# DIWA Report

## Sub-Activity 3.4.: IWT Data Model & Information Registry

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# Table of content


1 Executive Summary ..... 4

1.1 Data Registries ..... 4

1.2 Information Models ..... 4

1.3 Recommendations ..... 5

2 Introduction ..... 7

3 Work approach ..... 7

4 Objectives of this study ..... 7

5 Data Registries and Information Models ..... 7

5.1 Data Registries ..... 7

5.1.1 Definition of a Data Registry ..... 7
5.1.2 Centralized vs Decentralized approach ..... 8
5.1.3 EuRIS as a Data Registry ..... 10

5.2 Information Models ..... 10

5.2.1 RIS-Net ..... 10
5.2.2 Maritime Resource Name ..... 14
5.2.3 IHO Geospatial Information Registry ..... 15
5.2.4 TEN-T ..... 15
5.2.5 eFTI ..... 16

6 Recommendations ..... 17

6.1 Further elaboration of RIS-Net ..... 17

6.1.1 Maritime Resource Name ..... 17
6.1.2 IHO Geospatial Information Registry ..... 17
6.1.3 TEN-T ..... 18

6.2 eFTI ..... 18

6.3 EuRIS as a Data Registry ..... 18

6.4 Evolution of existing Data Registries ..... 19

7 Roadmap ..... 21

7.1 RIS-Net ..... 21

7.2 eFTI ..... 21

7.3 EuRIS ..... 22

7.4 Conclusion ..... 23


# List of figures


Figure 1: RIS Waterway Network – Hierarchical structure ..... 13

# 1 Executive Summary

This report considers the technological developments on Data Registries and Information Models. It considers both examples from other transport modes and potential (existing) solutions from within the IWT community. Solid Data Registries and Information Models are an important foundation for the harmonized and interoperable collection, integration, exchange, presentation and analysis of navigation, traffic, transport and logistics related information for the Inland Waterway Transport sector.

## 1.1 Data Registries

A Data Registry is defined as:

***An official record of uniquely identifiable data covering a field of importance for a specific domain.***

It is seen as an authoritative list of one kind of information where it is possible to see who has changed what information and when. All records in the registry have a unique reference ID, and (pull) requests can be made to update data.

Data registries can be set up as a centralized system or in a decentralized way. IWT examples of the former are the EHDB and ERDMS, examples of the latter the ECDB and R2D2. The pro's and con's of both approaches are discussed, and the conclusion is made that a critical architectural evaluation should be made before setting up new data registries, ensuring the final setup will be the one best fit for serving the intended use cases.

EuRIS, a single web portal that seamlessly combines River Information Services of 13 European partners[1] and one of the results of the EU funded RIS COMEX project[2], is investigated. As EuRIS offers a broad selection of IWT and RIS reference data, most of it directly provided by the competent authorities that 'own' the data, it meets all the requirements of a data registry, even though it does not have an authoritative character yet.

## 1.2 Information Models

The RIS Index is an information model with a corresponding registry that was established 20 years ago. As the RIS Index lacks information on the relation between objects and was also not designed to cover the characteristics of the waterways, it was necessary to develop a spatial database model to cover the needs of the RIS COMEX project. The resulting VisuRIS COMEX Reference Network Model had some issues and room for improvement, detected during the implementation of EuRIS, and as a result the elaboration of the **RIS-Net concept** was started, **a spatial dataset including objects and the links/relations between them, for both professional and recreational navigation**. This concept is currently further elaborated by the CESNI/TI/NtS TWG with the aim to eventually replace the RIS Index and formalize the new aspects introduced by the VisuRIS COMEX Reference Network Model.

The Maritime Resource Name (MRN) concept was developed by the International Association of Lighthouse Authorities (IALA). **The MRN is "a naming scheme that can uniquely identify any maritime resource on a global scale"** and both IHO and IALA strongly recommend to incorporate the MRN into S-100, including S-101 (ENC) and by logical extension S-401 (iENC). The MRN is a decentralized concept, meaning that any competent authority is able to independently generate MRN for their resources, as long as they stick to the subdomain they have been assigned. While there are currently no specific sub-domains for important IWT infrastructure (locks, bridges, berths, …) requiring the use of the 'object' wildcard, these sub-domains can be requested from IALA or IHO (depending on the nature of the infrastructure) if the MRN would be adopted by IWT. This will most likely be a task taken up by the IEHG during their elaboration of S-401 and the inclusion of the MRN therein.

**The IHO Geospatial Registry contains**, among other things, **a Concept Registry (or Data Registry) and a Data Dictionary Registry (or Information Model)** for relevant terms and features in S-100. As such it

[1] https://www.eurisportal.eu/
[2] https://www.riscomex.eu/

is a valuable source of information, especially when aiming to further harmonize terms and feature types between IWT and the maritime domain.

Another information model is related to the **Trans-European Transport Network** (TEN-T) which 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 corresponding TENtec portal provides a comprehensive overview of the European Commission's work in relation to TEN-T, and needs to be kept up-to-date with the network and infrastructure data of the responsible authorities, a task currently performed manually for the inland waterways information.

eFTI (electronic Freight Transport Information) is an important European development in the reporting of freight transport information, replacing paper documents and smoothing the exchange of information in the transport chain. eFTI is discussed in detail in the report of DIWA Sub Activity 3.2 – IWT Connectivity Platform. Although the eFTI data model was not finalized at the time of writing, it seems logical that there will be significant **overlap between the eFTI data model and the information in the ERI messages**.

## 1.3 Recommendations

**RIS-Net will be one of the pillars of the future of RIS**. While it already tackles many of the known issues of the RIS Index and the VisuRIS COMEX Reference Network Model, it still requires a lot of elaboration. Replacing the RIS Index can have a huge impact on the RIS Technical Services and most, if not all, RIS Operational Services. Therefore, **sufficient time and funding should be made available to further elaborate RIS-Net with the help of, at least, the CESNI/TI working groups and the IEHG**, for example in a follow-up project of RIS COMEX.

As the **Maritime Resource Name can harmonize the identification of objects** between the maritime and the inland domain, this SubActivity proposes to **adopt the MRN in RIS-Net**. It is also recommended to **interconnect the IEHG and CESNI/TI/NtS** (which is elaborating RIS-Net) considering the MRN **to avoid divergence in the final implementations in S-401 and RIS-Net**, and to **set up a sustainable governance model** for keeping the MRN values synchronized between S-401 and RIS-Net.

