the Danube is to harmonize forms, like arrival- and departure reports or passenger lists. This is a Danube-wide initiative, and focuses on more than border controls (Schengen Border) which is not relevant for Austria. To reduce travel times and harmonize the different forms of languages the use of CEERIS is stimulated. In this system the forms are included, customized routes are available for the specific transport, and the possibilities of connecting to ports and other authorities. By collecting and sharing the administrative information in the portal, this information will in time be accessible for a growing group of skippers, shippers, port operators, and authorities.. Furthermore, the inland waterways are using the EuRIS system. The EuRIS collects data from the connected countries, such as infrastructure information, vessel locations, locks information, and terminal facilities. This information service provides all data in one information service instead of finding information on different locations and information services. However, the digital information services are in the beginning phase and are not widely implemented or used in the country. Therefore Austria can be placed between the level Organized and Digitized. This means that Austria has:

- Specialists deliver changes using established processes;
- Traditional digital features;
- Building digital capabilities;
- The overarching vision established;
- The limited real-time situational picture is digitally available.

Specific Road map characteristics for Belgium

At this moment Belgium is working towards a national VisuRIS information service. However, as it is stated in the previous chapters, Flanders and Wallonia are not on the same synchromodal maturity level. Belgium is developing the new Seine-Schelde connection with France what will increase the share of inland waterway transport. Also, Belgium has different pilots e.g. smart vessels and smart infrastructure.

Multiple digital information services are also developed to offer real-time planning and modal shift. Unfortunately, because of the governmental structure in Belgium with Brussel, Flanders, and Wallonia working separately, there are multiple digital information services. This makes it difficult to offer one digital information service. The government is working towards a

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national VisuRIS information service that will take the synchromodality to a next level for Belgium. VisuRIS provides information regarding the network infrastructure, the terminal facilities, locks and bridges information, accessibility for planning routes, and signing up when the inland skippers arrive at Belgian waterways. In the future, the Walloon region will integrate and implement the VisuRIS system for operational uses. However, this will go in phases and take time, before this is all completely integrated with the other states and the digital systems. Because of this Belgium can be placed between the level Digitized from the DIWA Maturity Model. This means that Belgium has:

- Advanced digital features of the National RIS (VisuRIS) en EuRIS;
- The overarching vision established;
- Digital information exchange possible;
- The limited real-time situational picture is digitally available.

Specific Road map characteristics for France

France has limited digital information available. For example; maintenance information is not available in time for fairway users which makes inland waterway transport unreliable. However, France is heavily investing in inland waterway transport, for the physical and digital infrastructure.

The use of the RIS system is not sufficient enough, to collect and share data for optimizing logistics services. Therefore, the French government is looking into other digital information services or applications, which can give data about the cargo system, cargo reports, berth origin, destinations, and the type of (hazardous) goods. These could be compared with the Dutch BICS, which operates as a digital information service, for the skippers, freight forwarders, barge operators, and reduces administrative burdens. Other information services are reviewed, that could be implemented in the French waterways, such as the Dutch information service iBarge. Improvements can be made in implementing a harmonized digital information service across borders. For example, the European RIS information service (EuRIS). By implementing one harmonized digital information service like EuRIS the DIWA Maturity Level will increase. This results in the DIWA Maturity Level of Organized:

- Specialists deliver changes using established processes;
- Traditional digital features;
- Building digital capabilities.

Specific Road map characteristics for Germany

Just like France, Germany can still develop the national RIS capabilities. The use of the RIS system is not sufficient enough to collect and share data for optimizing logistics services. Germany has also recently started to use paperless administration. To reach a harmonized international level steps need to be made for Germany. However, different tests and pilots are performed with autonomous barges, but it lacks the needed infrastructure to operate smoothly. With this Germany distinguishes itself from France that has the same DIWA Maturity Level. For Germany the DIWA Maturity Level is Organized:

- Specialists deliver changes using established processes;
- Traditional digital features;
- Building digital capabilities.

Specific Road map characteristics for the Netherlands

Together with Belgium, the Netherlands is the most mature country in Europe when it comes to digitalization in inland waterway transport. The fairway authorities in the Netherlands have developed digital exchange services, such as the national RIS Vaarweginfo. Different private and public initiatives are researching, testing, and using different digital information services for the inland waterways. However, this results in many different information services with different information. Customers have to use multiple information services to get the information they need. Within the RIS COMEX project, The Netherlands is working together with other countries to develop a harmonized digital information service called EuRIS. By implementing the EuRIS digital information service the DIWA Maturity Level will increase. The next step which would be beneficial for the synchromodal planning capabilities of logistics service providers would be the integration of data exchange services from fairway and sea port authorities: Together with Belgium, The Netherlands is at the DIWA Maturity Level Digitized:

- Advanced digital features of the National RIS (Vaarweginfo) en EuRIS;
- The overarching vision of further development is the integration of the data exchange services of fairway and sea port authorities in three to four years
- Digital information exchange is possible and used by a large number of logistics service providers and barge operators in the Netherlands.
- The real-time situational location of inland waterway traffic is digitally available to companies, so that they can adjust ETA information to their cleints (manufacturers, retailers, wholesalers etc.)

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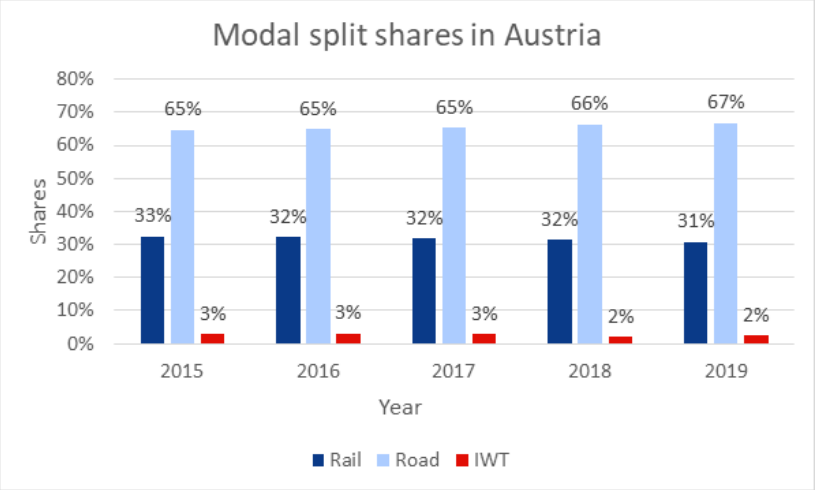
Annexe 1 Opportunities for inland waterway transport per country

A1.1 Opportunities for inland waterway transport in Austria

Current use of freight transport modes

To provide an overview of the current inland waterway freight transport situation in Austria, the statistics of the country are analysed for the past five years. This data provides an overview of the total goods transported by the different modalities, i.e., inland waterways, rail, and road. As shown in the figure below, Austria used the inland waterway modality for freight transport only for 2% to 3% of the total freight transportation of goods. For inland waterway transport, Austria has no regular container service available. Currently, containers are only shipped on demand. However, for rail, Austria is connected to a regular shuttle service. It is well known that Austria has a strong rail network and due to geographical reasons, most freight is transported by rail or road (R. Schwarz, personal communication, 23 December 2021).

Figure A1.1 Modal split shares in Austria



Source: Eurostat, 2021

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Freight that is transported via the three modalities crosses some of the TEN-T corridors in Austria. TEN-T corridors that cross Austria, are the Baltic-Adriatic, Scandinavian-Mediterranean, and Rhine-Danube (see figure below). The Baltic-Adriatic and Scandinavian-Mediterranean corridors are two of the European corridors, which connect the north and south of Europe by railway and road. The Rhine-Danube corridor is the most important corridor that connects the centre of the European Union with the regions of the Black Sea. Different modes of transport are used in this corridor. Nevertheless, with the links of the Danube and Rhine River, the inland waterways have the highest share of modality compared to the other modalities of road and rail on the Rhine-Danube corridor (European Commission, 2021; Fairway Danube, 2016).

Figure A1.2 TEN-T corridor map Austria

Source: European Commission, 2021

For the inland waterways in Austria, the most important waterway that crosses several nearby countries is the River Danube. This river is approximately 2,857 km long and starts in the German Schwartzwald to the marine delta of the Black Sea. The river Danube has a high potential for the transport of freight via inland waterways. However, at this moment only 10% of its potential is used. This is because the Danube has many bottlenecks. For the westbound direction, one of the bottlenecks in the water depths in Germany is between Straubing and Vilshofen. This is a big issue for fairway reliability, due to the effect on the capacity of the water levels. In addition, the westbound direction from Austria offers only low bridge clearance and generally a smaller-sized infrastructure (waterway UN/ECE class VI and smaller). There is also a long transit time to the big ARA sea Ports (Antwerp-Rotterdam-Amsterdam) because of numerous locks on the Danube, the Main, and the Main-Danube Canal. The alternative

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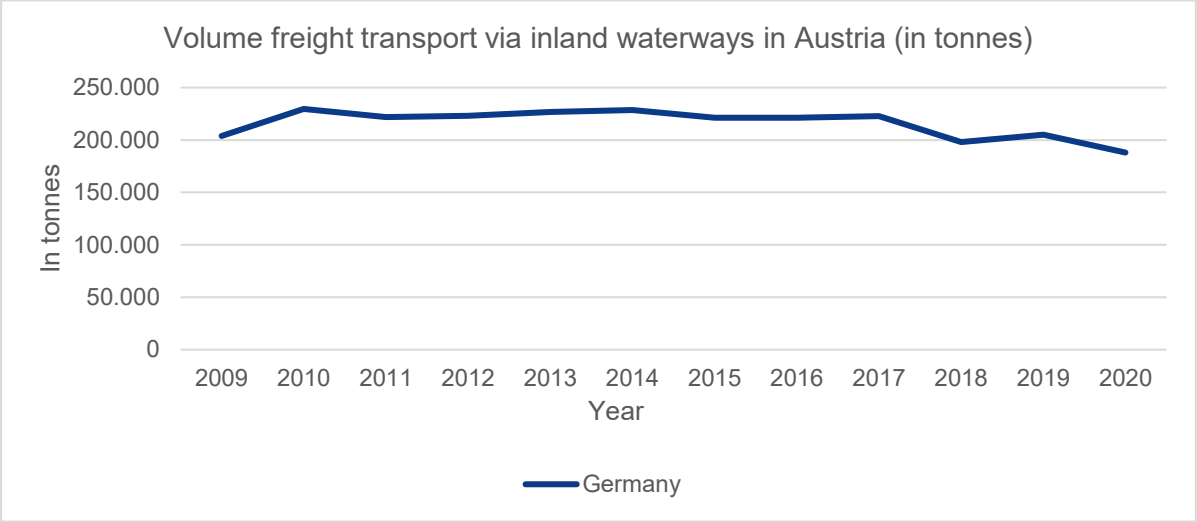
connection with rail is very attractive because of the shorter lead times (overnight) and the high frequencies to all Austrian Container Terminals as well as attractive prices.

For the eastbound direction to Constanta (Romania), there are infrastructural bottlenecks in Hungary, Bulgaria, and Romania. Canal dues for the Danube-Black Sea Canal and the container volume between Austria and Constanta is not very high. Skippers are not taken seriously and blockages are not being announced on time. Another bottleneck is the administration, this is related to the reporting of inland waterway transport along the Danube. Along the Danube, the Austrian government is making big steps in harmonizing the forms, for example, the arrival/departure report or passenger list. Many countries along the Danube have accepted these forms to minimize travel time. Partners from eight countries are now improving and implementing the RIS COMEX system with the system CEERIS (Central & Eastern European Electronic Reporting Information System). This is a joint electronic system with eight countries, from Austria downstream the Danube and to the Czech Republic. For this area, it includes the forms, customized routes for their specific transport, connecting to the ports and other authorities. With this information skippers, port operators and authorities will automatically receive their form (R. Schwarz, personal communication, 23 December 2021).

As stated before, Austria is one of the few countries in the European Union that has a relatively high share of rail freight transportation compared to other European countries (Kapfenberger-Poindl 2018). The infrastructure investments in 2019, for rail, road, and inland waterway, also show that the focus for Austria is on rail transport with 75.4%. The road received 24.4% and inland waterways only 0.2% (OECD, 2021). The infrastructure maintenance share for inland waterways is 1.0% and also the lowest compared to road and rail in 2019. The road received 56.4% and rail 42.7% (OECD, 2022). It must me said that road and rail are used more intensively because of personal transport.

Focussing on the volume of freight transported via inland waterways, insights are gained on the recent volume developments over the past years. The figure below shows a changing volume of freight transport via inland waterways over the past years. The decrease over the past years may be explained by the preference for other modalities such as road and/or rail or due to the bottlenecks in the Danube.

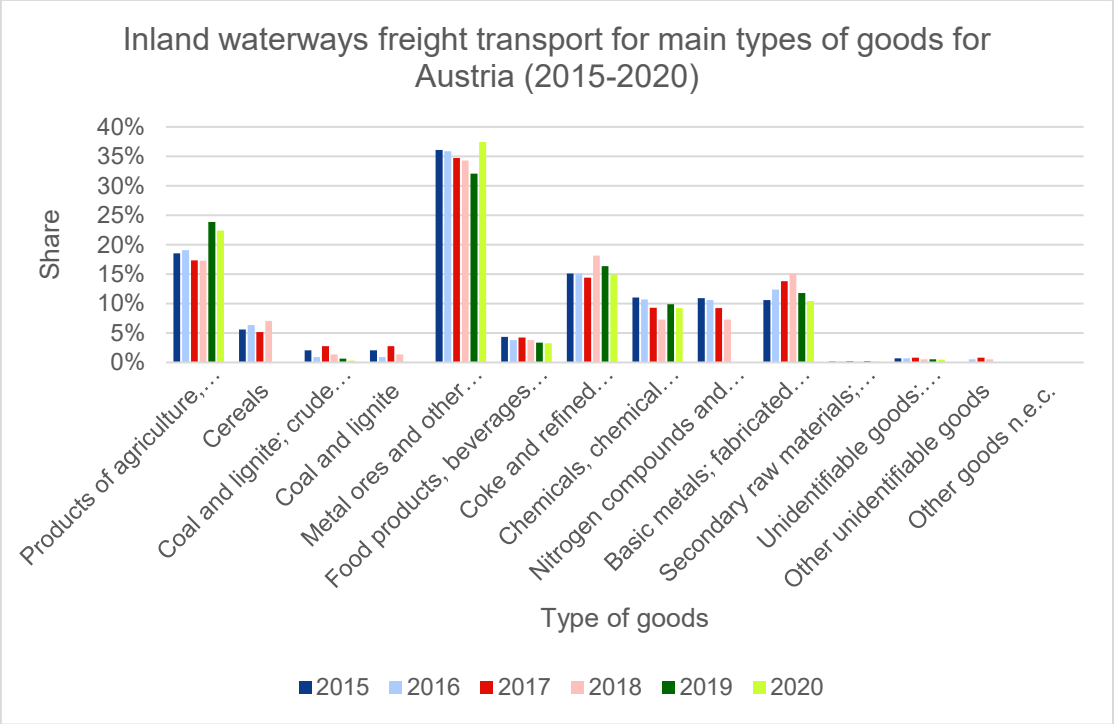
Figure A1.3 Volume freight transport via inland waterways in Austria (in tonnes)



Source: Eurostat, 2021

The Danube is currently mainly used for the transport of bulk and empty containers, as stated in the Table below. According to an interview with Viadonau, the biggest amounts transported on the Danube are forestry and agricultural products, iron ore, scrap, other metal products, minerals, petroleum products and fertilizers (R. Schwarz, personal communication, 23 December 2021). This is in line with the figure below

Figure A1.4 Inland waterways freight transport for main types of goods for Austria (2015-2020)



Source: Eurostat, 2021

Government Policy on intermodal transport

The Federal Ministry Republic of Austria made the Mobility Master Plan for passenger and freight transport. For Austria, freight transport will be climate-neutral, sustainable and crisis-proof by 2040. The aim is that the volume of freight transport only increases moderately, by no more than 10 percent by 2040. Due to its advantages in terms of energy efficiency, rail freight transport must continue to play an important role, and an even greater role in the future, to enable moderate overall growth in freight transport. For this to happen, attractive and easy-to-plan services need to be created, including international rail freight transport. Continued expansion of the infrastructure and extensive European collaboration will make this possible (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, 2021).

Rail freight transport and waterways are core components of a sustainable Austrian and European freight transport system due to their inherent advantages. Punctuality, reliability, planning capacity and speed of rail freight need to continue to increase, primarily in international rail freight transport. Austria wants rail and inland navigation to become primary com-ponents of climate-neutral supply chains by 2040. Solutions include single wagonload transport, unaccompanied combined transport, accompanied transport as rolling road, roll-on roll-off, block train transport (traditional point-to-point connections), and inland navigation by individual operators or transport associations. For the modal split in freight transport, Austria is mostly focusing on rail transport. For Austria, the rail share of the modal split must be increased to 40 percent (equivalent to some 35 billion tonne-kilometres) with the right European collaboration. Austria alone can only achieve a moderate increase (34%) (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, 2021).

Digitalization is an important aspect to achieve the goals of Austria. Digitalizing modes of transport and their interfaces should make transport capacity and multimodal supply chains more efficient. Technologies will be developed that will be consistent nationwide and internationally to facilitate access to, handling in and use of the rail and waterway systems (booking and use information services) (Federal Ministry for Climate Action, Environment, Energy, Mobility, In-novation and Technology,2021). Aims for digitalizing freight transport are:

- Translating potential that has already been identified and small-scale multimodal solutions into scalable and transformable concepts.
- Specifying frameworks and models for cooperation for an integrated mobility system and advancing solutions that have been harmonized throughout Austria and Europe.
- Using the digital infrastructure to share information effectively, for example about energy management and transport demand.

The digitalization of the transport industry is also encouraged by the approved electronic freight transport information (eFTI) regulation that will enter into force in August 2024. It establishes a legal framework for road, rail, maritime and air transport operators to share in-formation with enforcement authorities in an electronic format (IRU, 2021). This regulation stimulates every EU Member State to develop digital information services in the transport industry.

