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PROPOSALS ON FURTHER DEVELOPING THE CONTENTS OF DIGITAL WATERWAY GUIDELINE

# 1 Summary

The DTEC Committee is currently formulating a new guideline on digital waterways, and formed a draft framework of the Guideline at the DTEC 2. WG1 of the DTEC Committee held two online meetings intersessionally in May, June and August 2024 to further enrich and refine the draft Guideline, and it is also expected that an interim guideline will be prepared at DTEC3.

## 1.1 Purpose of the document

This proposal aims to further discuss and define the relevant contents of the draft Guideline on the basis of the draft Guideline formed in the latest intersessional online meeting of DTEC Committee WG1.

## 1.2 Related documents

Draft Guideline on Digitalization of Waterways developed at the latest intersessional online meeting held in mid-August 2024.

# 2 Background

According to the IALA working program (2023-2027), the DTEC Committee plans to formulate a new guidelines on digital waterways, which are still under discussion and at the stage of developing the framework formation.

# 3 Discussion

Supplementary information is provided additional to the existing contents of the latest draft Digital waterway Guideline developed at the latest intersessional online meeting held in mid-August in this chapter, which is recommended to be included in the framework of the draft Guideline.

## 3.1 Definition to be optimized

Chapter 9 of the latest draft Guideline seeks to define relevant terms, which is yet to be defined. According to the development process of digital waterways in the world, together with the research done and practical activities in China, this proposal believes that Digital Waterway and digital twins can be defined as follows:

Digital Waterway: comprehensively utilizing surveying and mapping remote sensing, geographic information system, computer, Internet of Things, cloud computing and other technologies to digitalize and network waterway jurisdiction areas, service objects and management activities, and establish waterway information infrastructure and platform systems with network-oriented data as the core. It has the functions of dynamic monitoring of waterway changes, waterway maintenance, network management, waterway data analysis and application, and convenient service of waterway information convenient service.

digital twins: the refined digital description of the product entity, which would enable the more truly reflection of the characteristics, behavior, formation process and performance of the physical product based on the simulation experiment using digital models, further to manage the relevant data of the whole life cycle of the product; the virtual-real interaction ability would realize the correlation mapping of real-time data collection to the digital twin, which would realize the product identification, tracking and monitoring, and at the same time the digital twins to the analog object behavior prediction and analysis, fault diagnosis and early warning, problem locating and recording would also help to optimize the control.

## 3.2 Supplement the discussion on “Waterway Digital Model”

Chapter 3.1.1 of the latest draft Guideline describes the digital waterway model to some extent, but with no detailed information, nor take into account the different modeling methods that may be applied to different waterways in digital modeling, and various elements should be included in the modeling process to make the digital model as close to the real waterway environment as possible. According to the current development status of modeling technology, waterway digital modeling would be roughly divided into two-dimension, three-dimension and multi-dimension models. Thus the Guideline should explain the differences between different modeling methods as much as possible, with the description as follows, but not limited to, as the reference :

Two-dimension waterway model is based on abstract symbols to summarize the real waterways, which may include all kinds of waterway spatial data presented in two-dimension waterway map, by that the real situation of the three-dimension waterway is not able to be restored directly.

Three-dimension waterway model, generally would realistically reproduce the real environment of the waterways and its ports by using high-resolution remote sensing or aerial images combined with 3D models of buildings, docks, bridges and AtoNs. It might include not only the spatial information on the water surface, but also underwater and land spatial information containing seabed, terrain, docks, port buildings and bridges. However, the human-set virtual space elements of AtoNs, monitoring and management such as equal depth area, forbidden water area and anchorage area are not clearly described.

The multi-dimension digital waterway model uses the two-dimension waterway map to make up for the shortcomings of the three-dimension waterway model in terms of water surface spatial data, and conducting drawing, superposition and matching the data of water surface spatial elements, except for the existence of entities on water surface, in the two-dimension waterway map with the topographic grid data in the three-dimension waterway model, so as to integrate the two-dimension vector waterway map data under the framework of the three-dimension waterway model. It takes into account the advantages of 2D and 3D spatial data to provide multi-dimension, multi-resolution, accurate and rich geospatial information for digital waterway applications such as ship navigating, monitoring, AtoN telemetry and remote control.