The IHO GI Registry contains a treasure of information on S-100 and maritime concepts, features/entities, … In light of harmonization between the maritime and the inland waterway world, it would be advisable to **use the definitions and feature types as defined in the IHO GI Registry in RIS-Net wherever possible**. Especially for **newly introduced entities** (e.g. Traffic Point) it is highly recommended to **investigate if a corresponding feature is already available in the IHO GI Registry.**

**Ensuring that the information in RIS-Net covers the information needs of TEN-T** would mean that the data only needs to be collected once (for RIS-Net) and could then be exported to TEN-T. This strongly reduces the possibility of discrepancies between the TEN-T data and the data visualized on, for example, EuRIS. This is much preferred to the current situation of maintaining multiple (manually construed) networks of the waterways and making sure they are all up to date. Moreover, **a single RIS-Net → TEN-T translator could be developed by TENtec, immediately covering the IWT TEN-T data needs**.

**eFTI should be considered an opportunity for IWT**. The final eFTI data model and the ERI data model should be aligned wherever feasible and beneficial, and **the creation of a common eFTI<->ERI translator service could be considered**. Although such a translator service will most likely not be fully self-contained, requiring additional input from the user, it could alleviate the administrative burden for the IWT community and authorities.

It is recommended **to consider extending the role of EuRIS as a Data Registry**, and this Sub Activity recommends to investigate the possibility of uploading the reference data of the EuRIS partners towards the ERDMS via EuRIS**. A thorough investigation of the reference data** contained within

ERDMS and EuRIS will of course need to be performed to ensure a 1-on-1 match for the data the EuRIS partners are responsible for. If brought into practice, this recommendation will also require some changes to EuRIS, and thus sufficient funds should be made available.

This Sub Activity would also like to suggest[3] a closer cooperation between the main involved parties, like the European Commission, CESNI, the CCNR and the RIS Authorities, during all phases of the life-cycle of the Data Registries for IWT. This might increase the overall efficiency, level of adoption and general level of satisfaction related of the Data Registries and create a multi-level benefit for the IWT community at large. Another suggestion would be to consider using EuRIS as a gateway between the RIS Authorities and the ERDMS, and possibly allow EuRIS, in its role as a single-stop-shop for a wide range of IWT information, to act as a cache of the ERDMS data.

There are many interesting recommendations and suggestions from this DIWA Sub Activity. Together they paint an **ambitious path** towards a safer, more sustainable, (multimodal-)harmonized, efficient and digitized IWT, **built upon a solid foundation of Data Registries and Information Models**, and ready to take on the challenges of the future.

[3] It should be noted that these suggestions are only that. They are in no way to be interpreted as formal opinions voiced by any of the DIWA partners or their associates. These suggestions may however be interpreted as an outstretched hand from the DIWA partners towards the European Commission and DG Move in an offer to further increase the collaboration to reach the common goal of strengthening IWT as a safe and efficient mode of transport in the European multimodal logistics chain on all possible levels (physical, digital, governmental, …).

# 2 Introduction

This report considers the technological developments for the harmonized and interoperable collection, integration, exchange, presentation and analysis of navigation, traffic, transport and logistics related information for the Inland Waterway Transport sector. The focal point of this report is on Data Registries and Information Models, considering both examples from other transport modes and potential (existing) solutions from within the IWT community.

# 3 Work approach

This report was drafted during several meetings with the members of this Sub Activity. During the Kick-Off meeting a brainstorm session fed by ideas from the SuAc Members and input for DIWA Activity 2 resulted in a list of interesting topics. These topics were investigated via Desktop Research, and the results were presented and discussed in the second SuAc meeting. By the end of the meeting a common view on most relevant topics for the SuAc report materialized. This common view resulted in a first draft report containing several placeholders for Desk Research topics that should be further elaborated or written down in a structured way. A second meeting on the draft report showed significant progress on the report, and several important recommendations already started to take shape. During the meeting on the final draft report, held in conjunction with the final draft report meeting for DIWA SuAc 3.2, the visions and ideas were fully aligned, allowing the finalization of the report for review by the PMT by December 2022. During the life cycle of this Sub Activity there were also meetings with external experts on some of the relevant topics, which allowed a deep-dive into topics on which none of the Sub Activity members are experts and added significant new insights and interesting recommendations.

# 4 Objectives of this study

The objective of this SuAc is to describe the new technological developments on IWT Information Models and Data Registries on the digital transformation with focus on a set of proposals for integral and harmonized technological solutions for the (future) business developments related to the digital transformation of Inland Waterways for each development.

It is important to note that it is not the aim of this SuAc to describe or propose a single Information Model and/or a single Data Registry for IWT. The SuAc members are convinced that the reuse and, where necessary, extension of existing platforms and models wherever possible is the best course of action. Especially considering the strongly related topic of SuAc 3.2 on an IWT Connectivity Platform that could link new and existing Data Registries and provide a next step towards a one-stop-shop for IWT related information. This does of course not exclude the introduction of new Information Models and/or Data Registries if no sufficient match is found in the existing ecosystem.

# 5 Data Registries and Information Models

In this chapter the current state on Data Registries (with a clear focus on IWT) and Information Models (including other transport modes) is described and analysed.

## 5.1 Data Registries

### 5.1.1 Definition of a Data Registry

A Data Registry is defined as:

*An official record of uniquely identifiable data covering a field of importance for a specific domain.*

It is seen as an authoritative list of one kind of information where it is possible to see who has changed what information and when. All records in the registry have a unique reference ID, and (pull) requests can be made to update data.

There does not seem to be an "official" definition of the term *data registry*. The Cambridge dictionary defines registry as: an official list[4]. Wikipedia states: "A registry is an authoritative list of one kind of information. Registries normally contain fields with a unique ID, so that the record can be referenced from other documents and registries"[5] and mentions examples e.g.:

- Civil registry, a government record of vital events (for example, births, deaths and marriages)
- Land registry, an official record of land ownership
- Registry of Motor Vehicles, a government agency that administers the registration of automobiles
- Cancer registry, a systematic collection of data about cancer and tumour diseases

Main characteristics seem to be:

- Record: a registry contains a record/collection of important data.
- Authoritative/official: a registry is recognized as a trustworthy/authoritative source.
- Unique reference id: a registry can be used as a reference for the recorded data because the data within the registry has a unique id.

### 5.1.2 Centralized vs Decentralized approach

Data Registries can be set up as central systems (e.g. EHDB, ERDMS, EuRIS, …) or in a decentralized way (e.g. ECDB, R2D2, eFTI). While the decentralized approach recently seems to be gaining a lot of traction (e.g. FEDeRATED, FENIX, …) it also has some downsides. The same goes for central systems which may have a clear benefit for specific use cases, but a very suboptimal solution for others.