To achieve this, Austria has national funding schemes offered for the transport of containers via rail and inland waterways. Fundings are for the amendment of ships for intermodal transport: “Investitionsförderprogramm Kombinierter Verkehr”. But also funding for additional ports superstructure like cranes: “Terminalförderprogramm”. In parallel, there are additional funding schemes existing to increase digitalization in logistics operations: “Logistikförderprogramm”. As well as increasing the environmental performance of the company: “Klima aktiv”. Next to these studies are funded to increase intermodal transport, inland waterway and digitalization.

Examples of companies active in inland waterway transport

Inland waterway operators

One inland waterway operator in the Danube is First-DDSG Logistics. This operator is focused on the eastbound of the Danube with locations in Austria, Slovakia, Hungary, Serbia, Romania, and Ukraine (First-DDSG Logistics, 2022). The second eastbound operator in the Danube is TTS Group from Romania. TTS Group offers inland waterway transport between Constanta (Romania) and Kelheim (Germany). Therefore it uses the Danube in Austria frequently (TTS Group, 2022).

Inland terminals

The four public Ports in Austria (Linz, Enns, Krems, and Vienna) are operating, next to their transhipment facilities for bulk and liquid goods, very efficient container terminals. However, they are mainly operated by rail. Next to their inland waterway access, they are included in the shuttle train rail network to the big seaports in Europe. Some ports shifted their capacity for the inland waterway to rail capacity when it comes to their storage. In the last years, the four ports have been modernising their infrastructure, superstructure, and increasing Digitalization. This makes them all suitable for additional container volumes by barge (R. Schwarz, personal communication, 23 December 2021).

Logistics service providers

One of the well-known logistic service providers in Europe is Rhenus Logistics. This company is located in multiple European countries, including Austria. Rhenus Logistics is located in Krems, next to the Danube, and provides intermodal transportation with the road, rail and inland waterway. In Germany, Switzerland, France, Luxembourg, Poland and Romania, Rhenus has multiple business locations at inland waterway ports (Rhenus Logistics, 2021). Felbermayr also offers multimodal solutions with the road, rail and inland waterway transport in Austria. However, their inland waterway service is done under the name of Haeger & Schmidt Logistics (Felbermayr, 2022).

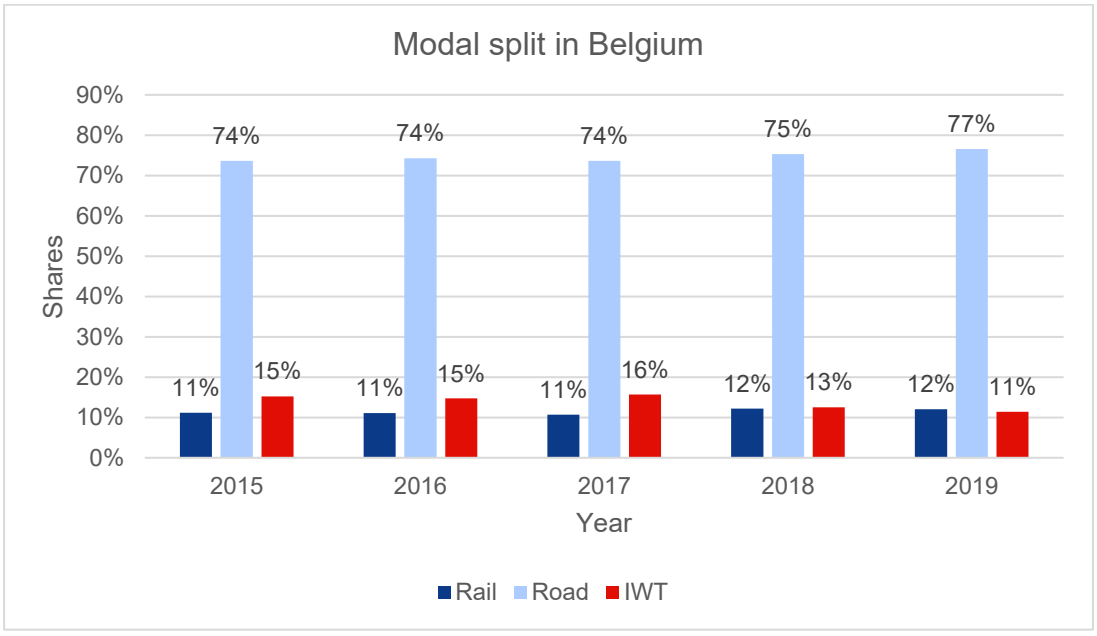
European Gateway Service from the Netherlands rarely has an inland waterway connection with Austria. The connection is only on peak times to relieve the rail connection. The average travel time is ten days which is very long compared to the rail connection (P. Zoeter, personal communication, 27 January 2022).

A1.2 Opportunities for inland waterway transport in Belgium

Current use of freight transport modes

The current freight transport situation in Belgium has been analysed, to provide an overview of the past five years. As shown in figure below, the modality road has a relatively high share of 75% over the past five years compared to the modal split shares of rail and road. In Belgium, the modalities rail and inland waterways have similar shares around 10-15% each. The share of the modality rail has been the same over the past five years. However, the last two years show a small decrease in the shares of the modality inland waterways and a small increase in the modality road. One of the possible reasons for not increasingly using the rail network in Belgium is due to the high costs of freight transportation by train. The main costs components, which influence the high costs of freight transportation by train compared to road transport are the operational costs, the first and last-mile costs, and the handling costs (Van Leijen, 2019). This gap of nearly 40% of the costs can be explained, due to the extra actions and costs components as shown in Figure below.

Figure A1.5 Modal split shares in Belgium



Source: Eurostat, 2021

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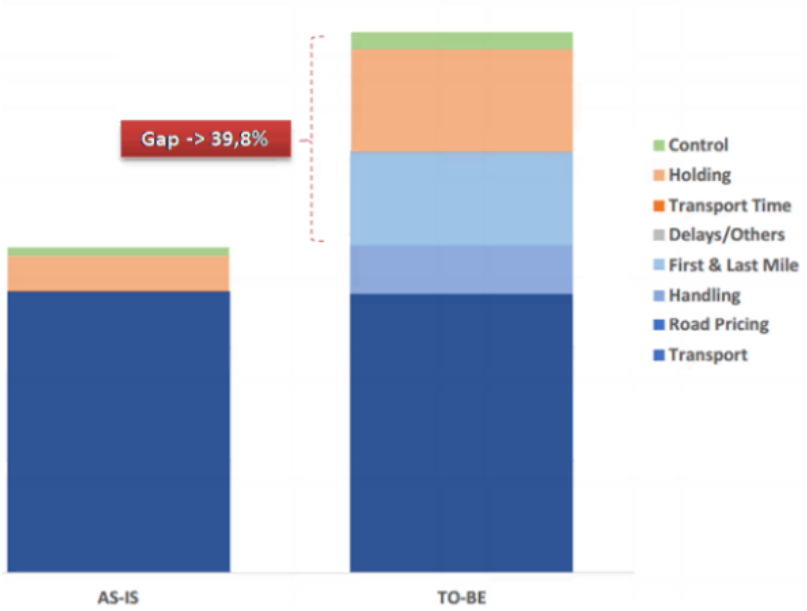
Figure A1.6 The gap between road and rail transport



Source: Vannieuwenhuyse, B., et al, (2019), Haalbaarheidsstudie maatregelenpakket voor een versnelde modal shift naar het goederenspoorvervoer, in opdracht van de Vlaamse overheid, Departement Mobiliteit en Openbare Werken, Afdeling Beleid, ir. Ilse Hoet.I

Inland waterway transport is mainly used on the canals in the Flemish part of Belgium where the terrain is mainly flat and from the port of Antwerp (which is very close to the Dutch border) to The Netherlands and Germany. The share of infrastructure investment for rail, road, and inland waterway for Belgium shows something else than the modal split in figure 2.6. In 2017 rail received 49.6%, road 37.0% and inland waterway 13.4% (OECD, 2021). The mainly used transport is by truck, however, rail received the highest amount of investments. For the maintenance investments, the shares were divided into rail 39.6%, road 49,5%, and in-land waterway 10.9% (OECD, 2021). The maintenance costs for inland waterway transport are relatively low. It must be said that road and rail are used more intensively due to passenger transport.

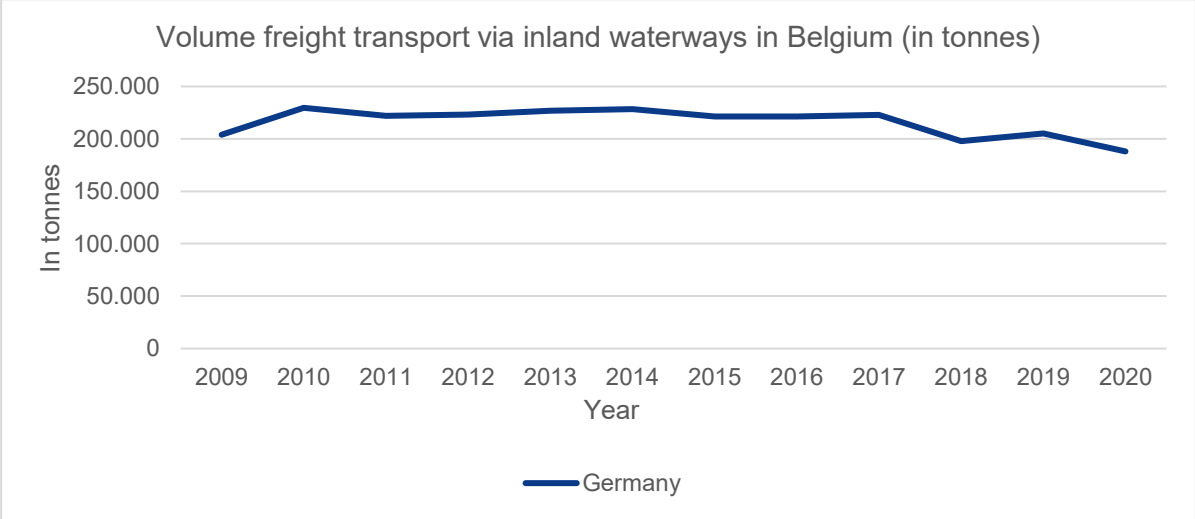
TEN-T corridors that cross in Belgium, are the North Sea-Baltic, Rhine-Alpine, and the North Sea-Mediterranean (see figure below). With these corridors, Belgium is connected to multiple countries in Europe which makes Belgium an important connection to the hinterland of Europe. Figure belos shows that Belgium has multiple inland waterways connected to all neighbouring countries (European Commission, 2021).

Figure A1.7 TEN-T corridor map Belgium

Source: European Commission, 2021

For the freight transport, via inland waterways, an overview of the developments in volume is shown in figure below. This figure shows that from 2010 till 2017 there was an increase in volume. However, since 2017 there was a large decrease of approximately 50.000 tonnes per year.

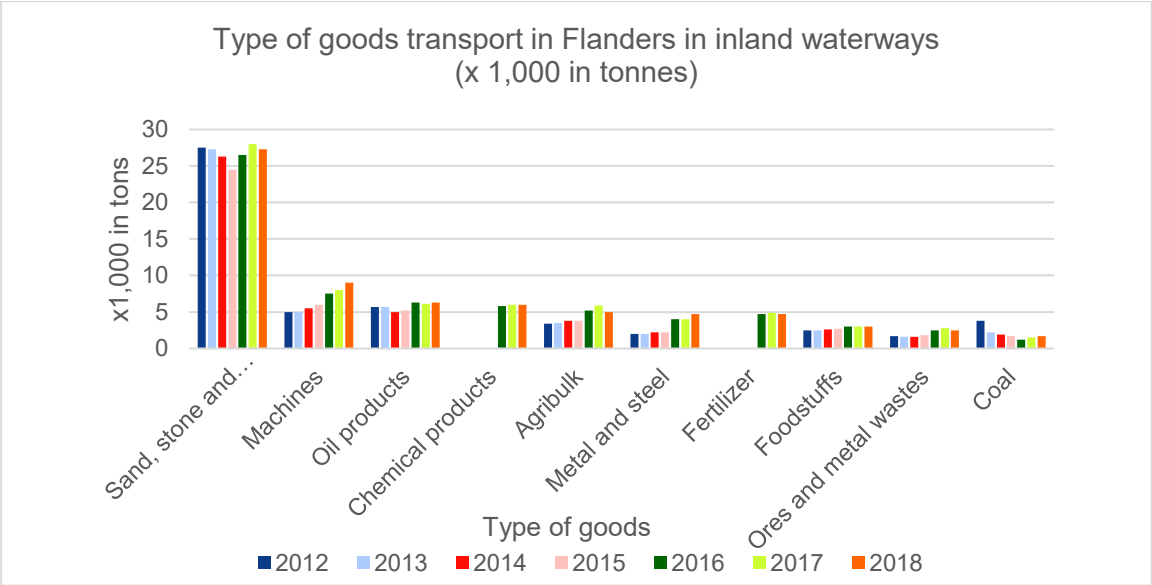
Figure A1.8 Volume freight transport via inland waterways in Belgium (in tonnes)



Source: Eurostat, 2021

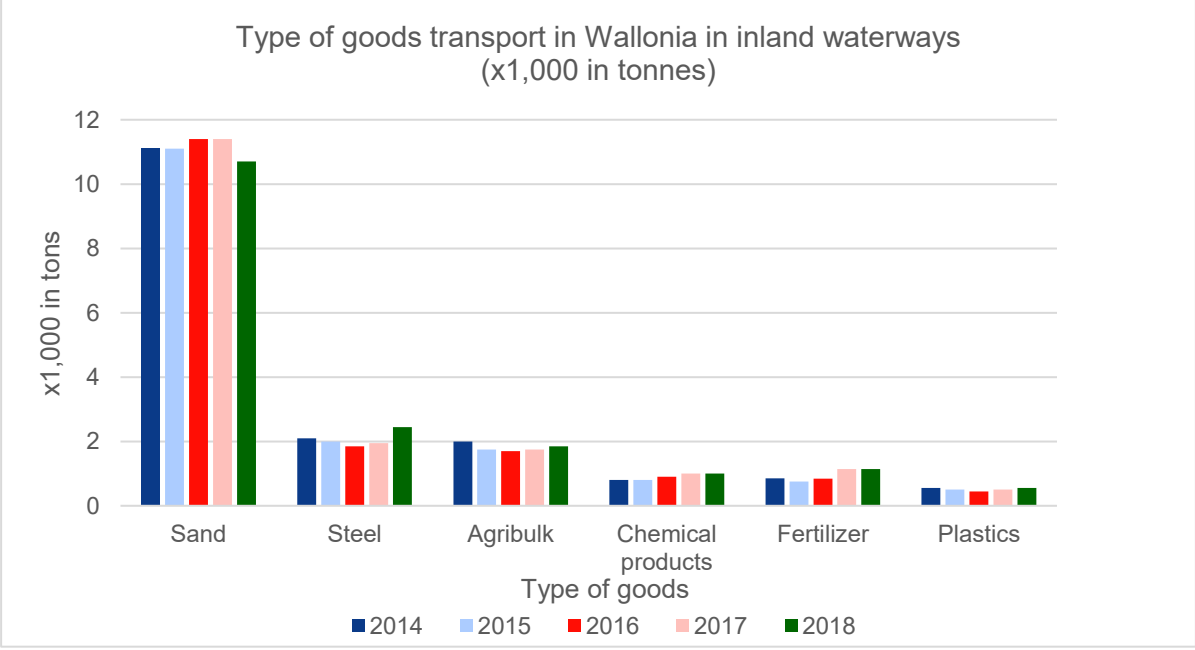
The figures below show an overview of the types of goods transported via inland waterways in Belgium. Since Wallonia and Flanders are working separately this data is also separately. For both, it shows that sand, stone, and construction materials have the highest shares (Decoster, Van Elsen, De Splenter & Van Snick, 2020).

Figure A1.9 Inland waterways freight transport for main types of goods for Belgium (2015-2019)



Source: De Vlaamse Waterweg, 2019 in Decoster, Van Elsen, De Splenter & Van Snick, 2020

Figure A1.10 Inland waterways freight transport for main types of goods for Belgium (Wallonia) (2014-2019)



Source: Directorate-General for Waterways, 2019 in Decoster, Van Elsen, De Splenter & Van Snick, 2020

Government Policy on intermodal transport

With the document 'Visie goederenvervoer Vlaanderen' the Flemish government wants to give some direction to freight transport in Flanders. Therefore, the vision for freight transport exists of three pillars: easy accessibility, a safe transport system, and sustainable freight transport. The first and third pillars are important for the logistic sector in Flanders. The government of Flanders has different policies to achieve this, an example is to invest in synchromodality and digitalization.

The first pillar, easy accessibility, needs to improve the logistic sector in Flanders and to distinguish it from the rest of Northwest Europe. An example to do this is smart shipping. Goals from the government of Flanders to achieve this pillar are:

- On congestion-prone segments on the main road, network speed needs to be im-proved.
- The various seaports, airports, and HST stations have multimodal access.
- An integrated network of multimodal accessible nodes for freight transport.
- The share of rail and inland shipping in the modal distribution increases to 30% by 2030.

To stimulate the modal shift from road to rail and inland shipping, Flanders already implemented kilometre charge for trucks. Next to the kilometre charge, De Vlaamse Waterweg nv started the Smart Shipping program to support innovation in the inland shipping industry. With this program, De Vlaamse Waterweg nv wants to stimulate the modal shift from road to inland waterways, since the potential of the waterway is being used less and less (De Vlaamse Waterweg nv, 2021). To help the future of automated sailing, the Smart Shipping program works around four pillars:

- Smart vessels: vessels with the minimal form of automation on board.
- Smart infrastructure: waterway infrastructure is highly automated and operated re-motely. Interaction between infrastructure and vessels takes place digitally to guide traffic as safely as possible.
- Smart data: data sharing that strives to be a smart, smooth and flexible process in which all communication between the government and the user of the waterway is digitalized and takes place according to internationally standardized procedures.
- Smart regulation: supports innovation and future-oriented initiatives.