It is suggested that the contents described above in this section be included in Chapter 3.1.1 of the draft Guideline to enhance the reader's understanding and knowledge of the digital waterway model.

## 3.3 Supplement the discussion on “Waterway Digital Twin”

Chapter 3.1.1 of the latest draft Guideline briefly describes the functions of digital twins that should be achieved, without any others illustrated. This proposal believes that the construction of a waterway digital twin should fully understand the characteristics that a twin might have. Thus it is suggested to include it in this chapter for consideration when conducting the construction of the digital twins, with elements to be contained, but not limited to, as follows:

a. Relying on the development of geographic information system;

b. Integration of water level, water depth, velocity and other sensor networks;

c. Using the hydraulic model as a link;

d. Achieving the iterative update of physical reality and digital information;

e. Reflecting the waterway scale and the flow pattern of the waterway section in real time;

At the same time, this chapter should define the key points and steps of the development of waterway digital twins, which may include but not limited to the following parts:

a. Developing a geographic information system to collect and display the information of various elements of waterways, ports and shipping hubs;

b. Establishing the real-time monitoring network of waterway, with water level, depth, velocity and other factors to be considered;

c. Using means of numerical simulation to establish the update iteration mechanism between sensor information and electronic waterway data to realize the development of digital twins of waterways.

d. Integrating and grafting video surveillance system and other digital information to enrich the functions of digital twins of waterways.

It is suggested that the contents described above in this paper be included in Chapter 3.1.1 of the draft Guideline or add a new section of Chapter 3 to improve readers' understanding and knowledge of digital twins.

**3.4 Supplement the discussion on”Digital Service”**

Chapter 4.1 of the latest draft Guideline briefly mentions the necessity to provide digital services but with no specific content covered. Therefore it is suggested that the following elements might be included in Chapter IV of the draft Guideline.

**3.4.1 Service Objects**

This chapter would explain the digital service content provided by digital waterways, with its service objects mainly categorized into ships and relevant competent authorities such as maritime administrations, port as well as waterway management departments. These services may include but not limited to the following contents:

Digital services provided to ships:

a. Real-time and accurate anchorage information, including anchorage operation information, to help ships better arrange voyage plans;

b. Real-time and accurate hydrologic and meteorological information to assist ships make better operational decisions and reduce navigation risks;

c. The best route for ships, based on real-time and dynamic ship flow, hydrologic and meteorological information, anchorage etc, to improve ship navigation efficiency and reduce the costs of shipping industry.

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Decision support for relevant competent authorities:

a. For management departments in charge of ports, waterways, and AtoNs, the operation status of various types of AtoNs infrastructure might be monitored in real time through telemetry, remote control, CCTV, etc. At the same time, the informationalized management of various kinds of AtoNs infrastructure would be realized through the application of specific digital models;

b. For management departments in charge of ports, waterways, and AtoNs, corresponding conclusions targeting to different demends as well as data support would be made through big data processing and analysis based on various kinds of information and statistics obtained, in order to assisting the decision-making on waterway planning, designing and maintenance and allocation of AtoNs;

c. For pilot departments, the optimal boarding time and boarding location might be formulated according to the acquired real-time wind, wave, current data to effectively reduce the boarding risk;

d. For maritime administrations, the best voyage plan might be developed by technical processing of the obtained dynamic data of various waterways, together with the comprehensive consideration of factors such as anchorage, port, ship flow, and weather to improve the utilization efficiency of anchorages and terminals. Furthermore, for emergency cases at sea, relative information would be acknowledged instantly and emergency response would be conducted in time.

**3.4.2 Service System and Platform**

After relative processing of the collected digital waterway data, a service system and platform for external display is required to realize the functions of data. Meanwhile, the digital modeling mentioned above in this proposal also relies on specific service systems and platforms. Thus it is suggested to add the description of the "service system and platform" to define the functions and features, which may include but not limited to the follows:

**3.4.2.1 Features**

User-friendly interface, easy to operate, efficient and stable, with good openness and scalability.

**3.4.2.2 Functions**

waterway management, waterway maintenance, dynamic monitoring, information push, etc.