#### Centralized systems

The most prominent centralized European data registries in the IWT domain operated over the last decade are the European Reference Data Management System (ERDMS) and the European Hull Data Base (EHDB). Both systems are aiming at acting as crucial central register for reference data like RIS Index, reference codes as well as hull and certification data. Most systems and services are dependent on good quality reference data as basic data layer and that explains the necessity of those initiatives.

The ERDMS as central repository is filled by the national authorities on legal obligation. According to ES-RIS the European Commission is obligated to operate the ERDMS also for the upcoming years. A technical revision to ERDMS 2.0 is currently under development and a further evolution towards ERDMS 3.0 is on the midterm-planning. Although having this reference data on a central system as requirement goes without discussion, two main drawbacks were identified in the last years. The data itself is a necessary basis but missing the links between the RIS Index nodes in order to create a GIS based fairway network graph. Second, the automatic synchronization of data via interfaces is lacking operational consistency preventing an easy update process but also preventing the usage of the ERDMS as a permanent data source for other national, regional, and European services.

The EHDB as central hull register is synchronized by the national authorities responsible for issuing the vessel certificates. As the ENI of a vessel shall be unique throughout the vessel's lifetime such repository is crucial in order to have the up-to-date information available per vessel and update reference data on request (e.g. change of owner, validity of certificates, dimension changes). The need for such central functionality is without doubt but also here the recent years have shown two main downsides originating from both the member states and the central operator. The data itself is incomplete and lacking quality: not all member states provide their data to the EHDB and the

[4] https://dictionary.cambridge.org/dictionary/english/registry
[5] https://en.wikipedia.org/wiki/Registry

provided hull information is partly outdated or of insufficient quality. The lack of operational consistency and support for the interfaces for automatic data synchronization also prevents a proper function and use of the service.

### Decentralized systems

Opposite to the centralized approach, decentralized systems are widely spread and gain momentum due to recent research projects and legal requirements like e.g. GDPR. By history, every player e.g. in the logistics chain has created their own system fulfilling the own operational needs and business requirements. In the digitalization era the processes get digitized or digitalized and actors/systems connected via APIs creating something like linked data or federated networks. While in bigger economic areas decentralized approaches seem indispensable by the grown IT infrastructure other initiatives in the past have provided lessons learned.

The European Crew Data Base (ECDB) holds information on crew qualifications and therefore sensitive data. This is one of the reasons the ECDB was designed as a decentralized system: every member state has to operate its own crew database and the European instance only provides the references or links to find the requested information. The advantage is clear: every member state keeps the national data it is responsible for in the own database and provides access on request. During the implementation and operation however, some serious drawbacks of this approach were discovered. The decentralized approach means that every member state has to procure, implement , operate and maintain a national Crew Data Base, multiplying financial and personnel resources compared to a single centralized development. Moreover, if the information flows via the predefined common interfaces do not cover all real-life use cases correctly, a cost may be incurred on all national implementations to implement an unforeseen change. Any diversion from the intended interface implementation creates issues in communication between the systems, thus intensive testing of all aspects of intra-national communication is a necessity. Last but not least, the points of failure and delay are also multiplied: all national databases and the central repository have to be fully operational to fulfil the intended functionality and response times often depend on the slowest link.

The RIS Data exchange Reference Documentation (R2D2) concept was elaborated and implemented during the IRIS Europe projects initiative to provide access to sensitive vessel position, voyage and calamity abatement information on the Danube river. Due to its sensitive information character, here too national systems were implemented holding the data itself and only exchanging references at which location the data can be found. Due to the complexity in the exchange and request processes this approach only got operational with three involved countries identifying a clear drawback for the users.

The examples given provide some major findings and experiences of important initiatives in the field of RIS/IWT over the last decade. To conclude, there is no right or wrong architecture. The architecture should also be chosen depending on the use cases and intended application.
For a specific domain or sector e.g. IWT, centralized registries or data repositories are envisioned and beneficial if being operational, complete and supported. Those central hubs can be linked to other regional/central hubs for information exchange creating a federated network. Such interconnection seems to be only efficient when done on a higher scale and not interfacing all national systems with all kinds of legacy systems.
Creating federated networks on a higher (European/cross-modal) scale seems the only realistic approach as there won't be a single central platform providing access to e.g. all transport information from all modes. Due to the grown nature of IT systems machine to machine communication via interfaces will be key. An important question still unanswered at the moment is what interfaces, which protocols and who is interfacing with whom[6].

It is clear that for newly set up decentralized systems the use cases and application should be evaluated critically. A good balance between legal options, central vs national costs, ease of operation and quality of service should always be kept.

[6] Possible answers to these questions are further investigated in the DIWA Sub Activity 3.2 report.

### 5.1.3 EuRIS as a Data Registry

EuRIS is a single web portal that seamlessly combines River Information Services of 13 European partners[7]. As one of the results of the EU funded RIS COMEX project[8], it is an operational platform backed by a solid governance model, including financing agreements allowing sustainable operation. As it discloses a treasure of high quality IWT information on many levels and over a huge geographical area, it is set to become an important, if not the, access point for information on inland waterways and inland waterway transportation.

The setup of EuRIS has already been described in other DIWA reports, therefore we will limit our scope to the Data Registry potential of EuRIS.

EuRIS is a web portal where a broad selection of IWT and RIS reference data of 13 European countries is made available to the public free of charge. It contains the following reference data:

- Fairway sections, bridges & bridge areas, bridge openings, locks and lock basins, terminals, berths, areas of competence and their relevant properties.
- RIS Index
- Inland Electronic Navigational Charts
- Supporting reference data (and their translations for the 13 partner countries), including but not limited to:
    - iENC reference data (e.g. depth units, datums, …)
    - NtS reference data (e.g. barrage codes, hinder states, limitation codes, …)
    - Facility reference data (e.g. types, target groups)
    - ADN and HS cargo codes
    - ERI reference data (e.g. container ranges, transport modes, message functions, …)
    - RIS Index reference data (e.g. RIS functions)
    - …

This data can be accessed both in a human readable format (maps, tables, …) and in a machine readable format (open APIs). The data is available free of charge, although some data may require the user to create a free account on EuRIS first (e.g. iENC).

All data records in EuRIS have a unique identifier. Some data records have a unique identifier from the base information they represent (e.g. ISRS code). All other data records get assigned a GUID/UUID at the moment of storage into the EuRIS database.

Via the European Corridor Management Agreement, all EuRIS partners have made the commitment to keep up to date that reference data for which they are directly responsible (e.g. fairway sections), allowing EuRIS to become an authoritative source for much of the aforementioned reference data. Other parts of the aforementioned reference data are not under the direct control/responsibility of the EuRIS partners (e.g. NtS reference data, ADN cargo codes). Nevertheless, the usage of the EuRIS platform as a candidate point of access for that reference data in IWT could be suggested to the responsible authorities.