Flanders has the ambition to become a green, low-carbon society. For sustainable freight transport, this means that improvements must be made on efficient network nodes and an efficient organization to achieve multimodality and synchromodality. Digitalization is one of the important elements (Flemish government: Policy area Mobility & Public Works ,2020).

In the Flemish mobility vision 2040, the government wants to develop a multimodal mobility system. This includes stimulating synchromodal transport with different types of mobility. To do this, both private and public mobility players are investing heavily in data information services and digitization to support and further develop services and operations. In the end, companies can optimally plan, book, pay, execute and arrange their freight transport without disclosing competitively sensitive business information. Data exchange and digital technologies drive synchromodal transport allowing to use the available transport capacity

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more optimally and making individual transports much more effective and efficient organized (Flemish government: Policy area Mobility & Public Works, 2021).

Since Belgium is divided into three departments of Flanders, Wallonia and Brussels the above-mentioned government policies only apply for Flanders. Nevertheless, Flanders is the frontrunner and the representative entity of the inland waterways for the DIWA subtask 2.2 Synchromodality for Belgium.

Moreover, Flanders, Wallonia, France, and Europe entities are collaborating and funding for the waterway connection between the Seine and the Schelde canal (see figure below).

Figure A1.11 The Seine-Schelde connection

Source: Sweco Belgium, 2021

The new canal will be 107 kilometres long and consists of seven locks, three canal bridges, and 61 bridges. The construction work of this area will be starting in 2022 and will be finished in 2028 (Sweco Belgium, 2021). This canal connects Flanders directly to Paris, via waterways, and will be available for the container- and push barge up to 4,500 tonnes. Different reasons are stated for the construction of the canal by the Vlaamse Waterwegen, such as the current lack of inland waterways infrastructure between the Scheldt river area and Paris, as these are two of the most important industrial regions in the European Union (i). Moreover, the freight transportation by a ship of 4500 tonnes via inland waterways, resembles up to 220 road trucks (ii), which will be saved from driving on the roads. This will

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lead to a reduction in congestion(iii) and contributes towards modal shift and sustainable environments (iv). This canal will be operated and connects seven ports in Europe: Rotterdam (The Netherlands), Antwerp, Gent, Zeebrugge (Belgium), Le Havre, Rouen and Dunkirk (France) (Varendoejesamen, 2019). Eventually, the predictions are that by implementing and using the new canal from 2030, the freight transport by road will decrease by 15- 20% on the tracks be-tween Amsterdam and Paris (Sweco Belgium, 2021).

Examples of companies active in inland waterway transport

Inland waterway operators

Danser Group and WeBarge are two barge operators in Antwerp. Danser Group is a multi-modal operator and provides barge and rail transportation. Their operations extend from the ports of Rotterdam and Antwerp to hinterland destinations in Benelux, Germany, and Switzerland. Offices from the Danser Group are in Belgium, The Netherlands, Germany, France, and Switzerland (Danser Group, 2021). WeBarge only offers inland navigations (WeBarge, 2021). Van Moer Logistics is located in Belgium and Romania and offers transportation by road and water. With their intermodal services, they provide inland barge transportation and first and last-mile transport by road (Van Moer Logistics, 2021).

Inland terminals

Belgium has many inland terminals. One of these inland terminals is Willebroek. This terminal is operated by European Gateway Services and offers connections between inland terminals in The Netherlands and Germany (P. Zoeter, personal communication, 27 January 2022). BCTN has terminals in The Netherlands and Belgium. In Belgium, the terminals are: Beringen, Geel and Meerhout (BCTN, 2022). Another important inland terminal in Belgium is Genk.

Logistics service providers

The port of Antwerp is one of the main connections to the hinterland of Europe. Because of this, multiple inland waterway operators are located in Belgium. The inland waterway operators also provide rail or road connections. One of the main operators is H.Essers in Genk, offices are all over Europe but mostly in Belgium. H.Essers has a large European network which makes it possible to respond rapidly to all transport demands. The rail terminal of H.Essers has fast routes to major economic centres in Europe, including Hungary, Romania, Bulgaria, Greece, and Turkey. These connections are the perfect link for further network expansion, including intercontinental logistics flows via the ports from and to the European hinterland. Next to the rail connections of H.Essers, they also provide an extensive European road transport network (H.Essers, 2021). Move Intermodal is also located in Genk and provides intermodal solutions. Other offices from Move Intermodal are in The Netherlands, Germany, Italy, Spain, and Turkey. Long distances are covered by train or ship, only the short pre and post transport is carried out by truck. Move Intermodal also provides synchro-modal services (Move Intermodal, 2021). The connections of Move Intermodal are shown in figure below and cover most of the European countries.

Figure A1.12 Network of Move Intermodal

Source: Move Intermodal, 2021

A1.3 Opportunities for inland waterway transport in France

Current use of freight transport modes

The freight transported in the past five years in France has been analysed by assessing the different shares of the modalities. As shown in figure below, in France the most common modality for freight transport has been by road for the past five years. One of the possible reasons, that the mode road is dominated is due to the operative way of working in France. Another reason for the high shares of road modality is due to the huge road network France has to offer. Moreover, in France, different large manufacturing industries are located and the roads are known for the most European-wide international freight transport (Santander, 2021).

In France, the freight transported by rail has an average of 11% modal split over the past five years. Throughout the years, the share of rail in France has been decreasing enormously

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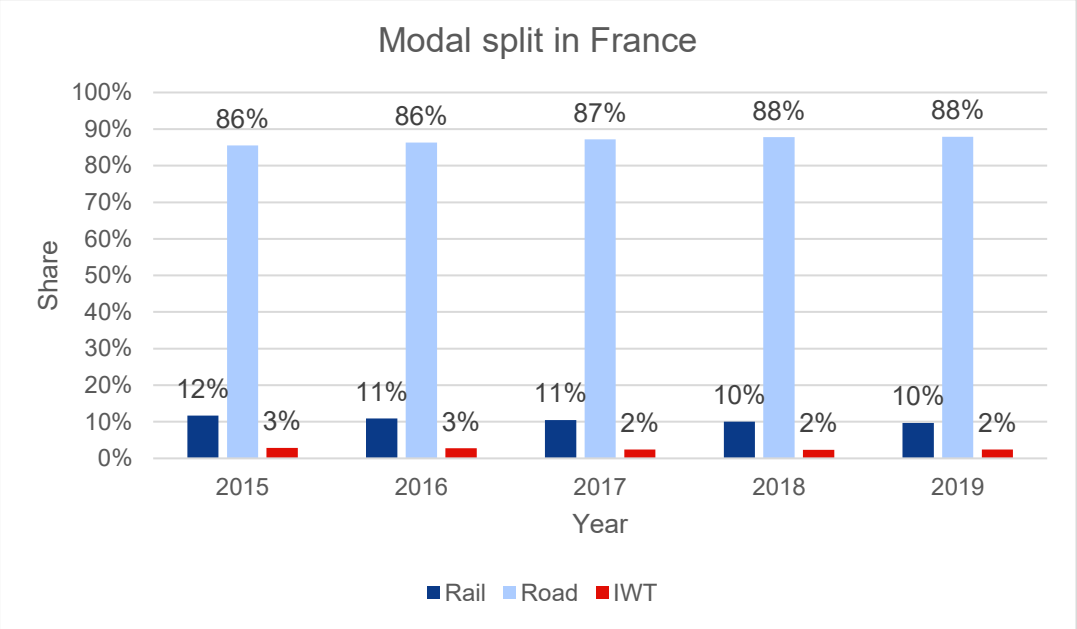
compared to the modal split share of 26% in 1984. An important reason for the relatively low freight rail modal split share is due to the lack of good quality links between the ports and rail in hinterland areas. Also, the complete French rail network exists at this moment as disjoint pieces instead of an integrated rail network. Therefore, the costs of using rail for transport do not outweigh the costs of freight transportation by road. To take advantage of rail's scale economies, increased rail freight should be realised (Railweb, 2020).

Figure A1.13 Modal split shares in France



Source: Eurostat, 2021

As shown in figure above, the modal split share of inland waterways in France only counts for 2%-3% of the freight transportation. One of the reasons for the relatively low modal split share of inland waterways in France is that the potential of the waterways is underexploited. Another reason, mentioned by Salah (2015), is that in the past few years the waterways only received 1.1% of the total transport investments, while the road sector received 66.3%. In 2019 the share of infrastructure investments between rail, road, and inland waterways was 53.8% (rail), 45.4% (road), and 0.8% (inland waterway). For the maintenance investments, inland waterway only received 15, road 39.7%, and rail 59.2% (OECD, 2021). It must be said that these investments also include passenger transport. This distinction in the transport investments leads to direct impact factors for modal choices regarding transport performances. Moreover, the shares and amount of the transport investments lead to interesting costs components, such as maintenance, replacements, deprecation, and renovations. Furthermore, in some parts of France, the geographical constraints lead to preferring the mode road instead of the rail or waterways. In the Northern part of France however, inland water-way transport does have the potential to grow (Salah, 2015). At the moment, the freight transported via the inland waterways in the norther part of France, where the French part of the river Rhine crosses, there is a count of 10 to 20% of transport via the inland waterway. Furthermore, for increased traffic on the barges, infrastructure and locks capacity are avail-able in the rivers Rhône, Saone, and the Seine. Nearly, four times the traffic

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can sail on the waterways without further challenges or issues (E. Flipo, personal communication, December 23, 2021).

Other bottlenecks that discourage, the use of inland waterways are the availability of certain fleets in France. One of the fleets, which is in shortage is the Spits Kempenaar, these are small-sized ships that transport bulk dry or general cargo. In the last 20 years, the stock of these ships went from 1800 to 1000 French units, while the loading capacity remained the same or showed a growth. Nevertheless, larger fleets are added to the inventory, but smaller fleets left the inventory. One of the other significant reasons, which are experienced by the stakeholders, is the handling costs. The first and last-mile costs are seen as a burden and lead to rather use the road modality instead of the inland waterways (E. Flipo, personal communication, December 23, 2021).

France has connected to three corridors: the Mediterranean corridor, the Atlantic corridor, and the North Sea-Mediterranean corridor (see figure below). With these corridors, France is connected to Spain, Italy, Belgium and The Netherlands. Only in the north and southeast France has inland waterways. However, all the corridors are covered with rail connections, but as stated before France has a disjoint network (European Commission, 2021).

Figure A.1.14 TEN-T corridor map France

Source: European Commission, 2021

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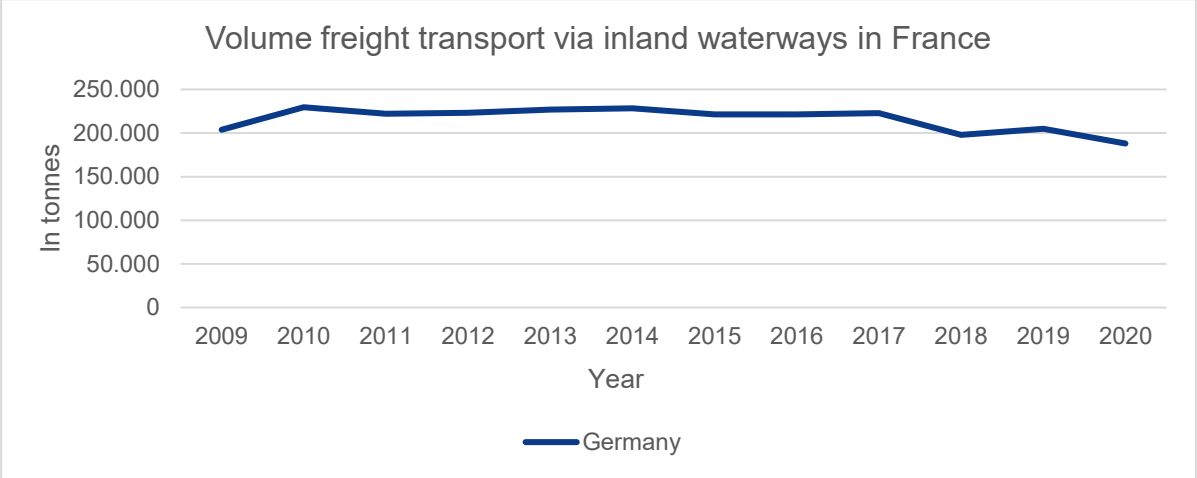
Figure below shows the development of the freight transportation volume via inland waterways in France. It shows that in the past 11 years, a decrease of 18% is realised in the inland waterways share in France. Possible reasons for the decline of the volume for the recent two years are the differentiation in the level of water levels, the COVID-19 restrictions in France which had a high impact on the transportation time, or the dominant preference of using the road network (Maritiem Nederland, 2020).

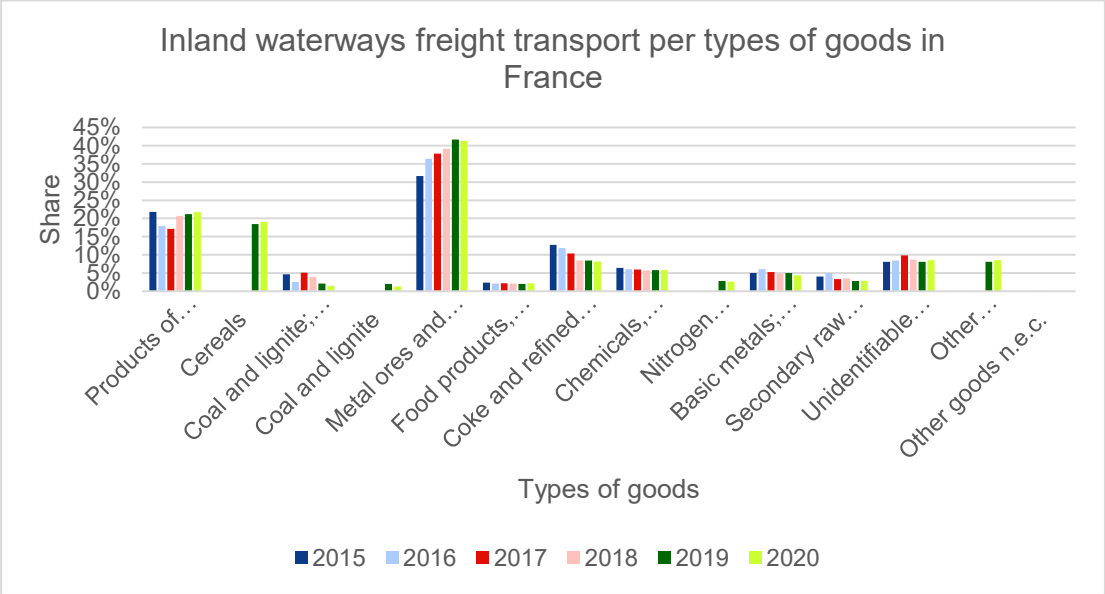
Figure A.1.15 Volume freight transport via inland waterways in France



Source: Eurostat, 2021

As shown in figure below, the type of products such as Metal ores, and other mining products count for 40% of the products transported by inland waterways in France. Looking at the past five years, this segment increased with a total share of 10%.

Figure A.1.16 Inland waterways freight transport for main types of goods for France (2015-2020)



Source: Eurostat, 2021

Government Policy on intermodal transport

In the Clean Mobility Development Strategy, the French government presents the guidelines and actions planned for the periods 2019-2023 and 2024-2028, to meet with France's objectives and commitments in the fight against global warming and lower energy consumption. One of the actions is "Promoting modals shift and freight transport towards river routes and railways and improving efficiency." The French government wants to do this by streamlining urban logistics by taking them into account in planning documents and by overseeing the activity of digital information services. Also, by developing mass modes for freight by increasing in-vestments in mass transport infrastructure (railways, river routes, and ports).

The inland waterway freight decreased by more than 30% since 1990. This is mainly due to the sharp increase in road freight transport. Across all freight traffic modes, the tonne-kilometres will increase by 15% between 2015 and 2030. However, the modal share of rail freight will stabilize and return to 11.4% in 2028. This is only a small increase since the share of rail is already 10% in 2018. The share of inland waterway transport will remain at 2.3% by 2030. Only for road transport, there is a limited growth allowed, 8% by 2028 due to an in-crease in truckload rates. The French government is giving more attention to sustainable fuel alternatives, for example, electric vehicles (Ministère de la Transition écologique et solitaire , 2020).

French policies for the development of infrastructure and service operations (notable freight) should be connected to those in other European countries. This includes the establishment of European freight corridors, support for port freight policies, development of projects in partnership with the EU, and the mobilization of European funds. The public policy must evolve to improve the competitiveness of maritime entry ports and their terrestrial access routes, and effective management of the explosion in final distribution flow rates Ministère de la Transition écologique et solitaire (2020). To do this, increasing investments in mass transport infrastructures are made:

- €3.6Bn/year over ten years to renew the existing rail network.
- €110M/year between 2019 and 2022, and €130M/year between 2023 and 2027, in the waterways network.
- €2.6Bn over ten years to desaturate urban rail hubs and constitute real Regional Ex-press Network in our metropolises.
- €2.3Bn over ten years to support the development of ports, as well as their rail and river/canal connections with the surrounding area.