It is suggested that the content described above in this section be included in Chapter 4.1 of the draft Guideline or adding a new section in Chapter 4 to improve readers' understanding and knowledge of digital service.

**3.5 Supplement Section 4.2**

Chapter 4.2 of the latest draft Guidanline refers to the concept of "Maritime services in the context of e-navigation" as described in IMO Circular MSC.1/ Circ.1610 Rev.1(2024), with a view on the waterway related services specifically, which this proposal considers could be supplemented as follows:

IMO Circular letter MSC.1/Circ.1610, adopted by the IMO Maritime Safety Committee at its 101st session (5-14 June 2019) and amended in June 2024, describes 16 types of maritime services in the context of e-navigation. Compared to the previous version of the document, the new version of the document adds the content of AtoN service. Among the 16 kinds of maritime services, this proposal considers that the services with high relevance to digital waterway are AtoN service, maritime safety information service and real-time water level and environmental information services.

IALA defines an AtoN as a device, system or service, external to vessels, designed and operated to enhance safe and efficient navigation of individual vessels and/or vessel traffic. Navigational aid services are needed by seafarers and coastal authorities for updates on new hazards, temporary shipping lanes, temporary areas to avoid hydrological changes, polar region, ice areas, and real-time location and integrity information of PNT.

The Maritime Safety Information (MSI) service is an internationally and nationally coordinated broadcast network containing notices to mariners, weather warnings, weather forecasts and other emergency safety information.

Oceanic and inland water level information is essential for the determination of under-keel clearance required for safe navigation. Real-time water level information is important for applications such as route planning, port entry and the determination of tidal prediction. Real-time tide and water level information can be used for activities such as situational awareness, hazard avoidance, installation of offshore renewable energy facilities and route planning.

**3.6 Supplement Section 4.3**

Chapter 4.3 of the latest draft Guideline is intended to introduce the concept of River Information Services (RIS) developed by PIANC and its application in various parts of the world (such as Europe). This article considers that this part can be supplemented as follows:

In order to improve the competitiveness of inland shipping and strengthen the seamless connection between water transportation and other modes of transport, the European Union utilizes modern information technology to provide collaborative information services for users from various segment of inland shipping.

The concept and pilot phase of RIS was from 1998-2004. At this stage, the concept and connotation of RIS was brought up, which is the collaborative river information service. The European Union has incorporated the development of RIS into the overall framework of the development of European inland waterway shipping in several legal directives, and has been continued to fund a series of relevant research, including key technologies and small-scale pilot studies. These research results provide abundant data and technical support for the formation of RIS standards and programs. Since 2004, the European Union has further developed RIS, standardized the relevant technologies of RIS, and legalized the implementation of RIS, providing a basis for the final promotion of RIS to the pan-European scale. The EU has implemented the RIS enabled Corridor Management Execution (RIS COMEX) project from 2016 to 2020, which covers 13 European countries and 14 partner companies. The objective of the project is to implement and operate seamless data business exchange based cross-border river information services with existing infrastructure and services of each country. By developing a common approach to transport management and traffic management among European stakeholders, the project is an important step towards a clear and unified vision for the management of European water transport corridors.

# 4 PROPOSALS

In summary, this proposal provides the following suggestions in further developing the content of the draft digital waterway Guideline:

a. To consider the explanation and definition of digital waterway and digital twin in this proposal, it is proposed to be included in Chapter 9 of the draft Guideline.

b. To consider the supplementary content of waterway digital model, it is proposed to be included in chapter 3.1.1 of the draft Guideline.

c. To consider the supplementary content of waterway digital twins, it is suggested to include it in Chapter 3.1.1 of the draft Guideline or add a new subsection to Chapter 3.1 for description.

d. To consider the supplementary content of waterway digital services, it is suggested to include it in Chapter 4.1 of the draft Guideline or add a new subsection to Chapter 4 for description.

e. To consider the supplementary content of chapters 4.2 and 4.3 and add them in the draft Guideline.

# 5 REFERENCE

Draft Guideline on Digitalization of Waterways developed at the latest inter-sessional online meeting held in mid-August 2024.

**6 Actions requested OF the CommiTTEE**

The committee is invited to consider the discussion and proposals mentioned above when formulating the Draft Guideline on Digitalization of Waterways, and take actions as appropriate.