Given the above and the definition from 5.1.1, it becomes clear that EuRIS meets all the requirements of an IWT Data Registry.

## 5.2 Information Models

### 5.2.1 RIS-Net

In order to offer enhanced Services like route- and voyage planning it is required to have the characteristics of the waterways to identify possible links. To uniquely identify objects, the RIS Index was established over 20 years ago as a registry for objects relevant for RIS services. These objects are very diverse, from locks to bridges, gauges, ports, terminals, berths etc. And sometimes objects themselves are related to other objects. For example, a lock can have several lock chambers, lock

[7] https://www.eurisportal.eu/
[8] https://www.riscomex.eu/

chambers have lock gates, lock gates have signal stations etc. The RIS Index was originally not designed to cover the characteristics of the waterways, it lacks information on relations between objects and also information on how the objects are connected with each other on the waterway. The objects are assigned with a unique ID – the ISRS Location Code, the fairway section they are located on, their name, their function and some more attributes.

For the implementation of EuRIS, it was necessary to develop a spatial database model, which is able to encode such relations in an efficient way. Also, the characteristics of the waterways had to be described to know maximum dimensions of vessels, sailing speeds and other parameters of the physical waterway links.

In the RIS COMEX project partners agreed on a common dataset structure called VisuRIS COMEX Reference Network Model 2.3.1 in order to meet the goals of the project. During the implementation issues and room for improvement have been identified. In order to come to a common definition for the Waterway Network that is independent from the EuRIS portal implementation and also considering all the lessons learned, the RIS-Net concept was elaborated.

The RIS-NET is a spatial dataset including objects and links for professional and recreational navigation. By connecting entities in different areas of competence (so-called 'Common border entities') waterways and objects at the border or even spanning over more than one country are considered and can be referred to by services of either of the countries.

Figure 1 shows the entities of RIS-NET having polygon, line or point geometries and their relations.

The ISRS Location Code is used in the RIS Index and within the RIS standards to uniquely identify objects. For many years it was known to national data providers and RIS experts that the composition of the ISRS Location Code causes problems with regard to the maintenance and usability as a unique identifier for RIS object information as it is composed of meaningful information. As unique IDs shall never change it was agreed that the ISRS Location Code shall never change throughout the lifetime of an object. The problem with this is that many applications are tempted to use the ISRS Location Code to extract meaningful information from it. To add to this some technical standards even required the extraction of information out of the ISRS Location Code, for example in the NtS standard up to version 4.0 it is defined that e.g. information on river hectometres is provided within the ISRS Location Code.

To solve this problem for the future, the RIS ID is introduced in the RIS-NET concept. By using the well-established UUID (Universally Unique Identifier), that can be created independently for any entity, a 'meaningless' identifier is introduced. Information that was originally included in the ISRS Location Code, such as Country Code, UN Location Code, Fairway section code and fairway hectometre are now attributes in the dataset. It is therefore possible to maintain this information in a coherent way without changing the unique ID of the respective object. Different alternatives on how to facilitate the transition from the ISRS Location Code towards the RIS ID as the primary key for entities have been elaborated. Where required for backwards compatibility or for Electronic Reporting ISRS Location Codes shall still be assigned to entities of RIS-NET as an attribute.

The temporary working groups of CESNI/TI got the assignment to investigate where ISRS Location Codes are used in parts they are responsible for and for which purpose, whether it is possible to change from the ISRS Location Code to the RIS ID in the key RIS standards or to add capabilities for including the RIS ID to the published messages.

The following steps are envisioned for further development of the RIS-NET concept:

1. Assess the concept in the DIWA project with focus on
    a. The impact for current and future technical services (specifically NtS, ERI and iENC, including S-401 & S-402).
    b. The intermodal connections, e.g. by integrating the Maritime Resource Name (MRN) as a reference
2. Support the Temporary Working Groups of CESNI/TI in their assessment on possible introduction of the RIS-ID in the technical RIS Standards.

3. Support the creation of maintenance procedures for RIS-NET, in cooperation with the task CESNI/TI/21 (develop organizational procedures for managing and maintaining the quality of the (reference) data required by standards in inland navigation and their management through IT systems of particular importance for inland navigation)
4. Prepare for Review of the RIS-NET concept by a database specialist in order to improve the technical specification
5. Test implement the RIS-NET concept as a proof of concept
6. Roll-out RIS-NET in a future European Project

The RIS-NET concept and story behind it are explained in the document "RIS-NET Information Paper" elaborated in the Framework of RIS COMEX SuAc 5.3.