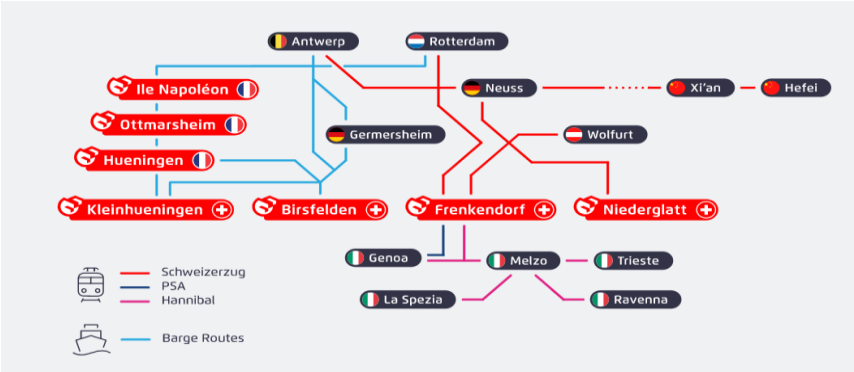
Besides, the aforementioned actions, the French government is providing subsidies to re-search and test different solutions for the inland waterways. One of the objectives of the French government is to reach a modal split share of 4% instead of the current 2.5%. This objective is further specified into the national, regional regions and the type of goods in France. Other possibilities that are researched, for modal shift of the inland waterways is by collaborating with the stakeholders for private funding (E. Flipo, personal communication, December 23, 2021).

Examples of companies active in inland waterway transport

Inland waterway operators

From the previous information about the French modal split and policy, it is known that France has a limited share in inland waterway transportation. Ziegler France is one of the few inland waterway operators in France. Ziegler has its headquarters in Brussels but operates on a large scale in France. In France, Ziegler offers transport solutions for road, rail in-land waterways and multimodal (Ziegler, 2021). Swissterminal also offers inland waterway transportation in France (Ottmarsheim), Germany, Switzerland, Belgium and The Netherlands. Swissterminal offers roundtrips from Basel, Birsfelden and Ottmarsheim to Rotterdam and Antwerp. The network of Swissterminal also includes two other inland ports of France with barge routes (Swissterminal, 2021).

Figure A1.17 Network map Swissterminal



Source: Swissterminal, 2021

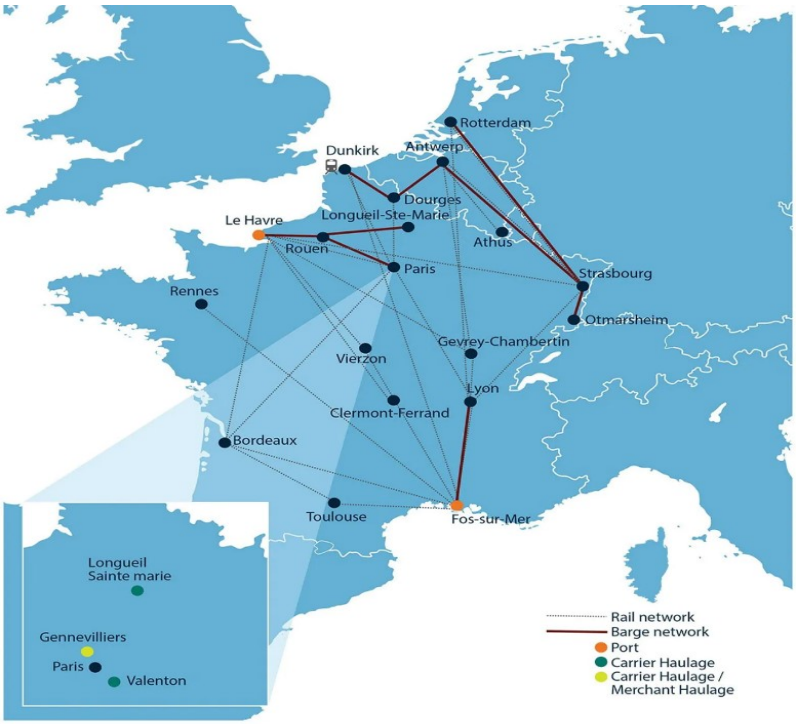
MSC is a large transport operator and offers road, rail and barge. They operate in all five countries, only in France, Belgium, The Netherlands and Germany MSC offers inland waterway operators. For France, there is a limited number of inland waterway routes. Figure below shows that most of the connections are by rail, only between Le Havre-Paris and Dunkerque-Lille MSC offers inland waterway services (MSC, 2021).

Figure A.1.18 Network map MSC

Source: MSC, 2021

Maersk is a worldwide logistic operator from Denmark. It operates in almost every country, including France, Belgium, The Netherlands, Germany and Austria. Only in Austria Maersk does not offer inland waterway transport. All the five countries are covered for road and rail transport. The inland waterway service for France is in the North of France and between For-sur-Mer and Lyon (Maersk France, 2021). Figure below shows the current inland network of Maersk France.

Figure A.1.19 Network map Maersk



Source: Maersk France, 2021

Inland terminals

Most of the inland waterway terminals are located in the North and East of France. Swissterminal also has multiple terminals in France and Switzerland. As it is shown in figure above Swissterminal has three terminals in France: Ile Napoléon, Ottmarsheim and Hueningen. These terminals are connected with barge routes (Swissterminal, 2021). MSC has a large transport network in France, MSC also has its terminals in France. The terminals with inland waterway connections are Marseille, Le Havre and Rouen (MSC, 2021). Close to the Belgium border Contargo also has its terminal. The terminal of Contargo is in Bruay sur l'Escaut. The network of Contargo is to Belgium, The Netherlands and Germany (Contargo, 2021).

Logistics service providers

Logistics service providers that operate in France, are almost equivalent to the operators in Belgium. Large service providers as Danser are operative in France, which provides intermodal transportation by road, rail and inland waterways.

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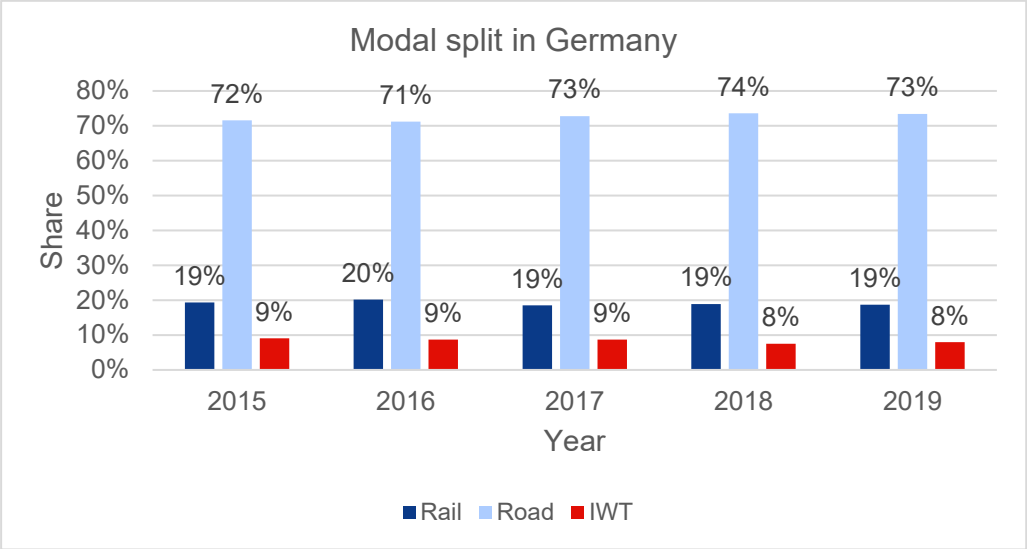
A1.4 Opportunities for inland waterway transport in Germany

Current use of freight transport modes

Figure below, presents the modal split shares in Germany for the past five years by looking at the three different modalities. As shown in the figure the modality of road has a relatively high share of 70%.

Figure A.1.20 Modal split shares in Germany



Source: Eurostat, 2021

The distribution of the different modalities has not been changed, throughout the past five years. The share of infrastructure investment between rail, road, and inland waterway in 2019 also shows that 67.4% of the investments went to the road. 28.1% went to rail and only 4.5% went to inland waterways (OECD, 2021). The importance of the freight transported by road is largely due to its flexibility. In most of the origin-destinations, the loading of the freight can be transported from the loading dock to the household doorstep. Moreover, transportation of small loads and over relatively short distances has economic and ecological advantages. In Germany making use of synchromodal transport, such as combing the rail and road transportation, the threshold is for distances of over 500 kilometres (VDA, 2020). Moreover, the rail associations in Germany point out that an expansion of the rail infrastructure is one of the methods to increase the modal shift from road to rail. Another method for shifting towards a modal shift of the train is by investing and expanding the Digitalization of the rail system. For instance, making data available such as information on timetables in real-time and on modern features such as occupancy data. Lastly, moving the traffic from the trucks to the rail,

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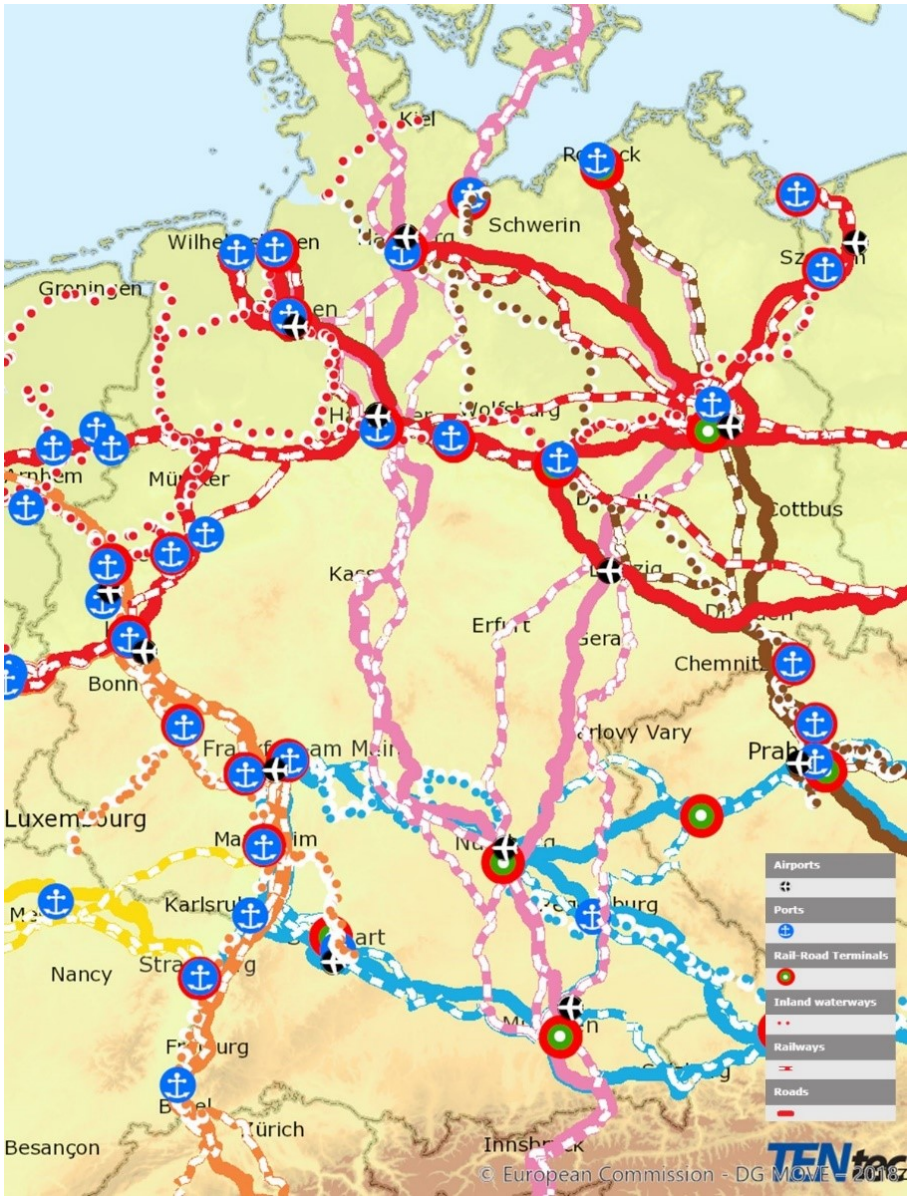
different policies measures are pro-posed, such as CO2 taxes on the road, truck toll on roads, exempting the railway from electricity tax, lowering the EEG surcharge (renewable surcharge) for electrically operated trains, build a framework for sustainable single-wagon traffic, and to permanently reduce the charges on the use of infrastructure in freight traffic (Geerts, 2021).

The inland waterway of the Rhine-Main-Danube Channel, which crosses in total ten countries (8 countries in the European Union) is the most important European inland water transport route (NEWADA duo project consortium, 2016). For Germany, the Rhine is the most important and largest river, it connects the large seaports with the hinterland of Europe. As mentioned by Kapfenberger-Poindl (2018), the possible reasons that the inland waterways are not often used is because of the low water levels or maintenance work on Watergates. According to CCNR (Central Commission for the Navigation of the Rhine, 2021), the low water levels are still decreasing since 2018. A combination of the traffic increased by a factor of 5 to 10 in the past decades and the hydrology of the Rhine waterways, this led to the vulnerability of the Rhine navigation. To create and re-main sustainable, reliable, and future proof on the inland waterways for the future, different measures need to be taken regarding the adaption of the fleet, infrastructure, logistics and storage concepts, and digital tools. Impacts on the infrastructure are more likely to occur in high water rather than low water. However, low water can have a significant indirect impact through higher traffic density and less keel clearance, resulting in increased shear stress on the river bottom, or the operations of ship locks causing possible obstacles for navigation.

According to the Federal Ministry of Transport and Digital Infrastructure (personal communication, February 9, 2022), there is room to increase the share of inland waterway transport. However, the lack of maintenance on locks, bridges, and the overall infrastructure are the bottlenecks in Germany. In 2018 Germany had problems with low and high-water levels due to climate changes. This affected the fleet of the vessels. To solve these problems the government has founded and funded different test fields for research and optimization for the barges and inland waterways. The solutions for the bottlenecks are tested before being ap-plied in practice (Federal Ministry of Transport and Digital Infrastructure Germany, personal communication, February 9, 2022). Digital solutions offer a unique possibility to support in-land navigation with real-time information on available navigable channel depth, short-term and long-term water level forecasts, traffic intensity, and the estimated time of arrival (ETA). By making use of these digital systems, the skipper has a better understanding of the actual situation and can thus optimize vessel loading. For the future, different investments are being made for stimulating the use of inland waterways, such as autonomously vessels, fully/remote automation navigation, automation of processes, modernization of fleets, and/or port optimization (Federal Ministry of Transport and Digital Infrastructure Germany, personal communication, February 9, 2022).

Germany is connected to almost all TEN-T corridors in Europe. The corridors that cross Germany are North Sea-Baltic, Orient/East-Med, Scandinavian-Mediterranean, Rhine-Alpine, Atlantic, and Rhine-Danube. This gives Germany a great position within Europe be-cause Germany is connected to every neighbouring country. The north, south, and west of Germany are also well connected to inland waterways with neighbouring countries (European Commission, 2021).

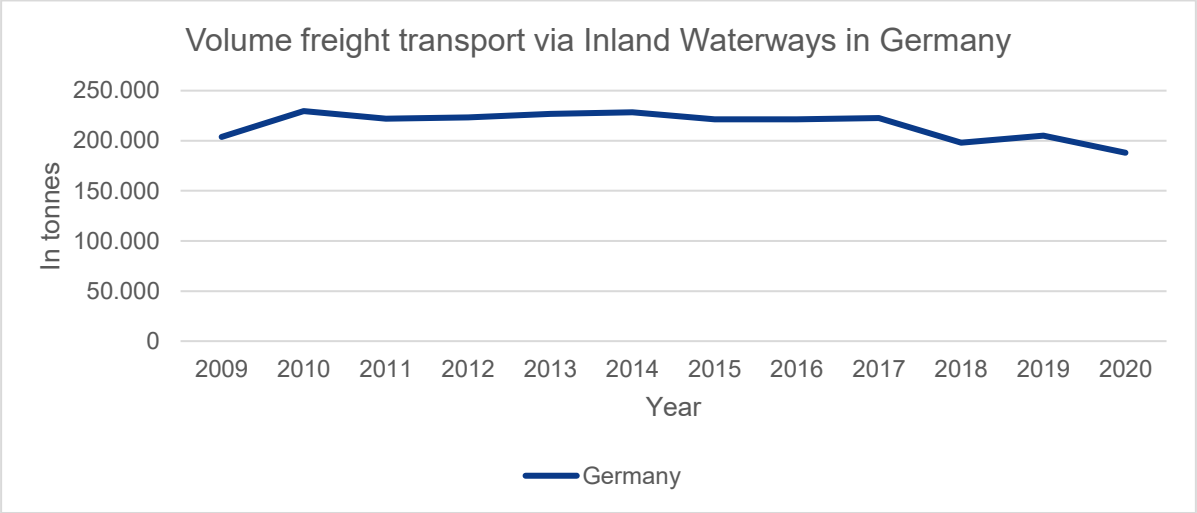
Figure A.1.21 TEN-T corridor map Germany TEN-T corridor map Germany



Source: European Commission, 2021

Figure below shows the trend in the volume of the freight transported expressed in thousand tonnes in Germany over the past eleven years. It presents that in the past three years (2017-2020), a decline of 16% occurred. Possible reasons for the decline of the volume for the recent two years are the differentiation in the level of water levels, the COVID-19 restrictions, which led to a decline of international and national volumes trend and the preference of using the road network, because of the cost-effectiveness and the direct origin-destination delivery (Schuttevaer, 2020).