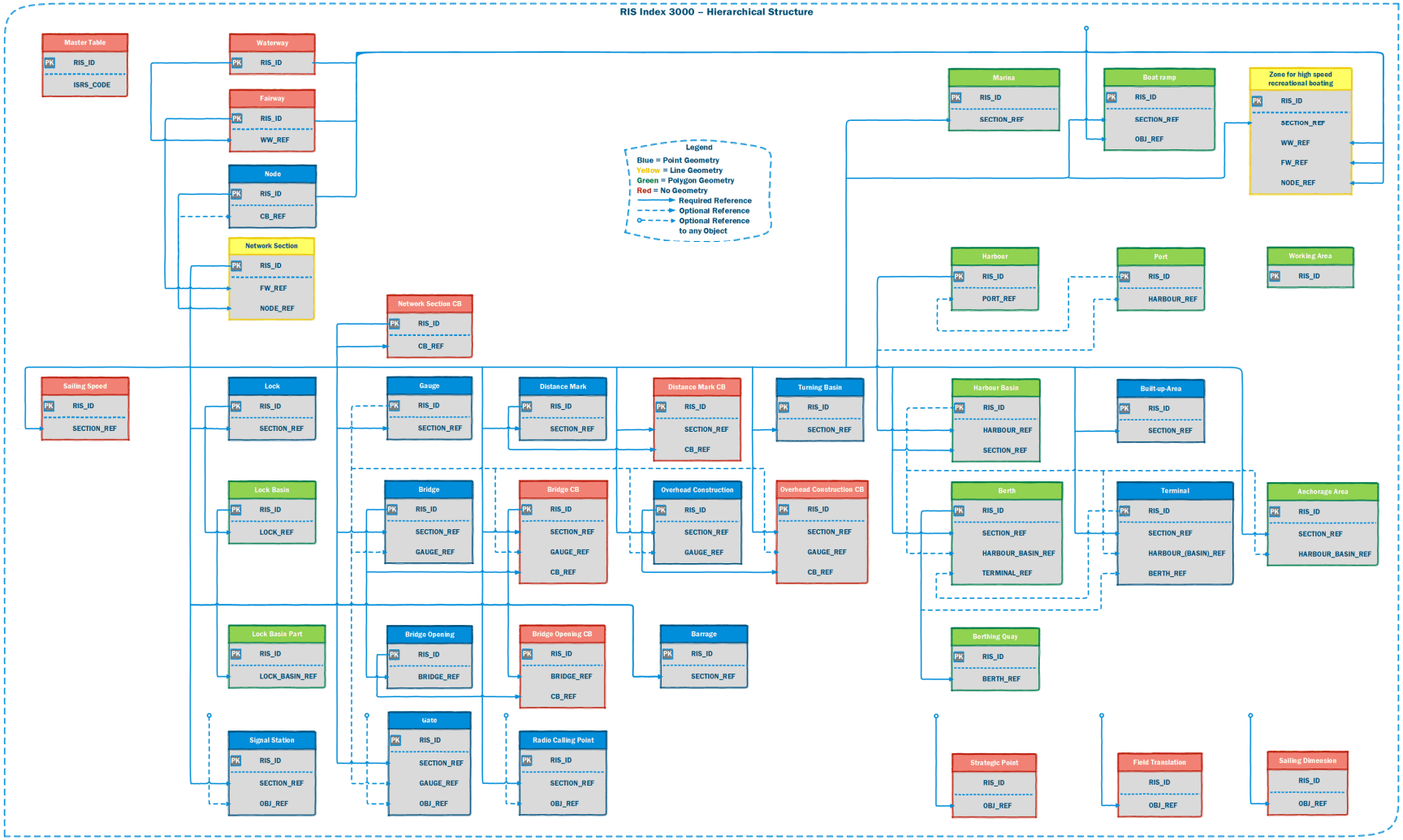


*Figure 1: RIS Waterway Network – Hierarchical structure*

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### 5.2.2 Maritime Resource Name

The Maritime Resource Name (MRN) concept was developed by the International Association of Lighthouse Authorities (IALA). IALA guideline G1143 Unique Identifiers for Maritime Resources[9] covers the intended use and syntax of the MRN. In this document the MRN is defined as "a naming scheme that can uniquely identify any maritime resource on a global scale."
MRN is gaining a lot of traction, and both IHO and IALA will strongly recommend to incorporate the MRN into S-100, for example in S-101 (ENC). As a logical extension, MRN will also be incorporated into S-401 (future standard for inland ENC) and thus become highly relevant for the inland waterways.

In order to maintain compatibility and harmonization with ENC, avoid the need for (additional) conversion-tools for iENC data, facilitate data linking in the intermodal transport chain and ease data-linking in mixed-traffic zones, a connection between an object's representation in IWT (e.g. RIS Index entry) and the MRN is considered beneficial. This connection would mainly be applicable for mixed-traffic zones where both inland and maritime vessels navigate. However, the use of a MRN might be considered by the IEHG for all data objects in S-401, even in pure inland traffic zones.

MRN's active use is currently limited to pilot projects and testbeds for maritime services (often in combination with the Maritime Connectivity Platform concept). The U.S. and Canadian Coast Guard and Korea are reportedly working on putting MRN's in their maritime modelling. A MRN registry is planned to be set up by KHOA (Korea Hydrographic and Oceanographic Agency).
The MRN is a decentralized concept. The top level of the namespace is governed by IALA, which assigns domains to governing bodies and provides a reference table linking these domains to their responsible bodies. Each governing body is then responsible for its own subdomains, and should again provide a reference table linking its subdomains to the correct body. There are some general namespace items (e.g. pub for publications), and some specific ones (e.g. iala:aton for Aids to Navigation). Most namespaces will have a subdivision on country level (e.g. mrn:iala:aton:us), and in general the body that 'owns' the infrastructure will be responsible for generating/assigning the MRNs after being assigned a subdomain in the MRN namespace.

The MRN is designed to be used in a flexible way with existing identifiers. It could for example be created by putting a prefix before an existing identifier. So for a mixed-traffic object like the sea locks at Terneuzen, the MRN could look like this:

- urn:mrn:iala:obj:nl:rws:tnz130B20948400005

This uses the option "obj" to indicate (in compliance with G1143) an object and the (ISO 3166) ISRS country code is used to indicate it is located in NL, 'rws' indicating the infrastructure is owned by Rijkswaterstaat.

Another option is to explicitly mention it is an ISRS code based MRN:

- mrn:mrn:iala:obj:nl:isrs:tnz130B20948400005

To leave the ISRS code intact:

- urn:mrn:iala:obj:nl:isrs:nltnz130B20948400005

Or even to generate a new ID (e.g. in compliance with RIS-Net):

- urn:mrn:iala:obj:nl:rws:2f75f14f-8263-48f5-b9e3-0219be66b53a

It should be noted that using 'rws' in the MRN is not considered as a potential issue by IALA. As a reference table on the national level will link 'rws' to Rijkswaterstaat, a change of name of Rijkswaterstaat is not problematic. It would only require updating the record in the national

[9] https://www.iala-aism.org/technical/data-modelling/mrn/

reference table and, if desired, using an acronym of the new name for the MRN of any newly generated objects.

While there are currently no specific sub-domains for important IWT infrastructure (locks, bridges, berths, …) requiring the use of the 'object' wildcard, these sub-domains can be requested from IALA or IHO (depending on the nature of the infrastructure) if the MRN would be adopted by IWT. This will most likely be a task taken up by the IEHG during their elaboration of S-401 and the inclusion of the MRN therein.

### 5.2.3 IHO Geospatial Information Registry

The IHO Geospatial Information Registry (GI Registry) is defined as follows on the website https://registry.iho.int:

> *This Registry is owned by the International Hydrographic Organization (IHO) and is managed by the Secretariat of the IHO. The site contains several Registers of hydrographic related information administered by specialist domain experts. Each Register type may be further sub-divided into Domains, for example Hydrographic, Nautical Publications, Ice, Weather, and Inland ENC. The administration of this Registry conforms to IHO Publication S-99 (Operational Procedures for the Organization and Management of the IHO Geospatial Information Registry).*

As it is called an Information Registry, one might wonder if it is a Data Registry or an Information Model? In fact, it is a bit of both. Indeed, two very interesting parts of the GI Registry are the Concept Registry (a Data Registry) and the Data Dictionary Registry (an Information Model):

- Concept Registry: Contains the definitions and codes for relevant terms in S-100 and the maritime world. As such we can consider it a Data Registry.
- Data Dictionary Registry: Contains relevant features of S-100 and the maritime world and their attributes. As such we can consider it (the building blocks of) an Information Model.

Any developments under S-100 (including S-401) use the information available in the IHO GI Registry and if new concepts, features, feature attributes, … are needed, these can be proposed and added to the Registry via a clearly defined governance model.

### 5.2.4 TEN-T

The Trans-European Transport Network (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[10]. The TENtec portal provides a comprehensive overview on the European Commission's work in relation to TEN-T and aims to raise awareness to the benefits of the TEN-T policy development[11]. To keep the status of the TEN-T network up-to-date (including the TENtec interactive map[12]) the network and infrastructure data of the responsible authorities must somehow be transferred to TENtec.

For the inland waterways this network and infrastructure data is currently created manually from different (national) information systems. There is, however, a pilot program in progress to make it possible to automatically import the data into TENtec. Within this program the use of data from EURIS for the inland waterways is under investigation.

[10] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t_en
[11] https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/index_en.htm
[12] https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/map/maps.html

### 5.2.5 eFTI

eFTI (electronic Freight Transport Information) is an important European development in the reporting of freight transport information, replacing paper documents and smoothing the exchange of information in the transport chain. eFTI is discussed in detail in the report of DIWA Sub Activity 3.2 – IWT Connectivity Platform.

With relation to the topics in this report, the focus should be on the data model of eFTI. Unfortunately, this data model is not yet finalized by the European Commission and recent feedback on the draft version of the data model indicates that several changes may be required before the data model covers the entire scope of eFTI as defined in the EU Regulation.

Despite these uncertainties, it seems logical that there will be significant overlap between eFTI and the information in the ERI messages and investigating an update of the ERI data set to increase its alignment with the eFTI data set is already on the program of CESNI/TI/ERI. It is expected that the development of a translation service from ERI to eFTI (and vice versa) should be possible. Although such a translation service may not be fully self-contained (i.e. it may require additional input from the user to get a full translation) it could still make the incorporation of eFTI a lot easier for parties transporting cargo via the inland waterways.

Given that reporting of cargo and voyage information on the inland waterways is already a highly digitalised process, it seems that IWT has an advantageous position regarding the introduction of eFTI and could gain a competitive advantage via a swift implementation of eFTI.

# 6 Recommendations

In this chapter recommendations for the future development of Data Registries and Information Models in IWT are formulated based on the results of the SuAc 3.4 meetings, meetings with external experts, and the desk research.

## 6.1 Further elaboration of RIS-Net

**RIS-Net will be one of the pillars of the future of RIS**. By combining the RIS Index and the RIS COMEX Reference Network Model, it removes a lot of duplication, streamlines data creation and information distribution and enables a next step in professionalizing data management for RIS.

The scope of RIS-Net is however very big, and it will have a direct impact on the RIS Technical Services (VTT, ERI, NtS and Inland ECDIS) and most, if not all, RIS Operational Services in Europe. As such it is clear that the resulting Information Model cannot be drafted and finalized by a small team in a matter of months. It will take considerable efforts to create draft versions for RIS-Net, analyse, test, validate and update them towards more mature versions, and hone those down to a final product fit for publication as an official European standard. This process will require time, a close cooperation with experts and expert groups on the RIS Technical services, technical, legal and business RIS experts, and policy makers on all relevant levels.
Therefore, **sufficient time and funding should be made available to further elaborate RIS-Net with the help of, at least, the CESNI/TI working groups and the IEHG**, for example in a follow-up project of RIS COMEX.

### 6.1.1 Maritime Resource Name

Given that the incorporation of MRN into S-100 is strongly recommended by IALA and IHO, and that the IEHG intends to follow this recommendation for the implementation of S-401, it seems clear that the MRN should be taken into consideration for the development of RIS-Net.

How the MRN will be included in RIS-Net strongly depends on the planned level of adoption. Will the MRN be used to make the link between the inland and maritime world in mixed-traffic zones? Will it only be used in S-401 (Inland ENC), or do we see an added value in other aspects of RIS & IWT? Do we want to create an MRN-like ID for all relevant RIS objects?

As the added value of the MRN for internal use by IWT & RIS seems limited, **this Sub Activity proposes** the following steps for **adopting the MRN in RIS-Net**:

- All (or most) RIS-Net features should have an optional MRN attribute
- The MRN attribute should be empty by default
- Whenever an MRN gets assigned to an object in a mixed-traffic (or exclusively inland-traffic) zone, this MRN should be taken over in the MRN attribute of the corresponding RIS-Net item.
- The same goes when an MRN gets updated (although this should occur only in exceptional circumstances)
- If an MRN is generated by/for S-401, using the RIS_ID as part of the MRN should be taken into consideration.

This approach should enable a direct MRN link between the information in RIS-Net and that in Inland ENC (S-401). While the further adoption of MRN in S-401 is considered out of scope for this SuAc, **it is recommended to set up a line between the IEHG and CESNI/TI/NtS (which is elaborating RIS-Net) considering the MRN to avoid divergence in the final implementations in S-401 and RIS-Net, and to set up a sustainable governance model for keeping the MRN values synchronized between S-401 and RIS-Net**.

### 6.1.2 IHO Geospatial Information Registry

The IHO GI Registry contains a treasure of information on S-100 and maritime concepts, features/entities, … In light of harmonization between the maritime and the inland waterway world, it would be advisable to **use the definitions and feature types as defined in the IHO GI Registry in RIS-**

**Net wherever possible**. Especially for **newly introduced entities** (e.g. Traffic Point) it is highly recommended to **investigate if a corresponding feature is already available in the IHO GI Registry** (e.g. Radio Calling-In Point). In this light, again a close cooperation with the IEHG which is currently elaborating S-401 is considered highly beneficial.

### 6.1.3 TEN-T

**Ensuring that the information in RIS-Net covers the information needs of TEN-T** would mean that the data only needs to be collected once (for RIS-Net) and could then be exported to TEN-T. This strongly reduces the possibility of discrepancies between the TEN-T data and the data visualized on, for example, EuRIS. This is much preferred to the current situation of maintaining multiple (manually construed) networks of the waterways and making sure they are all up to date. Moreover, **a single RIS-Net → TEN-T translator could be developed by TENtec, immediately covering the IWT TEN-T data needs**.

## 6.2 eFTI

**eFTI should be considered an opportunity for IWT**. The final eFTI data model and the ERI data model should be aligned wherever feasible and beneficial, and **the creation of a common eFTI<->ERI translator service should be considered**. Although such a translator service will most likely not be fully self-contained, requiring additional input from the user, it could alleviate the administrative burden for the IWT community and authorities.