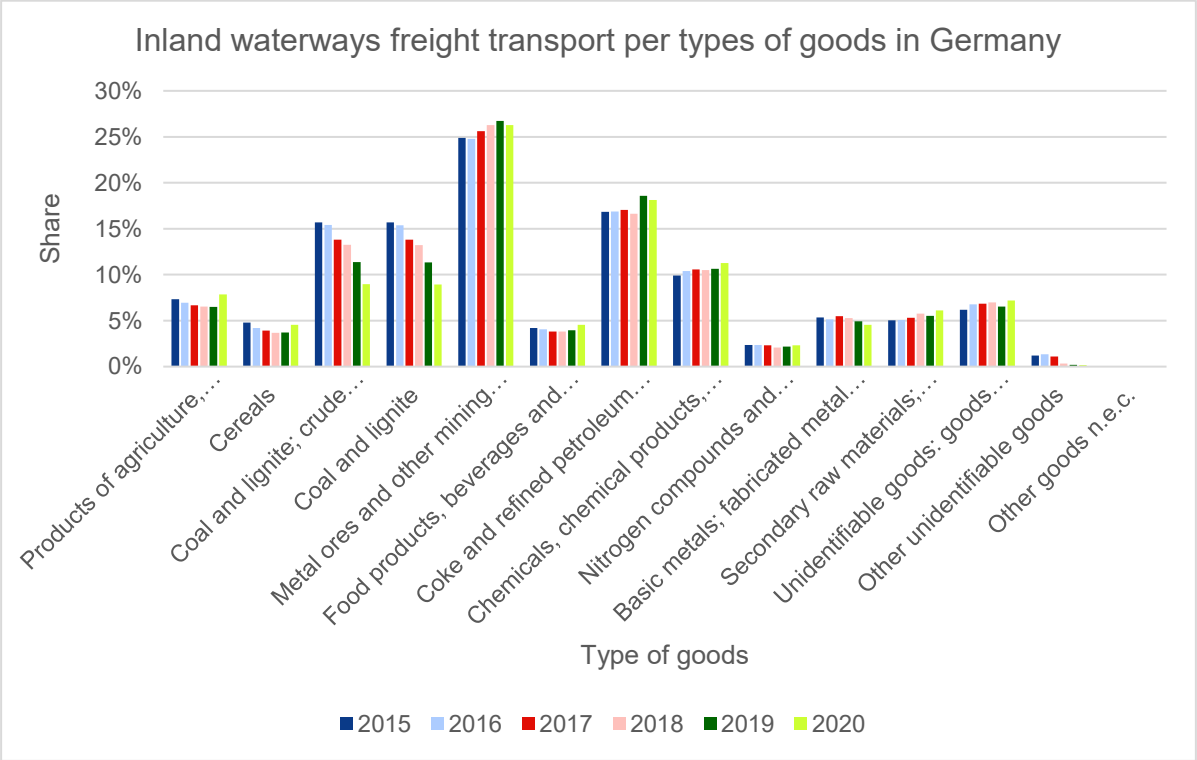
Figure A.1.22 Volume freight transport via inland waterways in Germany (x1,000 tonnes)



Source: Eurostat, 2021

Figure below presents the shares of the type of products that are transported in Germany. As shown in the figure, the segment products of metal ores and other mining products count for 25% of the total freight transported via inland waterways.

Figure A.1.23 Inland waterways freight transport for main types of goods for Germany (2015-2020)



Source: Eurostat, 2021

Government Policy on intermodal transport

The Federal Republic of Germany states in the Inland Waterway Transport Masterplan (2019) that digitalization has established itself predominately for the road and rail modes in recent years. Digitalizing inland waterway transport and waterways is mainly a European task that is jointly progressed by the Member States within the framework of various EU projects. The Federal Republic of Germany is heavily involved in these projects. In the future, inland waterway transport users are to be able to obtain up-to-date infrastructure data for route planning (e.g., fairway depth, number of locks, opening hours of the locks, etc.) from a one-stop-shop. The cross-border flow of registration data is also planned. In the future, inland waterway skippers can share data with relevance for their customers, such as the ship's position, the arrival time, journey and cargo data, with their logistics partners via a protected system. The decision as to which data to share is to lie with the vessel operator. Setting up the services is expected to take until 2021 (Federal Ministry of Transport and Digital Infrastructure, 2019). Since September 2021 electronic shipping documents via eCMR are legally accepted in Germany. With eCMR EU Member States use the same digital information service for shipping documents which reduces administrative costs. The eCMR is also a step in the digitalization direction since the EU approved the electronic freight transport information (eFTI) regulation that will enter into force in August 2024. It establishes a legal framework for road, rail, maritime and air transport operators to share information with enforcement authorities in an electronic format (IRU, 2021). This regulation stimulates not only Germany but also Austria, Belgium, France and The Netherlands to develop digital information services in the transport industry.

At the same time, a legal framework is to be established which allows for uniform digital cargo documentation throughout the EU. Digitalization offers great opportunities for optimizing and automating this exchange of information and thus enhancing the efficiency of transport operations. An impact assessment by the European Commission has shown that there are two major obstacles to the further digitalization of transport chains in Europe (Federal Ministry of Transport and Digital Infrastructure, 2019):

- Fragmented legal framework. The regulations on when and in which form authorities are permitted to accept electronic documents still vary from one European country to another.
- Unconnected and incompatible IT systems for electronic transport information and data exchange.

The Federal Ministry of Transport and Digital Infrastructure will take measures in the short- and medium-term to address the digital challenges for inland waterway transportation. These measures are connected to the following subjects (Federal Ministry of Transport and Digital Infrastructure, 2019):

- Optimization of locking processes.
- Implementation of new technologies.
- Establishment of digital information services and their evolution.
- Improvement of network coverage.
- Evolution of the Reporting and Information System for Inland Waterway Transport.
- Automated and connected navigation, including autonomous navigation.

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To strengthen inland waterway transport within multimodal transport chains the Federal Ministry of Transport and Digital Infrastructure is also taking different measures. These measures are connected to (Federal Ministry of Transport and Digital Infrastructure, 2019):

- Strengthening container transport by inland waterway vessels.
- Strengthening bulk cargo transport by inland waterway vessel.
- Strengthening the transport of abnormal loads by inland waterway vessels.
- Integration of inland waterway transport in the initial and continuing training of the haulage and logistics industries.

Examples of companies active in inland waterway transport

Inland waterway operators

Germany is well-known for some large international logistic companies. One of these international companies is Kuehne + Nagel. The European River connection from Kuehne + Nagel Euroshipping GmbH between Rhine-Main-Danube is located in Regensburg, Germany. The main activities are concentrating on traffic between the ports of Antwerp, Rotterdam and Amsterdam to the Black Sea and vice-versa. Kuehne + Nagel also offers road, rail, sea and air logistics in many countries (Kuehne + Nagel, 2021).

Haeger & Schmidt Logistics is located in Duisburg but has also offices in France, Belgium, The Netherlands and Poland. Haeger & Schmidt Logistics is specialized in logistics solutions for container transport along the Rhine and established reliable scheduled services to and from Antwerp and Rotterdam. Their inland waterway connections are between the ports of Antwerp and Rotterdam, Lower Rhine (Emmelsum, Duisburg, Neuss), Middle Rhine (Andernach), and Upper Rhine (Kehl, Strasbourg, Neuf-Brisack, Ottermarsheim, Weil am Rhein, Basel, Birsfelden). Together with inland waterway connections, Haeger & Schmidt Logistics offers their fast train connections to the hinterland. The train connections are between Antwerp and Andernach, and between Rotterdam and Kehl. Haeger & Schmidt Logistics offers an intermodal service by combining these two transport services (Haeger & Schmidt Logistics, 2021).

Inland terminals

Germany has many inland terminals. Contargo has 20 terminals located in Germany along the Rhine. With these terminals, Contargo offers a large network connection with Belgium, The Netherlands, Germany and France. Examples of the terminals are: Dortmund, Duis-burg, Emmerich, Frankfurt and Koblenz (Contargo, 2021). CTV Multimodal Container Transport and European Gateway Service have their terminal in Duisburg (CTV, 2021; European Gateway Service, 2021).

Logistics service providers

CTV Multimodal Container Transport and European Gateway Service (EGS) are two Dutch companies. Both companies also provide logistic services in Germany. CTV is located in Duisburg and combines rail, water and road in the European network. The intermodal connections are connected from the international terminals Rotterdam and Antwerp to Venlo, Duesseldorf, Dortmund, Strasbourg, Nuremberg, Munich, and Vienna (CTV, 2021).

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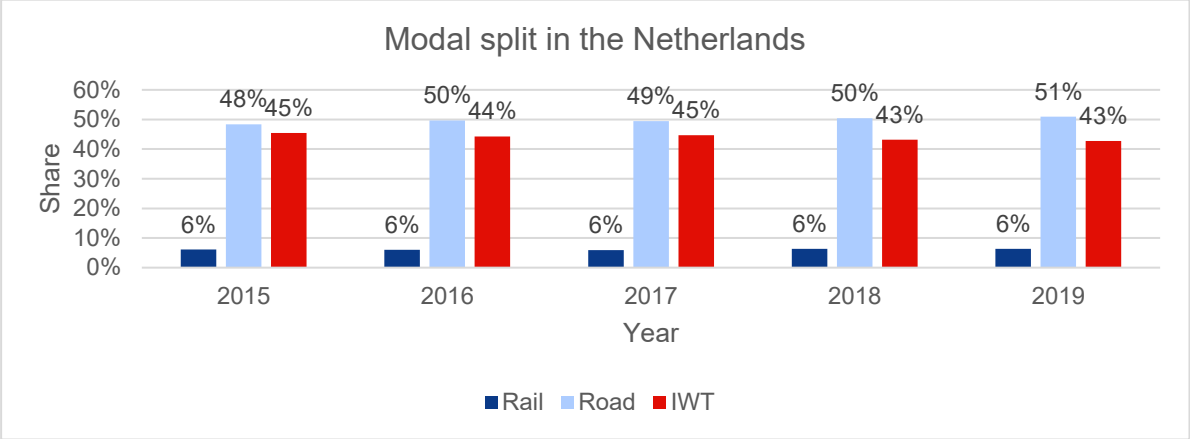
A1.5 Opportunities for inland waterway transport in the Netherlands

Current use of freight transport modes

As for other countries, also the modal split shares in the Netherlands are analysed as shown in figure below.

Figure A.1.24 Modal split shares in The Netherlands



Source: Eurostat, 2021

Compared to the other aforementioned countries, the Netherlands has a relatively strong position of freight transportation via inland waterways. Looking at the past five years, from 2015 to 2019, the Netherlands held an inland waterway modal split share of nearly 43%. Compared to the rest of Europe, the Netherlands has the densest network of inland waterways. Nearly about 5,046 kilometres and 4,800 kilometres are suitable for freight transport to hinterland destinations. Moreover, with the geographical location from the port of Rotterdam and the important connections with some of the rivers that connect with other European countries. Some of the significant European rivers that are connected with the Dutch hinterland waterways are the Rhine, Maas, and Schelde. Therefore, these connections with the rivers and the fundamental waterway infrastructure are optimally used in Europe (Bureau Voorlichting Binnenvaart, 2020).

The modal split shares of the trains remained the same over the past years. When looking at the infrastructure investment shares for the Netherlands it shows that in 2011 the investments mainly went to road 62%, rail was second with 30.8% and inland waterway only received 7.2%. The maintenance investments on the other hand show something different. Rail received most of the investment share in 2011 with 73%, road 13,1%, and inland waterway 13.9% (OECD, 2021). However, the high maintenance investments for rail still result in

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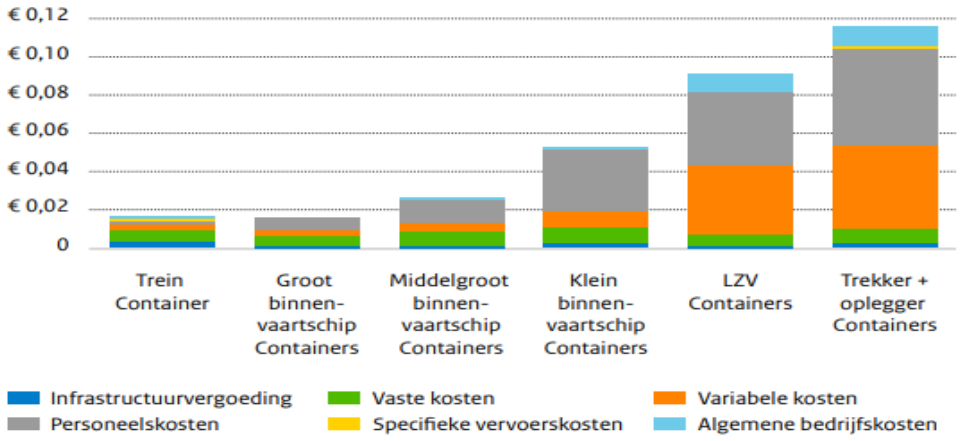
performance issues in the Netherlands (P. Zoeter, personal communication, 27 January 2022).

Different arguments are given by the researchers for still preferring the modality road in-stead of the rail or inland waterways, at some conditions, such as small loads, time-critical goods, or the lack of other alternative modes. Overall, the costs per ton per kilometre for transportation by inland waterways are significantly lower than transportation by train in the Netherlands. According to Kennisinstituut voor Mobiliteitsbeleid (KiM) (2020), for the use of all modalities, the costs inefficiencies as utilization rates, ineffective hours, and the detour factors are taken into account. However, the Dutch operators indicate that in practice other indirect cost components have a significant role which increases the rail transport costs. The indirect costs components relate to infrastructure utilization, such as interoperability costs (costs for using the different rail network in the Netherlands, but also in other countries), failure costs (the possibility that the route or junction is out of error, which leads to detour(s)) and route complexity (the route choice is influenced by the available capacity, constraints regarding the (dangerous) goods or noise rules). These indirect and variable costs of the train operations are taken into the variable costs. An overview of these costs is shown in figure below.

Figure A.1.25 The container transport per modality in costs per tonkm in 2018.



Source: Kennisinstituut voor Mobiliteitsbeleid [KiM] ,2020)

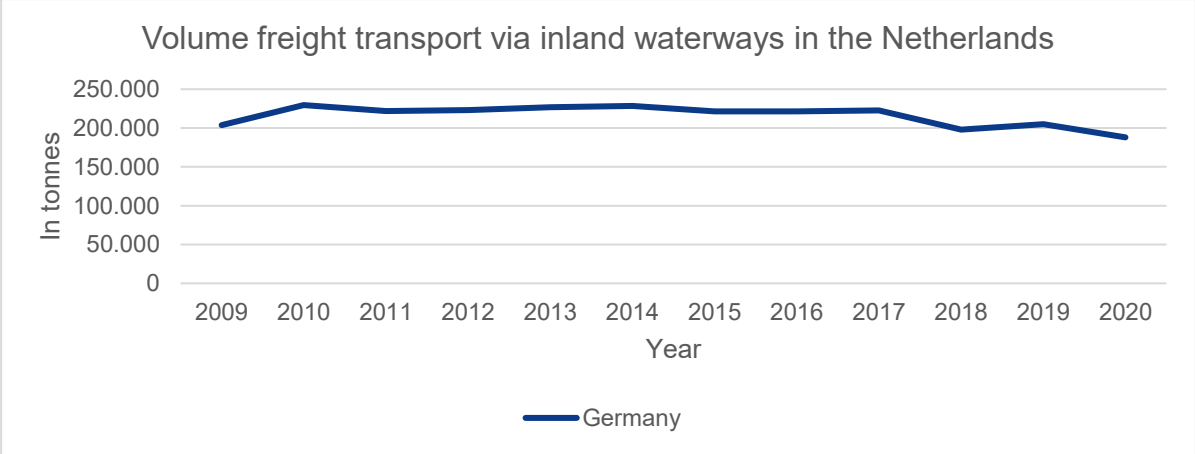
The Netherlands is well connected to neighbouring countries and the hinterland of Europe. Corridors that cross The Netherlands are North Sea-Baltic, Rhine-Alphine, and North Sea-Mediterranean. As it is shown in figure below The Netherlands has more inland waterway connections than rail or road. (European Commission, 2021). The main connections in The Netherlands are the Betuweline and the Brabantline.

Figure A.1.26 TEN-T corridor map The Netherlands

Source: European Commission, 2021

Figure below shows the trend in the volume of the freight transported expressed in thousand tonnes in the Netherlands over the past eleven years. It shows that in the past eleven years, the volume of freight transported via inland waterways remained nearly the same. Possible reasons for the decline of the volume for the recent two years are the same as for the other countries, the differentiation in the level of water levels, the COVID-19 restrictions, which led to a decline of international and national volumes trend (Schuttevaer, 2020).

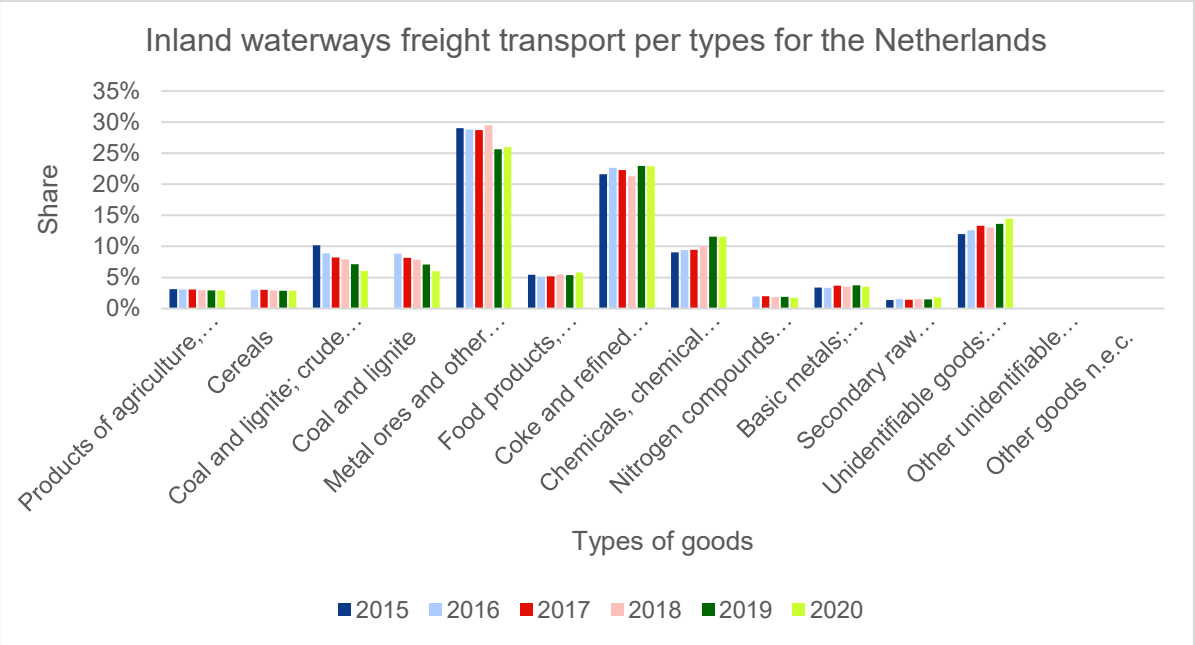
Figure A.1.27 Volume freight transport via inland waterways in The Netherlands (x1,000 tonnes)



Source: Eurostat, 2021

Figure below presents the shares of the type of products that are transported in The Netherlands. As shown in the figure, the segment products of metal ores and other mining products count for 30% of the total freight transported via inland waterways.