For other recommendations concerning eFTI we refer to the report of DIWA SuAc 3.2 – IWT Connectivity Platform.

## 6.3 EuRIS as a Data Registry

Given the information from 5.1.3, it is recommended **to consider extending the role of EuRIS as a Data Registry**. EuRIS bundles a lot, if not all, reference data for which the EuRIS partners are responsible. Furthermore, it also contains a lot of, if not all, 'external' reference data that is relevant for IWT & RIS, and more specifically the reference data that is maintained in the European Reference Data Management System (ERDMS).
Keeping the data in the ERDMS fully up to date can be a cumbersome and complex task, and nearly all updates that need to be uploaded to the ERDMS also need to be imported to the EuRIS platform. Furthermore, there are recurring costs for maintaining the software libraries and systems for uploading data to and downloading data from the ERDMS.
At the same time, importing reference data to the EuRIS platform is quite straightforward and there is an intrinsic motivation for the RIS Authorities to keep the data on EuRIS up-to-date as it is actively used by the IWT community.
From a legal point of view, the RIS Authorities are obliged to feed their reference data towards the ERDMS, it is however not defined how they should do this. This means there is no obligation to feed the ERDMS directly from the national systems. Indeed, from a legal point of view, one could set up a data upload towards the ERDMS from a common system that contains the national data of multiple countries.

**Based on the above, this Sub Activity recommends to investigate the possibility of uploading the reference data of the EuRIS partners towards the ERDMS via EuRIS.** The biggest advantages of such an approach are listed below:

- The data needs to be uploaded only once (to EuRIS) instead of twice (to the ERDMS and to EuRIS)
- Costs for maintaining the up- and download libraries for the ERDMS can be shared and strongly reduced as only one implementation needs to be maintained
- Throttling of uploads, avoidance of parallel uploads, error handling, … can be handled centrally by the EuRIS platform, avoiding discrepancies in the data sets
- EuRIS can be used as a point of access for the reference data contained in the ERDMS, reducing the number of systems IWT users and software companies need to connect to
- While the access point functionality could be limited to the data of the EuRIS partners, it could further ease the life of the IWT community if EuRIS would also be able act as a point of

access for the other reference data contained in the ERDMS (e.g. HS-codes, AND-codes). For that data, of course, EuRIS would need to download any updates from the ERDMS in a timely manner whenever new or updated reference data is made available in the ERDMS.

A thorough investigation of the reference data contained within ERDMS and EuRIS will of course need to be performed to ensure a 1-on-1 match for the data the EuRIS partners are responsible for. If brought into practice, this recommendation will also require some changes to EuRIS, and thus sufficient funds should be made available.

## 6.4 Evolution of existing Data Registries

It should be noted that the suggestions in this section are only that. They are in no way to be interpreted as formal opinions voiced by any of the DIWA partners or their associates. These suggestions may however be interpreted as an outstretched hand from the DIWA partners towards the European Commission and DG Move in an offer to further increase the collaboration to reach the common goal of strengthening IWT as a safe and efficient mode of transport in the European multimodal logistics chain on all possible levels (physical, digital, governmental, …).

The European Data Registries are currently undergoing a lot of changes. New versions are being brought into service (e.g. ECDB), updated versions are in final testing phase (e.g. ERDMS) and others are under elaboration for renewal (e.g. EHDB). During previous development and update cycles of these registries, the cooperation between the involved stakeholders was sometimes perceived as less than optimal. In some cases the operational service and daily use of the registries proved to be challenging.
Given the importance of Data Registries for the sector of inland navigation, this Sub Activity would like to **suggest a closer cooperation between the main involved parties like the European Commission, CESNI, the CCNR and RIS Authorities**. A close cooperation during all phases of the life cycle of the Data Registries (conceptual phase, design phase, implementation, testing, maintenance, upgrades, …) might increase the overall efficiency, level of adoption and general level of satisfaction related of the Data Registries and create a multi-level benefit for the IWT community at large.

Given the potential that EuRIS is showing for the IWT community, its broad support base, its sustainable governance model and the ambition of the EuRIS partners to further facilitate the digital transformation in IWT, one option could be to **consider extending and formalizing the role of EuRIS as a Data Registry**. There are several interesting data categories for which the inclusion in and adoption of EuRIS seem worthwhile considering:

- Static hull information
- Information on vessel certificates
- ERI, NtS & Inland ECDIS/iENC reference data
- RIS Index information

Obviously, such Data Registry extensions of EuRIS would require significant additions to the existing platform. Due to the flexible framework on which the platform is built (the Service Oriented Architecture) EuRIS is technically fully capable of adding the required functionality. But in order to become an official Data Registry, several steps must be taken and hurdles overcome:

- Technical: the implementation of new data structures will require efforts and time.
- Legal: steps should be taken to make EuRIS an official Data Registry for the selected data categories. Specifically the related provisions in ES-RIS may need to be adopted to allow a shift from Commission operated Data Registries towards community operated Data Registries. Alternatively, changes could be made to recognize EuRIS as an official 'cache' of the data kept in Commission operated Data Registries.
- Organizational & governance: The current governance setup should be reviewed and where necessary adapted in order to enable a good and efficient framework for the governance of the new data categories.
- Financial: sufficient funds should be made available to realize the aforementioned points in a successful and sustainable manner.

- Operational: An important European IWT Data Registry should be hosted on a stable and robust platform with high service level agreements and should be set up as a high-availability system with 24/7 monitoring, preventive, corrective and adaptive maintenance.

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# 7 Roadmap

In this chapter a roadmap is painted based on the information from the previous chapters. The different recommendations are classified based on their topic, complexity (technical, legal, organizational), time horizon and assumed priority.

While it may not be possible to fully implement all recommendations within the time horizon considered by DIWA (2022-2032), they should at the very least be part of the bigger picture for the evolution of IWT in the upcoming decade.

## 7.1 RIS-Net

RIS-Net will be one of the pillars of the future of RIS. By combining the RIS Index and the RIS COMEX Reference Network Model, it removes a lot of duplication, streamlines data creation and information distribution and enables a next step in professionalizing data management for RIS.