Figure 5.28 Inland waterways freight transport for main types of goods for The Netherlands (2015-2020)



Source: Eurostat, 2021

Government Policy on intermodal transport

To make the Netherlands more competitive in logistics, the Ministry of Infrastructure and Water Management (I&W) has an agenda for a robust, efficient, and sustainable transport system. To follow this agenda the Ministry of I&W (2019) has four priority themes. The goals for each priority theme are listed in table below.

Table A1.1 Overview of goals per priority themes

Priority themes	Goals
Digital transport	• Harmonized data exchange on freight transport possible (2025) • Data sharing between data information services possible (2025) • Paperless transport legally possible (2030)
Sustainable freight transport and logistics	• 20% CO_2 reduction inland and sea shipping (2024) • 2% annual reduction in CO_2 emissions by improving logistics efficiency (2030) • 30% reduction in CO_2 emissions from the hinterland and continental transport (2030)
Sustainable and efficient city logistics	• 1 Mton CO_2 emission reduction annually • Improving air quality through medium-sized Zero Emission Zones in 30 to 40 larger municipalities

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	• Fewer transport movements and better traffic flow in the city (2030)
Integral freight corridors	• Action program with a focus on the modal shift from road to water by removing concrete obstacles (2020) • Action plans for a modal shift for all multimodal business sites on the freight corridors (2021) • Increase in freight transport by rail from 42 million tons to 54-61 million tons (2025) • 5 million tons and 0.7 TEU from road to rail and water within the MIRT Freight Transport Corridors (2030)

Source: Ministry of Infrastructure and Water Management, 2019

Digitization promotes the possibility to make easier use of multiple transport modalities within a logistics chain. In short, digitization improves the efficiency, speed, and reliability of the logistics process. However, companies and governments are still not benefiting enough from the opportunities offered by the digitization of freight transport and logistics systems. Due to fragmented legislation and the lack of a common digital language, the government has not yet been able to provide a digital infrastructure. To achieve a working system of digital exchange of logistics information the Ministry of Infrastructure and Water Management has drawn up the Digital Transport Strategy (DTS). With the DTS, the ministry is focusing on a digital transport policy that has four milestones (Ministry of Infrastructure and Water Management, 2019):

- The realization of paperless transport.
- The development of digital collaboration between governments.
- The development and reinforcement of a future-proof basic data infrastructure to enable seamless transport by road, rail, air, inland shipping, and sea shipping.
- Structural - smart mobility - innovations and large-scale applications.

Examples of companies active in inland waterway transport

Inland waterway operators

The port of Rotterdam is an important gateway to the hinterland of Europe. And with logistic hotspots like Rotterdam and Venlo, multiple inland waterway operators are located in The Netherlands.

Inland terminals

For the inland waterway connections, Venlo is an important inland terminal. European Gateway Service, CTV Multimodal Container Transport, and New Silk way Logistics have their terminal in Venlo.

Logistics service providers

CTV Multimodal Container Transport is located in Venlo (The Netherlands), Duisburg (Germany), and Basel (Switzerland). CTV combines rail, water, and road in the European network with the multimodal concept. CTV uses European barge terminals to transport from large ports to inland ports. The intermodal connections are connected from the international terminals Rotterdam and Antwerp to Venlo, Duesseldorf, Dortmund, Strasbourg, Nuremberg, Munich, and Vienna (CTV, 2021). Besides CTV, European Gateway Service is also located

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in Venlo and Rotterdam. Through EGS, ECT offers shipping lines, logistics service providers, and skippers an extensive network of highly frequent rail and inland barge ser-vices. These services directly connect the international terminals in Rotterdam with a growing number of strategically located inland terminals in the European market. From various modes of transport – rail, inland shipping, truck – the best option for that moment is selected. The connections for EGS are located in the Netherlands, Belgium, Germany, and Austria (see figure below). Some locations, like Vienna, Kehl and Amsterdam are operated by partner connections (European Gateway Service, 2021).

Figure A1.29 Network map European Gateway Service

Source: European Gateway Service, 2021

New Silk Way Logistics is a joint venture by H.Essers and KLG Europe and is located in Venlo. Within the New Silk Way Logistics, they provide logistics services between Europe and China. Rail transport from Tilburg, Duisburg, Nuremberg and Lodz to China is the main used transportation. New Silk Way Logistics can also provide synchromodal transportation (barge, road and rail) if needed. In the future, it is possible to connect more locations to China. In addition to intermodal rail transportation, New Silk Way Logistics can offer complementary short sea transportation in Europe and Asia. Short sea connections to The United Kingdom, Ireland and Scandinavia are connected via ports and rail terminals in The Nether-lands, Belgium, Germany and/or Lithuania. Japan, Taiwan and South Korea will be connect-ed via ports and rail terminals in China (New Silk Way Logistics, 2021). One of the founders of New Silk Way Logistics, KLG Europe, is also located in Venlo. KLG Europe offers inter-modal transport by road, water and rail (KLG Europe, 2021).

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A1.6 Modal split and investments in Europe

In the paragraphs above the current situation for all five countries is described. In this paragraph, the focus lies on the comparison of the modal split and investments in contrast with the EU-28.

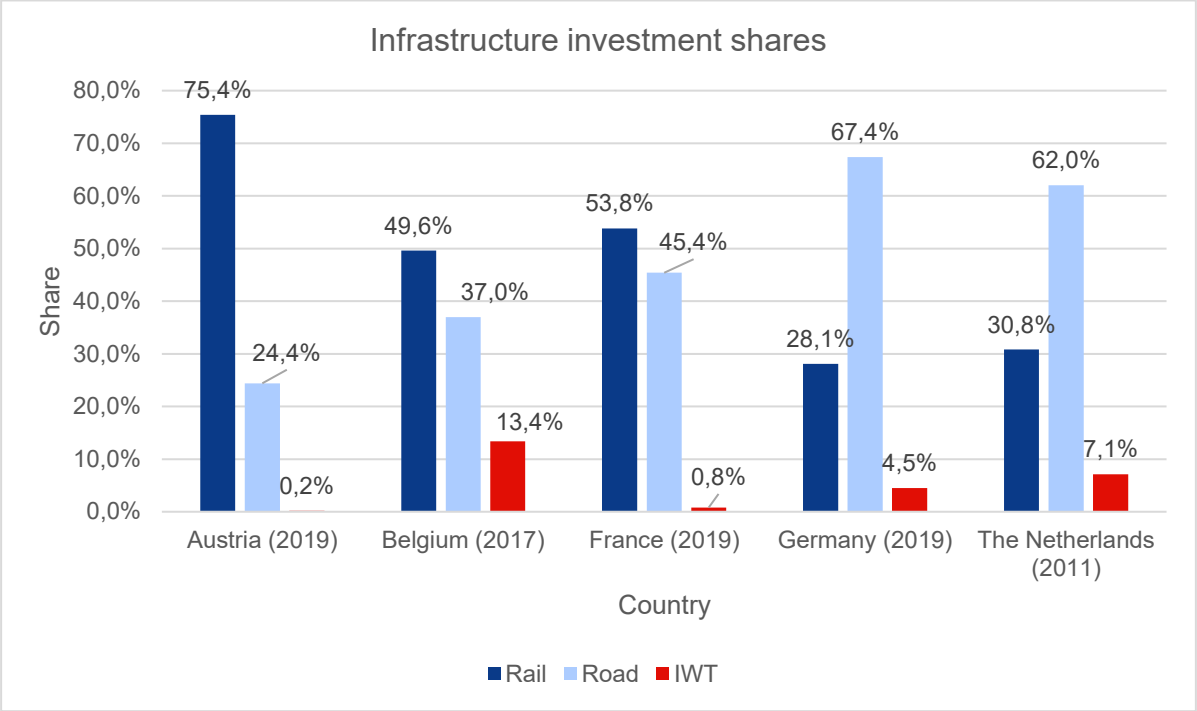
Table A.1.2 Modal split EU-28, Austria, Belgium, France, Germany and The Netherlands in 2019

2019	EU-28	Austria	Belgium	France	Germany	The Netherlands
Rail	17%	31%	12%	10%	19%	6%
Road	77%	67%	77%	88%	73%	51%
IWT	6%	2%	11%	2%	8%	43%

Source: Eurostat, 2021

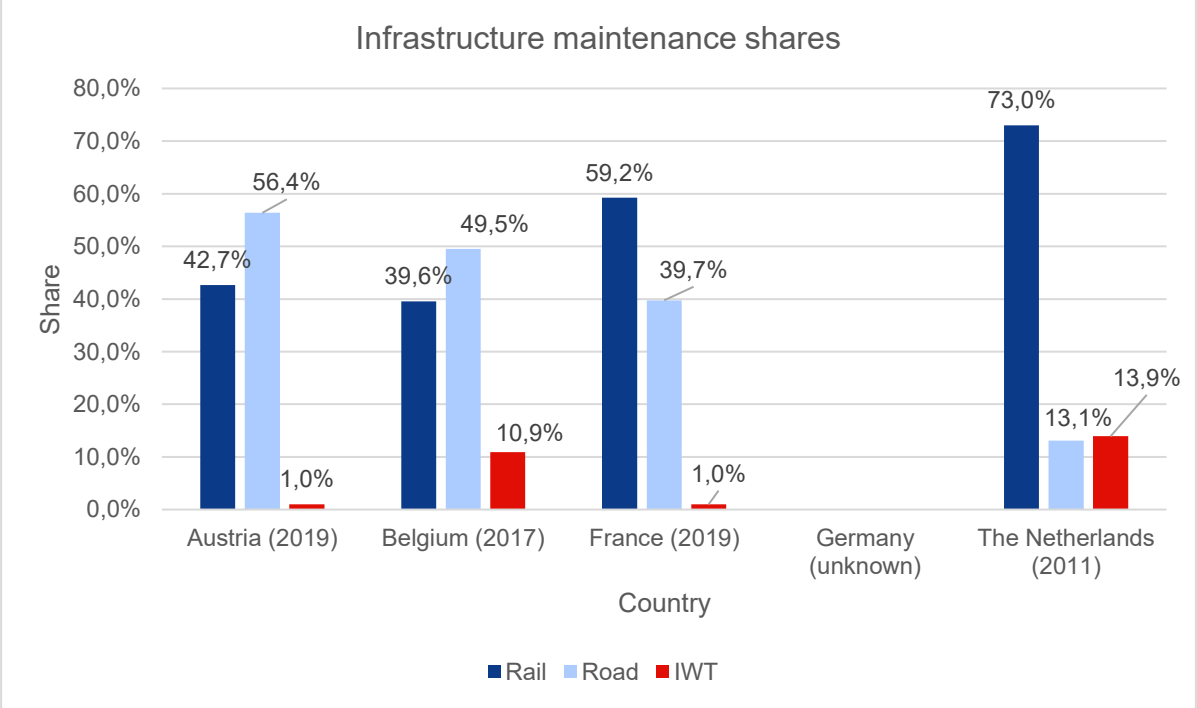
Table above shows that the average of the EU-28 for rail is 17%. Compared to the five investigated countries, Austria scores much higher with 31% and Germany comes close to the EU-28 average. Austria and Germany have an extended rail network, therefore rail is preferred over the use of the inland waterways. While the Netherlands has the lowest share of rail use of the five researched countries and compared with 28 European countries. Moreover, looking at the road shares of the five countries, France has the highest shares, mostly due to the dense road network and Belgium is in line with the average shares of the EU-28. Lastly, the Netherlands is the frontrunner and the country that has the highest share of the inland waterways. Also, looking at the other four countries and the EU-28, France and Austria have the lowest shares of inland waterways. Nevertheless, every country is working towards a modal shift to reduce the shares of the road to inland waterways or rail. Every country states that the inland waterways are often not optimally used, while the capacity allows for more barges and freight to be transported.

Figure A.1.31 Infrastructure investment shares



Source: OECD, 2021

Figure A1.32 Infrastructure maintenance shares



Source: OECD, 2021

The infrastructure investments show that Belgium has the highest share of investments in inland waterway transport together with the Netherlands. Germany and Austria have the lowest share in inland waterway investments. It must be said that these investments also include passenger transport (see figure above). Despite that, it can be concluded that the focus for modality is not so much on inland waterway transport. This also accounts for the maintenance investments. Austria and France almost have no maintenance costs. Only Belgium and the Netherlands, where more inland waterway is used, have a higher share of maintenance investments in an inland waterway.

Annexe 2 List of commercial information services

Name of the digital information service	Origin of the information service	Key components of the information service	Involved modalities	Source
Last Mile TEAM	Spain	• Artificial Intelligence (AI) • Track and trace trucks • Reduced administrative burdens • Integrate and coordinate all available transport and people resources	Truck transportation	Last Mile Team - Solve Smart City Urban Distribution Problems
People	Greece	• Smart ports • Smart containers • Real-time monitoring • Cloud-based • Cold logistics management • Cargo sensitivity	Rail, Road, and Inland waterways	peoplethinkbeyond | PEOPLE Think Beyond (people-t.com)
Wartsila (RIS)	Finland	• Traffic management • Optimization of supply chain • Real-time monitoring of • Vessel information • International inland navigation standards	Inland waterways	Wärtsilä River Information Systems (wartsila.com)
Periskal	Belgium	• RIS • Navigation software expert • One of the world leaders in maritime navigation and software	Inland waterways	Periskal Group - Navigation software inland shipping, River...
SHIPNEXT	Belgium	• Using AI to search freight transport • Automation process emails • Manage shipping data, trade, and digitalize workflows • Is-Possible to find open ship positions • Freight indexes • Automated freight calculator • Port related data • Real-time data flow • Monitoring • Connecting for end-to-end supply chain	Maritime, inland waterways, Road	SHIPNEXT - Shipping Marketplace and Freight Management Information service SHIPNEXT Marketplace
Spotvessels GMBH	Germany	• Shows Voyage activities • Booking/ Planning systems for skippers and carriers • Track and trace for skippers and carriers	Inland waterways	SpotVessels
Bearingpoint	The Netherlands	• Connecting stakeholders. • Maximise cargo • Long-term planning of routes and arrival times • Forecast of water levels	Inland waterways, Road	Digital Information services for Transportation Operators |

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Name of the digital information service	Origin of the information service	Key components of the information service	Involved modalities	Source
		• Shows essential points in the voyage		BearingPoint Netherlands
Twill	The Netherlands	• Covers the end-to-end logistics with inland transportation • Transportation and tracking for cargo	Maritime, Inland waterways, Road	Twill | A new logistics service for a new way of working
Covadem	The Netherlands	• Smart Navigation, inland navigation • Smart Dashboard, measurement of water levels	Maritime, inland waterways	CoVadem Services BV
BICS (Binnenvaart Informatie- en communicatie Systeem)	The Netherlands (Rijkswaterstaat)	Sends electronic messages: • About the ship • The crew and passengers onboard • The voyage and cargo to waterways • Harbour authorities • Uses EDI (standardised electronic messages) • Information about dangerous goods • Data on ships and shore locations	Maritime, inland waterways, shore locations, Ports	WELCOME to the BICS website | BICS Website
Nextlogic	The Netherlands	• Digital information service for container inland shipping • Data exchange between barge operators and terminals • Planning for arriving at terminals	Ports, Inland waterways	Home - Nextlogic
Portbase	The Netherlands	• Digital information service between public and private parties • Communication between operators and ports • Data-exchange between barge operators with road or rail operators	Ports, inland waterways, rail, road, public authorities	Portbase
AIS hub	World	• Real-time vessel tracking	Sea and inland waterways	Free AIS vessel tracking | AIS data exchange | JSON/XML ship positions (aishub.net)
PortXchange	The Netherlands	• Real-time vessel location • Reliable estimated time of arrival to the destination port • Improves planning	Sea and inland waterways	PortXchange - Digital collaboration Information service | Maritime logistics (port-xchange.com)
NxtPort	Belgium	• Data sharing between operators and ports • Create more transparency in shipping processes • More accurate planning of freight transportation on ports, vessels, labours and cranes	Ports, inland waterways, maritime	Nxtport | Unleash the power of Together!
CCS(Cargo Communicating SysteM)	Belgium	• Data exchange between rail, terminals, intermodal operators, skippers.	Terminals, Trains, road	Hinterland (Inland) - CCS vzw: Cargo Community System
BTS (Barge Traffic System)	Belgium	• Data exchange between terminals and barge operators, especially for the transport of containers • Terminal planning	Terminals, inland waterways	Port of Antwerp (c-point.be)

Name of the digital information service	Origin of the information service	Key components of the information service	Involved modalities	Source
		• Terminals can request the position of inland vessels		
Ibarge-app	The Netherlands	• Data exchange in inland waterways • Insights in transport states, rea-time data • The reduced administrative burden	Terminals, inland waterways	iBarge App: Welkom op onze website | Voor bevrachters & schippers

Annexe 3 Interviews

Austria

Interview Austria – 22 December 2021

Robert Schwarz (viadonau)
Mario Kaufmann (viadonau)
Katrin Steindl-Haselbauer (viadonau)
Kees Verweij (Buck Consultants International)
Anouk de Wilde (Buck Consultants International)

Current use of inland waterways

- The Danube is currently mainly used for the transport of bulk and empty containers. This is correct. The biggest amounts transported on the Danube (in total 8.3 million tons in 2020) are forestry and agricultural products, iron ore, scrap, other metal products, minerals, petroleum products, and fertilizers. In Austria, currently, only empty containers are shipped on demand (the last five years between 2500 and 5000 TEUS per year). This means that there is no regular container service available in Austria for inland waterway transport. Back in 2004, there was this idea at Viadonau to set up a regular container line service. But it turned out that at that time there was not enough demand.
- The capacity of the Danube is not fully used, there are some bottlenecks. The Danube is an east-west corridor with bottlenecks, mainly about water depths.

For the westbound direction:

- One of the bottlenecks is in Germany between Straubing and Vilshofen, which is a big issue for fairway reliability. In addition, the westbound direction from Austria offers only low bridge clearance and generally a smaller-sized infrastructure (waterway UN/ECE class VI and smaller). There is also a long transit time to the big ARA sea Ports because of numerous locks on the Danube, the Main, and the Main-Danube Canal. The alternative connection with rail is very attractive because of the shorter lead times (overnight) and the high frequencies to all Austrian Container Terminals as well as attractive prices.

The eastbound direction:

- For the eastbound to Constanta (Romania), there are infrastructural bottlenecks in Hungary, Bulgaria, and Romania. Canal dues for the Danube – Black Sea Canal and the container volume between Austria and Constanta is not very high.

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- We often hear complaints from shippers that their work is not taken seriously. Shippers have problems with the eastbound directions and blockages that have not been announced. There are a lot of improvement opportunities.
- Another bottleneck is the administration. This is related to the reporting of inland waterway transport along the Danube. Along the Danube, they are making big steps in harmonizing the forms, like arrival/departure reports or passenger lists. Many Danube countries have accepted these forms because before there were different forms, in different languages which made the travel time longer. Partners from 8 countries are now improving and implementing the RIS COMEX system with the system CEERIS (Central & Eastern European Electronic Reporting Information System). This is a joint electronic system with eight countries, from Austria downstream the Danube and to the Czech Republic. For this area the national reporting requirements are configured (which data has to be reported to which authorities for which type of transports) and it includes customised report forms. A Reporting Party (Fleet Manager, Skipper) can enter the route and the type of transport and is informed about all relevant configured reporting requirements along that route for the specific transport. The CEERIS system then creates all related reports and provides them to the Receiving Authorities.
- There will be big steps in the upcoming months for administration (reduction of administrative barriers and reporting burdens) but still, some improvements have to be made on infrastructure, competitiveness for inland waterways compared to rail.
- The most important seaports for Austria are Koper, Triest, Hamburg, and the ARA Ports.

Inland Waterway Operators:

- There are many more reliable operators also offering container transport on demand, but at the moment there is no regular liner service existing. These operators are also looking into the future for modernizing and digitalization.
- A list of possible operators is available at the Danube Logistics Portal (Danube-logistics.info).

Plans for increasing the use of inland waterway transport:

- The four public Ports in Austria (Linz, Enns, Krems, and Vienna) are operating – next to their transhipment facilities for bulk and liquid goods – very efficient container terminals. But they are mainly operated by rail. Next to their inland waterway access, they are included in the shuttle train rail network to the big seaports in Europe. They can provide synchromodal since they can easily shift between inland waterway and rail, this is not happening at this moment. Some ports shifted their capacity for the in-land waterway to rail capacity when it comes to their storage.
- In the last years, most of them were increasing their container handling capacities and their shuttle train connections. However, all of them are also transhipping empty containers shipped by barge and interconnecting them with the other modes. Additionally, many of them have been modernising their infrastructure, superstructure, and increasing Digitalization – they are all suitable for additional contain-er volumes by barge.

Intermodal Policies

Ambition for using inland waterway transport in the future:

- Austria is following the goals of the European Commission for modal shift etc. In Austria, they recently published “Masterplan Güterverkehr” by the Federal Austrian Ministry for Climate Action. They started the development of climate-neutral and sustainable cargo transport by 2040. The segments of this strategy are (a) reducing car-go transport, (b) shifting cargo towards environmentally friendly modes like rail and inland waterway, and (c) improving the environmental friendliness of all transport modes.
- The Fit for 55 from the EU is also influencing the policy of the Austrian government.

Main policies of the Austrian government to achieve this?

- There are some national funding schemes offered for the transport of containers via rail and also for inland navigation (e.g., the amendment of ships for intermodal transport; “Investitionsförderprogramm Kombinierter Verkehr), but also funding for additional ports superstructure like cranes, etc. (“Terminalförderprogramm”) In parallel there are additional funding schemes existing to increase digitalization in logistics operations (“Logistikförderprogramm”) as well as increasing the environmental performance of the company. (“Klima aktiv”).
- Studies are funded to increase the intermodal transport, inland waterway but also for digitalization.

Digitalization

The ambition of Austria for digitalizing inland waterway transport and their actions:

- Fully support digitalization within IWT by operating and further improving the RIS COMEX systems (EuRIS and CEERIS) together with other partners. As mentioned before to reduce the administrative bottlenecks.
- To make the specified RIS Corridor Services available to the users, the RIS COMEX partners agreed to realize a common and centralized single access point, the EuRIS system. EuRIS, an adapted clone of the existing Flemish VisuRIS system, was advanced to serve as a European RIS information service fulfilling a great variety of information needs of inland waterway stakeholders.
- EuRIS gathers relevant RIS information from the national data sources to provide optimized fairway-, infrastructure- and traffic-related services in a single point of access for the users enabling reliable route- and voyage planning as well as traffic- and transport management on a pan-European level.
- Public information is available for everyone, specific information is only available for authorized users.
- There were many challenges (technical, organizational, legal, and financial) to establish the sustainable framework and to operate such a joint system. Some parts are already signed, others are in the final phase.
- Both systems EuRIS and CEERIS will start to operate around March/April 2022.
- Not everyone will use it from day one, it will be implemented step-by-step.

- National data from Austria will be put into EuRIS and shared with all the other European countries in this system.
- A shipper can use the EuRIS system to plan a route. It then shows all the bottlenecks, water depth, etc. included on this route. It is possible to adjust this route to any wishes. The electronic reporting system will transfer this information to the arrival port.

Synchromodal transport

- More cooperation is needed, not only between shipping companies but also between rail and inland waterway operators. Especially these two modes are environmentally friendly and can transport big amounts of containers. They are suitable for the increasing demand for intermodal transport services. To make use of the advantage of both modes of transport better cooperation is needed.

Within RIS COMEX 13 European partners have developed the digital possibilities to make the relevant information available at one single point.

What is your expectation on the DIWA report task 2.2 Synchromodality?

The steps that Austria has to take to face the challenges are divided into short and medium/long-term measures with concrete steps to be tackled potentially in upcoming implementation projects.

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Belgium

Interview Belgium – 20 December 2021

Piet Creemers (Vlaamse Waterweg NV)
Bjarne Bellen (BDO Belgium)
Kees Verweij (Buck Consultants International)
Abdulsamad Munir (Buck Consultants International)

Current use of inland waterways

- It is important to understand that the responsibility of the inland waterways in Belgium is divided into three departments: Flanders, Wallonia, and Brussels. For the Flemish department, we have our input.

Intermodal Policies

Documents:

- These documents cover the new future vision 2050 and the adjusted vision of 2040 of the Flemish Government. The 2040 document is an important document that covers the ambition of connecting smart traffic, smart transport, smart sustainable people, and smart companies. The focus lies on creating more sustainable and working towards more synchromodal transport. Synchromodal transport is an important topic for the Flemish government. A distinction is made between passenger and freight transport. For the inland waterways, the focus is on freight transport and not so much on passenger transport.
- The concept of synchromodality also includes the concept of MAAS (Mobility as a Service). Through a joint digital channel, it enables users to plan, book, and pay for multiple types of mobility services. The concept describes a shift away from personally owned modes of transportation and towards mobility provided as a service.
- The second document is the Flemish multi-modal strategic plan for intelligent transport systems. This document covers the technological innovation in mobility and can be used as inspiration for inland waterways. The ITS (Intelligent Transport Systems) is a passenger management system. However, this can (partly) be useful for the inland waterways. Other projects have interfaces between passenger and freight transportation. For both types of transportation, there are important components: traffic management, personalized data, big data, and/or dynamic road changes. In freight transportation, they are also looking into implementing dynamic road-charging. For instance, charging higher traffic in peak hours and stimulating with a lower process for driving in the off-peak hours. Physical internet is also an important topic that also covers synchromodality.
- The third document is the policy note 2019-2024. This policy note describes the ambitions of the ministry for digitalization, synchromodality, and mobility based on operational or strategic objectives. One of the objectives is to create a sustainable and re-liable infrastructure that is ready for digitalization, mobility, and climate change. For the inland waterways, the actions that are taken always have the strategic objectives as the fundament.

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Digitalization

Digital systems:

- Until a few months ago the three departments of Belgium (Flanders, Wallonia, and Brussels) had their systems for inland waterways. In Flanders, the VisuRIS is used for data capturing, planning for internal and external activities. This system provides the network infrastructures, portal accessible for internal and external parties. It is possible to make advanced route planning based on the traffic, locks, and bridges. This system is used in Flanders. The information from RIS (River Information System) is also available in VisuRIS.
- At this moment Flanders is looking into collaborating with Brussels for using VisuRIS for the support of internal and external processes. Wallonia is still using outdated (digital) systems. Wallonia is going to implement VisuRIS in different phases. This will result in the standard use of digital systems in Belgium. The steps that are taken are in line with the RIS-COMEX project.

Type of static and dynamic data:

- The Flemish waterways are working closely with the ports because the ports have their port systems. For now, research is done on the digital notifications of skippers. Once a skipper arrives at Flemish waterways it is automatically signed up into the system. There is still the option to sign up at the ports via mobile phone or the physical offices. Digitally signing up is at this moment not mandatory yet.
- Research is also done on the expansion and implementation of big data sharing information services between the waterways and the ports. The challenge is to what extent the data can be shared.

Bottlenecks and opportunities for digitalization:

- Different relations and data sharing are required, between the government and the private sector. Data sharing between private parties can be helpful. These information services can exchange information on route planning for criteria such as costs or CO2 emissions.

Synchromodal transport

- Private companies have different synchromodal alternatives. Interesting to see is the strategic ambition of rail (Rail Roadmap 2030 - Rail Roadmap). It also covers the ambitions for the (multi-modal) road, rail, and inland waterways for 2030 and a guided short movie. The road share of freight cannot be increased but must be shared to rail or inland waterways. The road will also be innovative with alternatives since it is the most convenient method of transport for shorter distances. The three modes are individually looking to integrate and collaborate for synchromodal transport.
- The question was asked: The Synchromdal Maturity Model describes a 100% train-barge component on level 5. In what way should this be interpreted? What are the conditions and indicators for reaching this level?
  - The first and last mile transport should be transported by road. The main type of goods that are intended for transporting via rail or inland waterways are bulk and container freight. The modal should not be used for every type of good. But rather, supporting companies and policies.

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What is your expectation on the DIWA report task 2.2 Synchromodality?

- At this moment the Flemish government is working on the 2.5 DIWA project, which is looking into synchromodality. The type of data needed and missing at this moment should be discussed in this report.
- Different conditions of synchromodality are inevitable, such as high reliability, real-time data, and capacities. These different conditions are described with experts over the world. Maintaining the inland waterways' reliability and punctuality are important for the synchromodality in-between the different modes. Otherwise, it endangers and reduces the trust of the modality inland waterways. The description of 2.5 DIWA in Belgium is: “The most efficient and appropriate transport solution in terms of transport costs, duration, sustainability, and their reliability, in which the configuration of the transport chain is not static during transport, but is flexible, being able to adapt the mode of adequate transport according to the conditions in real-time of infrastructure and capacity, through collaboration and the exchange of information in real-time of all modes of transport, the terminal facilities and the actors involved in the transport logistics chain.”

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France

Interview France – 23 December 2021

Eloi Flipo (Voies Navigables de France (VNF))
Kees Verweij (Buck Consultants International)
Abdulsamad Munir (Buck Consultants International)

Current use of inland waterways

- France has more than 3000+ commercial barges on the French waterways, 50% is with the French flag. The share of inland waterway transport is mostly in the Northern part of France, the Moselle river.
- The current use of inland waterways in France is 2.5%. However, the use of inland waterways is much higher in the Northern part of France and the French part of the Rhine. In these parts, the share is up to 10-20% of the freight transport in that area. The VNF is trying to show other figures what will show the growth in inland waterways per region. Now the figures do not give the 'right' image. In the regions that have rivers and canals, inland waterways are used.
- It is possible to increase the share of inland waterways for the rivers Rhône, Saône, and Seine. For the Saône and Seine, it is even possible to increase the freight transport by four without changing or challenging the infrastructure or locks.

Bottlenecks:

- There is a lack of small-sized ships that transport bulk dry or general cargo. In 2000 France had nearly 1800 units of these ships, in 2020 only 1000 units are available. Despite this, the loading capacity has remained the same or even increased. Larger ships are added to the inventory, but smaller ships leave the inventory.
- Another bottleneck is the lack of inland ports. This makes it difficult for transporting to cities.
- The handling costs at sea terminals are high. Also, the first and last-mile costs are high. From the fright forwarders and the inland shippers, the total costs are soon as too high compared to the modality road. Due to environmental awareness of the in-land skippers, freight forwarders, operators, and other stakeholders the urge is avail-able to look for other solutions. Rail is often seen as unreliable.
- VNF developed a funding program to shift to inland waterway transport.

Intermodal Policies

- A performance objective project contract is signed by the ministry of transport, the government, and VNF. Through the contract, the government provides funding of 300 million EUR each year to VNF. One of the ambitions is to reach the share of 4% for inland waterway transport. The statistics will be translated per region or type of goods.

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Digitalization

- VNF is responsible for the RIS program in France. RIS will mostly be used for safety and navigation and not for optimizing logistics in France.
- At this moment barge operators use different portals with information about width, length, water levels, locks, and bridges.
- VNF is now researching how to collect and share data. This cargo system is similar to BICS (information service of The Netherlands). VNF collected more than 80,000 cargo re-ports in the last year. With this data, VNF can dispose to freight forwarders and use them cleverly. VNF wants to move to an online digital information service for shippers, forwarders, and barge operators can digitalize the administrative burdens.
- Different information services were reviewed by VNF, also the Dutch system iBarge. VNF wants to share data based on blockchain.
- VisuRIS is an access portal point to get information.
- To reach synchromodality VNF signed a partnership with the infrastructure rail network. How can we exchange data between rail and inland waterway transport? More static and dynamic data will be shared, statics but also the traffic and quantities. This project is called ‘green freight’.

Synchromodal transport

- Large shippers are interested in this concept. Medium and smaller-sized companies are less interested to invest their energy and time in synchromodality.
- Synchromodality is seen as a more strategic idea for the future.

What is your expectation on the DIWA report task 2.2 Synchromodality?

- The Netherlands is the best logistic expert. VNF is curious about the findings of this report.
- In June there will be an event on the TEN-T policy in Lyon. Maybe it is interesting to have you and the ministry present the findings and recommendations on this event.

Germany

Interview Germany –8 February 2022

Kees Verweij (Buck Consultants International)
Abdulsamad Munir (Buck Consultants International)
Niels Braunroth, Bundesministerium für Verkehr und Digitale Infrastruktur (BMDV)
Tobias Aretz, Wasserstraßen- und Schiffahrtsverwaltung des Bundes (WSV.de)
Birgitta Schäffer, Bundesministerium für Verkehr und Digitale Infrastruktur (BMDV)

The current use of German inland waterways

- On the German inland waterways, there is sufficient space to increase and to have a modal shift for inland waterways.
- On the other modes road or rail, the infrastructure is the determining factor. For the inland waterways, there is a lack of maintenance which is a big bottleneck. In some parts of the inland waterways, issues are found with the capacity restriction of the locks. From the government, these bottlenecks are intended to be tackled and are described in the Bundesverkehrswegeplan 2030. Therefore, funding from the government will be given for the development of the port or the waterways.
- Regarding the infrastructure, the locks, the bridges, and overall infrastructure are the specific bottlenecks. Also, the infrastructure requires deferred maintenances due to overload use, deficit, and material losses.
- In 2018, Germany faced problems regarding low and high-water levels due to climate changes. This affected the fleet of the vessels and was solved by the industry. The government-provided funding.
- From the ministry, different test fields are funded and founded to research and test different optimization for the barges and inland waterways. Also, the solutions for the bottlenecks are tested, before implementation in practice.
- For the future, different investments are being made for stimulating the use of inland waterways, such as for autonomously vessels, fully/remote automation navigation, automation of processes, modernization of fleets, and/or port optimization. Different guidelines are set for the investments. By providing the investments, the inland waterways are promoted to be used for in the future.

Intermodal Policies & digitalization

- Germany is actively participating in the European projects, to achieve cross-border data harmonization. Also, supplying data from the Germany cross-border is one of the ambitions of the government.
- EuRIS is the system that will lead to a big step forward of information in the same format and manner. In this European portal, it will be possible to view waterways, lock management options, etc.

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- Also, the RIS of Germany, ELWIS, forecasts the future water levels for the upcoming days. In the past, the forecast was up to 3 days, but it has improved to forecast up to the upcoming 10 days. This function will be implemented in the EuRIS portal by a plug-in element.
- The feedback from private parties provided shows that the current information can be efficiently used for freight transport in the inland waterways.
- It will be nice to have access to real-time data, this information provides insights into the hinterland bottlenecks of the inland vessel. Eventually, EuRIS will provide this element, by providing the actual position for planning at the lock. This supports making the planning and calculating the travel times.

Synchromodal transport

- Using the different modes more often is needed for the optimization of the supply chain. Moreover, it is important for freight transport to take other factors into account, such as sustainability, infrastructure maintenance, and/or external costs. An overview of the digital ecosystems is given in INDUSTRIE 4.0 information service.

What is your expectation on the DIWA report task 2.2 Synchromodality?

- It will be useful to gain insights into the documents and future activities for Germany. It is important to create transparency and visibility over the European countries. This report could lead to insights to tackle bottlenecks, where the government could invest or work with private parties.
- Another interesting project that can be useful for the report is GAIA-X. In this project, documents are managed in a lean way and as much as digitally possible. Also, Ger-many would like to promote the inland waterways by improving the accessibility of the digital systems as much as possible.