Below are the recommendations concerning RIS-Net:

- Continue the elaboration of RIS-Net, securing funding where possible to enable all important stakeholders to participate and contribute
    - RIS-Net is already on the agenda of CESNI/TI/NtS. However, the voluntary efforts of the experts participating in CESNI/TI will not be sufficient to complete the massive task of creating a mature RIS-Net information model and all related tasks.
    - Putting the elaboration of RIS-Net on the task program of future European IWT projects seems like a logical next step
    - This recommendation has a High priority, Short time horizon, a High technical complexity and a Low organizational & legal complexity.
- Consider the incorporation of the Maritime Resource Name (MRN) in RIS-Net, in tight cooperation with the Inland ECDIS Harmonization Group.
    - The incorporation of the MRN is especially important in light of the envisioned inclusion of MRN in S-401 (future iENC standard)
    - While the technical inclusion of the MRN in RIS-Net should be rather straightforward, setting up a governance model for sustainably synchronizing the MRN information between RIS-Net and S-401 (and S-101) may prove challenging
    - This recommendation has a Medium priority, Medium time horizon, a Low technical & legal complexity, and a High organizational complexity.
- Consider the information available in the IHO Geospatial Information Registry when elaborating RIS-Net
    - Using the features/entities from the IHO GI Registry wherever possible will help the harmonization efforts between the inland and maritime world and is also an important aspect of keeping S-401 and RIS-Net aligned
    - This recommendation has a High priority, Medium time horizon, a Medium technical complexity, and a Low organizational & legal complexity.
- Consider the TEN-T information needs in RIS-Net, so that the RIS-Net data can be translated into TEN-T data without the need for manual data additions
    - Using the RIS-Net data as a source, a single translator could be built by TENtec (RIS-Net → TEN-T) covering the IWT TEN-T data needs
    - This recommendation requires a clear view on the TEN-T information needs and thus cooperation with TENtec.
    - This recommendation has a Medium priority, Medium time horizon, a Low technical and legal complexity and a Medium organizational complexity.

## 7.2 eFTI

eFTI should be considered an opportunity for IWT with the potential of creating a competitive advantage for IWT. As the eFTI data set is not final yet, some of these recommendations could become more difficult to achieve (or even obsolete) once the final dataset is published.

Below are the recommendations concerning eFTI:

- Stay closely involved in the elaboration and finalization of the eFTI data set
  - Given its potential impact, eFTI and its data set are already on the agenda of CESNI/TI/ERI and the RIS Authorities. We should however ensure the attention does not dwindle if it takes longer then expected for the data set to get published
  - This recommendation has a High priority, Short time horizon, and Low technical, organizational & legal complexity
- Consider the creation of a common ERI <-> eFTI translator service
  - Such a translator service could alleviate the administrative burden for the IWT community and authorities alike
  - If implemented as part of existing ERI-systems, it could strengthen the position of these systems (and IWT in general) in the multimodal chain
  - This recommendation has a Medium priority, Short time horizon and a potentially High technical, organizational & legal complexity

It should be noted that several more recommendations concerning eFTI are formulated as part of the DIWA SubActivity 3.2 – IWT Connectivity Platform report.

## 7.3 EuRIS

EuRIS is a single web portal that seamlessly combines River Information Services of 13 European partners[13]. As one of the results of the EU funded RIS COMEX project[14], it is an operational platform backed by a solid governance model, including financing agreements allowing sustainable operation. As it discloses a treasure of high quality IWT information on many levels and over a huge geographical area, it is set to become an important, if not the, access point for information on inland waterways and inland waterway transportation.

Below are the recommendations concerning EuRIS:

- Consider using EuRIS as a gateway between the RIS Authorities and the ERDMS
  - Bundling the data upload of IWT information towards the ERDMS for the RIS Authorities would decrease costs, improve efficiency and reduce technical complexity.
    - Only one interface between EuRIS and the ERDMS needs to be maintained instead of 10+ interfaces between national systems and the ERDMS
    - Central throttling, error handling, retry mechanisms, … are much easier to implement, enabling a robust data synchronization
    - Authorities need to upload their reference data only once (to EuRIS) instead of multiple times, which creates a risk of discrepancies
    - The data upload to EuRIS is straightforward and the authorities are intrinsically motivated to keep their reference data on EuRIS up-to-date
  - EuRIS could act as a cache of the ERDMS data
    - This results in a high-availability solution for the ERDMS data
    - It can also reduce the number of systems IWT data consumers need to connect to
  - This recommendation has a Medium priority, Short to Medium time horizon, a Medium technical and legal complexity and a Low organizational complexity

Furthermore, there are also some suggestions in relation to IWT Data Registries and EuRIS[15]:

[13] https://www.eurisportal.eu/
[14] https://www.riscomex.eu/
[15] It should be noted that these suggestions are only that. They are in no way to be interpreted as formal opinions voiced by any of the DIWA partners or their associates. These suggestions may however be interpreted as an outstretched hand from the DIWA partners towards the European Commission and DG Move in an offer to further increase the collaboration to reach the common goal of strengthening IWT as a safe and efficient mode of transport in the European multimodal logistics chain on all possible levels (physical, digital, governmental, …).

- Aim for a strong collaboration between all involved shareholders when existing IWT Data Registries need to be replaced or significantly redesigned in the future
    - The European Commission, DG Move, CESNI, the CCNR and the RIS Authorities & Providers are all parties that share the common goal of strengthening IWT.
    - A close cooperation during all phases of the life cycle of the Data Registries (conceptual phase, design phase, implementation, testing, maintenance, upgrades, …) could increase the overall efficiency, level of adoption and general level of satisfaction related of the Data Registries and create a multi-level benefit for the IWT community at large
    - This suggestion has a High priority, Long time horizon, a Low technical complexity and a High organizational and legal complexity
- Strengthen and extend the position of EuRIS as a Data Registry for IWT
    - Given the position of EuRIS in the IWT landscape and the wide range of reference data it already contains, it could be interesting to consider formalizing its position as a Data Registry for specific data
    - This suggestion has a Medium priority, a Medium time horizon, a Low technical and organizational complexity and a Medium to High legal complexity
- Consider the merits of EuRIS when existing IWT Data Registries need to be replaced or significantly redesigned in the future
    - Given the position of EuRIS in the IWT landscape and the wide range of reference data it already contains, it could be interesting to consider extending EuRIS to become a Data Registry for other data in the future
    - Although this will require significant technical and operational efforts, it should also result in significant synergy-benefits compared to a stand-alone solution.
    - This will require some legal changes (e.g. obligation in ES-RIS for the EU Commission to *operate* certain Data Registries may need to be rephrased)
    - This suggestion has a Low priority, a Long time horizon and a High technical, organizational & legal complexity

## 7.4 Conclusion

There are many interesting recommendations and suggestions from this DIWA Sub Activity. Together they paint an ambitious path towards a safer, more sustainable, (multimodal-)harmonized, efficient and digitized IWT, built upon a solid foundation of Data Registries and Information Models, and ready to take on the challenges of the future.