The Netherlands

Interview The Netherlands – 1 February 2022

Roeland van Bockel (Ministry of Infrastructure and Water Management)
Kees Verweij (Buck Consultants International)
Abdulsamad Munir (Buck Consultants International)

Intermodal Policies

- Shippers are motivated to use the inland waterways for their freight transportation. However, internationally the aspect of geopolitics influences the modality choices. For instance, in Germany, the Deutsche Bahn has a broad rail network. Therefore the urge to use the rail instead of inland waterways can be explained.
- Also, other European countries do not have the same waterway infrastructure. Using the inland waterways is not always as attractive as it should be.

Digitalization

- In the past pilots were executed at the deep-sea transport, to transition a paperless customs arriving. After these successes, the paperless transition in inland waterways followed.
- To harmonize the data in inland waterways and maritime transport, it is necessary to combine data of different involved countries, data of different freight forwarders, data of ports, data information from barge operators, and data from governmental parties. Working towards the interest of the involved parties is one of the main challenges in the transition of digitalization.
- Some concerns are raised, like, in which 'language' is the data spoken? How are we able to fine-tune the different data and systems on each other, to be operational for everyone?
- Often the reasoning is from translating the documents to a message structure, nevertheless, it is understanding the segmentation, fragmentation, and search of the data elements and exchange between the parties.
- The private parties are taking benefit of this market gap (lack of exchange of data), by providing commercial information services for shippers. By having multiple information services, the overview is often lost. Also, the main objective of freight transportation from origin to destination is lost.
- Now, the objective is transitioned with an economic objective, and scaling up systems or creating standards are not performed for an optimized supply chain for the freight transportation for origin and destination.
- The standards for inland waterways over Europe are not harmonized, not regarding, the data, regulations, and/or legislations. Each country or even inland terminal has its demand or rules.
- From the barge operators, there is a lack of trust to provide data. Some of the barge operators are living their life on the barge and are not willing to endanger their privacy.

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Synchromodal transport

- There are possibilities to increase the synchromodality in freight transportation.
- One large independent information service is required, which would have the objective to transport freight from origin to destination, instead of individual parties and information services that offer separate services.
- The EuRIS project is one of the creative projects, which is executed. However, this system is designed only from the perspective of the waterways, and not in collaboration with commercial parties or information services
- Rules and demands at each inland terminal differ on national levels. This is one of the hurdles for freight transportation by inland waterways.

Conclusion

- Independent system based on the system-based approach from public and private parties.
- Standard rules and demands at an inland terminal on (inter) national level are required.
- Harmonization across borders is demanded to stimulate the use of inland waterways.

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H.Essers (Belgium)

Interview H.Essers – 26 January 2022

Hanno Reeser (H.Essers)
Kees Verweij (Buck Consultants International)
Abdulsamad Munir (Buck Consultants International)

Current situation of H.Essers

- H.Essers is from origin a road modality company and is moving more towards the clients' wishes with inland terminal logistics. Some of their clients are willing to work towards freight transportation by barges to their warehouses. However, the journey must be as smooth as possible on the inland waterways with a connection between the deep-sea terminal and the inland terminals.
- The opportunities for inland terminal logistics are explored based on pricing, carbon footprint, and/or duration.
- H.Essers is a company that transports by their rail network to the inland locations. These trains are loaded with large volumes of freight with fixed timing schedules. Today clients are more asking for dynamical freight transport.

Synchromodality

- In the past and still today, all of the freight transportations from origin and destination (O-D) were tendered. This is seen as a static way of deciding the modality. Advice from H.Essers is to choose the modality on the duration of the O-D. if the loading has an emergency, it can be transported by truck. If the freight has longer durations it will be transported by barge or rail. By doing it this way, the freight is transported dynamically. In the past, there were penalties when freight arrived too late.
- H.Essers is discussing the type of modality with its client. To stimulate barge and rail the price of transporting by truck is higher. Also, the carbon footprint is researched and discussed with the client. In the future, the carbon footprint will be compensated by using Hydrotreated Vegetable Oil (HVO).
- With the clients of H.Essers, it is decided that different prices are discussed based on their duration. If the duration is four days, the freight will be transported by train. With a duration of two days, the freight will be transported by truck and different prices are charged to the client.
- The strategy of H.Essers is to design the warehouse di-modal where two modalities can arrive and if possible a tri-modal warehouse will be designed.
- An example is the takeover of the inland terminal in Bergen op Zoom, The Netherlands. This stimulates the inland waterway transport between Gent, Antwerp, Genk, Bergen op Zoom and Rotterdam.
- H.Essers has a broad intermodal rail network in Europe and is looking for worldwide extensions of this network.

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Digital information

- Static information is used by H.Essers for planning. H.Essers makes fixed routes and also backup routes are planned for the trucks. Standardised work patterns are re-quired due to the large scale of staff workers.
- Both rail and barge are outsourced. For planning the barge data must be clear and consistent. For instance information regarding inspection, customs, and type of cargo. This information should be autonomous and be delivered as soon as possible.
- In the future barge transportation is included in parts of France.
- For now, it is difficult to say where bottlenecks occur regarding data because most of the operational work is outsourced. Nevertheless, the connections between Rotter-dam – Bergen op Zoom, Gent – Genk, and Antwerp – Genk do not lead to bottlenecks or issues at the inland waterways.
- For the future, regarding autonomously or electric bares, it is important to look at the data such as bridge heights and waterway routes.
- The IT department of H.Essers is developing its own TMS portal where it can be possible to gain insights into the planning of fixed routes and the modalities.

Conclusions

- H.Essers is one of the frontrunners at synchromodal services in the Benelux, so it could be ranked at number four of the synchromodal maturity model. Now, a-modal bookings are already possible. Also, the client should have an advantage (pricing, carbon footprint, or durations) for a-modal bookings. H. Essers is looking into real-time carbon footprint measurements, due to the nature of the company (asset-based company). By discussing the opportunities of compensating the expelled emissions, rail and barges will be more attractive for the clients. Eventually, the next step is to compensate and allocate the carbon footprint of freight transportation.

European Gateway Services (The Netherlands)

Interview European Gateway Services – 27 January 2022

Paul Zoeter (European Gateway Services)
Kees Verweij (Buck Consultants International)
Anouk de Wilde (Buck Consultants International)

Current situation of European Gateway Services (EGS)

- EGS has a network that is orientated to the West Ports (Rotterdam and Antwerp). EGS connects these two ports with the hinterland of Europe. On some inland ports, EGS has its ports or has a participation of the ports. The inland ports are Willebroek (Belgium), Venlo (The Netherlands), and Duisburg (Germany). Other ports that EGS has interests in are Moerdijk and Amsterdam (The Netherlands). However, Moerdijk and Amsterdam are not an active part of the transport network.
- Within this interview, the focus will be on the ports that EGS is active. The active ports for inland waterways are Willebroek, Venlo, and Duisburg. EGS is also active in the Port of Rotterdam, this is called the Intercity Barge. This is an inland waterway connection within the Port of Rotterdam. Next to this, there are many rail connections. The rail connections are mainly to South Germany (Nuremberg, Munich, and more) and Austria (Linz and Vienna).
- For inland waterway transport EGS always works with a barge operator. Only the cargo of the ships is under the control of EGS. The registration and processing at the terminals are done by the barge operator. In the Benelux Danser is the barge operator for EGS. For Duisburg EGS works in an alliance with Contargo and Hager & Schmidt.
- The number of vessels operating in Willebroek is three, Venlo three, and Duisburg with six. For Willebroek and Venlo the freight is fully from EGS. At Duisburg ships go to multiple locations, therefore the freight of EGS is combined with other freight.
- Rarely does EGS has an inland waterway connection with Austria. This is only on peak times to relieve the rail. The average travel time is ten days which is very long compared to the rail connection.
- EGS has no ambition for an inland waterway connection to France in the future. The only connection is the existing rail connection to Kehl (Germany) and Strasbourg (France).

Synchromodality

- For the challenges for synchromodal transport, the obstacles do not primarily lie with the government. EGS mainly experiences challenges with the customer. Some customers do not want to hand over control. They book a specific trip with the planning of EGS. These types of customers largely determine the planning of their containers themselves.
- EGS defines three types of synchromodal transport:
  - The first group is the customers that give a timeframe to bring their containers from A to B. However, they still book a specific transport modal.

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  - An even more flexible customer is the group that leaves everything to EGS. These customers do not care what type of transport modal is used. This is only possible for Venlo and Duisburg because the modalities of rail and inland waterway can be used.
  - The third group is the optimal synchromodality group. This group gives flexibility for the timeframe, transport modal, and if it does not matter over which in-land ports the freight is transported. However, this group is very small.
- Struggles for barge operators are the low water depths. This is more an issue for Duisburg, not so much for Willebroek and Venlo. Venlo and Willebroek have more is-sues with high water depths. This changes last-minute and makes it difficult to plan. For travel times of 48 hours, it is difficult to know what the water depths will be for the whole trip. The information to react to these changes is already very good.
- Additional road taxes (i.e. Maut) would support synchromodal transport growth on short distances.
- The cost of using the rail track and the performance issues in The Netherlands but also Germany.
- The empty containers are also a bottleneck for applying synchromodality. This is due to the location of the empty container and its destination. The customer is not always able to change the empty pick-up or drop-off location which supports a synchromodal routing. As a result, flexible scheduling is often not possible.
- EGS is one of the frontrunners in synchromodality. For the Synchromodal Maturity, Modal EGS can be placed in level 4.

Digital information

- The digital information in international seaports is different. Improvements can be made in harmonizing and integrating these digital information services for Rotterdam and Antwerp. Rotterdam works with Portbase, and Antwerp works with Nxtport and BTS systems. These different systems have the same goal but only work differently. International ports build their information services to comply with legislation.
- The predictability of deep-sea traffic is also an issue. Monitoring this traffic is a lot of work but very important for the planning process. How it is done today is very outdated.

Conclusion

- Improving digitalization lies more in the integration of different systems in seaports than in inland waterway transport. However, it must be said that EGS is not a barge operator.

Danser France (France)

Interview Danser France – 8 March 2022

Jérôme Baudy (Danser France)
Kees Verweij (Buck Consultants International)
Abdulsamad Munir (Buck Consultants International)

Inland waterway transport

- At the moment from Danser France, more than 100 barge shuttle every day dedicated for containers with project cargo possibilities
- Currently, the barges are designed with large TEU capacities, towards 350 TEU per barge on the Rhine river. Due to heights of bridges in North of France, smaller barge are in use. 6 barges are in property. Others are chartered.
- Especially, the barge operation is focused on the huge Inland waterway network in the Nothern parts of Europe
- Especially, the corridor with the Northern parts of France- Gent- Antwerp-Rotterdam up to Basel is where the Danser group operates with the barges.
- Danser group provides two main transport activities to its clients:
    - 1. The container transport between the seaports and the inland ports
    - 2. The container transport between the seaports to the warehouse, that also includes the last-mile transport.
- All the other activities are performed by sub-contractors, and Danser only focuses on the barge transport. Danser has also some trucking and railway services (example : Rotter-dam/Strasbourg) but that are not operated directly by Danser.
- The statistics from past years show that Danser Group was responsible for transporting 1.6 million TEU by barge, truck, and rail in the year 2021
- Due to high congestion and sea delays at the ports, the shift for using the road transport is increased. The reliability of using the barges is decreased, due to the high uncertainties.
- It is difficult to provide information to clients regarding the expected transport time of the freight.
- Different factors play a role, that causes the congestion at the handling of the containers at large seaports. One of the factors is the bad communication between the shipping line to the customers. The ETA information given by the shipping line is not always accurate or correct. Or the planning on ports is not real-time, which causes customers to use the truck more often instead of the barge.

Digitalization

- As a company, the information concerning the location of the barge is not always possible.
- It is possible to see, at which moment the barge passes the different locks on the routes via AIS systems. But it is not possible to see what the traffic is
- For instance, between two inland ports in France, 2 locks need to be passed and it takes theoretically 3 to 4 hours. However, in practice, this can take up to 5-6 hours. So, it is not possible to foresee traffic by the locks on the canals.
- Once, this information is known, the planning and routing of the barge vessels can be ad-justed.
- So, on shorter routes, if this information is known, the barges could wait on inland ports, so more containers could be loaded before it heads towards its direction. Also,

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for larger routes, if forecasts for the close future are available, this could help to adjust the speed of the vessels and the routes of the barges.

- The maintenance information from public authorities is shared too late, which causes last-minute route planning changes. This could be avoided if the information was shared be-forehand, so the routes are planned differently. I precised nevertheless that communica-tion was better and that France and Belgium are now trying to work together to get almost same agenda for maintenance
- EuRIS could be helpful, as the Danser group provides European services.
- •Lastly, information on the ports combined with the maintenance, and forecast could be helpful to tackle some of the congestion in Inland waterways transport.

Synchromodality

- Synchromodal services are offered and performed to specific requests.
- Danser group often offers the possible transport modes that are available on a certain origin and destination. This is more often organized by the freight forwarders.
- So, for performing optimal synchromodal transport, accurate information before planning and take-off the containers is needed. Also, the closing day, from the rail operator is es-sential information. Information from and to the trucking that is required. Lastly, the in-formation on booking the container on barge transport. The information must be on time.
- The information on capacity on other transport modes is confidential. However, gaining insights into this information supports the use of synchromodality.
- Currently, Danser Group performs partially synchromodal transport. It takes time, due to the complex processes that are involved. The ETA of barges is an important component of performing synchromodality.
- Policies for the future concerning sustainable road freight transport are regarding replac-ing road transport, investing in more green barges.
- Local/ small-medium French barge transport should be increased, as now Danser group is operated from the Netherlands.
- In a normal situation, without the high congestion delays at seaports, the barge transport is relatively reasonable on the price compared to the other transport modes.

Tomas Ambra (Expert from IMEC from Belgium)

Interview IMEC – 10 February 2022

Paul Zoeter (European Gateway Services)
Kees Verweij (Buck Consultants International)
Abdulsamad Munir (Buck Consultants International)

Involvement IMEC and DIWA

- IMEC is involved in the development of nanotechnology and digital solutions in different industries, so one of the industries is the Freight transport & Logistics industry. This is the industry where different projects are working on, such as for the ports, terminals, freight transport, maritime transport, and inland waterways.
- Also, the developments of intramodality and synchromodality are researched and are supported from the digital solution perspective.

Synchromodality and digital information

- Synchromodality is evolved and different definitions are given in the past years.
- Eventually, it leads to the increased combined use of intermodal transport, using a more proactive approach and promoting freight transportation sustainably.
- It is crucial to focus on the aspect of stock, inventory, and replenishment options of companies. This factor leads to different logistics decision factors, such as the duration and perishability of the products.
- In an ideal situation, an overview is provided for the availability of the different modes between the origins and destinations. In this overview, the decisions can be made, for planning- and execution levels. This requires information to flow.
  - It is important that agreements/deadlines would be stated, till which moment a container could be signed up for transport by rail or barge. For instance, 3-to-4-day notifications before arrival the freight must be signed up in the system, otherwise, there is insufficient time to adjust modes accordingly to take the freight by intermodal transport.
- To have optimized logistics networks, the network of the different transport modes should be designed in an open interoperable manner with the mindset of the physical internet.
  - In this design, all the involved parties have the ability to look into each logistics related information based on standards and business agreements in a data-space setting.
  - Than the capability or occupation of a certain truck or barge can be open for others when needed.
  - With the end destination of the freight other modes can anticipate and support for the last-mile delivery by truck
  - The information from and towards the ports can help for the loading and unloading of freight what the next mode of transport is and ETAs.

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  - At the moment each party has their own IT systems or information services with information about each of their standards, this is not always compatible with other parties.
  - It would be great if there is a decentralized system that synchronizes data from the different information services in a federated data space, to allow for the discoverability of solutions between the systems
- RIS-COMEX is an innovative implementation project, which takes a step towards more interoperability across borders. This project is a scale-up project from the VisuRIS system from Flanders.
- (Frontrunner) private freight forwarders and shippers have options to transport freight in a synchromodal way, because of the economies of scale. Therefore, they have the option to offer transport sustainably to the shippers.
- On the other hand, small and medium-sized freight forwarders do not have the same options, and often only offer trucks as the modality. While, in most of the cases the companies should seek collaboration, so the small and medium-sized companies can use the remained capacities on the trains or barges.
  - Now, this information is only within the frontrunner freight forwarders systems and is invisible for the outside of the world (e.g., competitors, small and medium-sized companies).
- It is important to increase the modal shift, by increasing the trust of shippers and working more agile and flexible for promoting the rail and barge modes.
- Transferring existing road flows to rail or barge is a difficult assignment, however, the new projected flows could be directly headed to the modalities barge and rail.
- In the future, the Internet of Things (IoT), can lead to monitoring and managing freight remotely more accurately.
- Today, different standards are used, for each portal, which leads to problems and inconsistency in-between systems. It would be great to have a common ‘language’ for in the future between the systems.

Role of public authorities.

- Public authorities should contribute the supporting the infrastructure.
  - Different tests and pilots are performed with autonomous barges, but it lacks the needed infrastructure to smoothly be operative.
  - For instance, by implementing autonomous locks or smart ports, it could be possible that freight has the option to be delivered overnight.
- The public authorities should provide tools, and integrated public for efficient logistics planning.
- Focus on the DIWA project should be creating connectivity to other transport modes.
- Also, the role of the skipper needs to be included and the link between the other information services for transport planning.

Conclusion

- The first main conclusion should be that the digitalization does not end only at Inland waterways but should integrate and ensure for other transport modes.
- Secondly, the role of small/medium-sized flows should be taken into account, be-cause the frontrunners are using/will use synchromodal transport in the future, but the focus should be on all different sized companies to attract more flows to inland waterways
- Lastly, the role of the skipper should be more included, sharing some data from the skipper could be privacy sensitive; GDPR rules should not spur innovation. There-fore, solutions should take this into account.

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