ISSN 2616-5767 Vol.6, Issue 11: 90-94, DOI: 10.25236/AJETS.2023.061113

Research on the Construction of Smart Shipping Standard System

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Abstract: *In order to enhance the standardization development level of smart shipping in Jiangsu Province and provide a standard basis for the development of smart shipping related technologies, research on the construction of smart shipping standard system is carried out based on the framework of smart transportation standard system and the overall architecture of smart shipping.*

Keywords: *Smart shipping; Standard system; System framework; Key directions*

1. Introduction

Intelligent transportation is proposed and developed on the basis of intelligent transportation systems. At present, the construction of intelligent transportation systems and the formulation of relevant standards and standard systems are relatively mature and complete, while the construction of intelligent transportation systems has not yet taken shape, and the formulation of relevant standards and standard systems is also in the initial and exploratory stage. It is worth noting that although the concept of intelligent transportation comes from abroad, the scope of intelligent transportation and intelligent transportation has not yet been defined and distinguished in foreign countries. After localized development in China, its scope has covered various fields of transportation systems, including roads, railways, aviation, civil aviation, postal services, intelligent vehicles, etc. [1-4].

Intelligent shipping refers to a new modern shipping industry that utilizes modern information, communication, navigation, perception, control and other technologies and means to fully intelligentize shipping production, operation, service, and management, and reflects basic requirements such as intelligent and efficient production, scientific management, flexible and transparent services, and strong security. In order to fully leverage the leading role of smart shipping in the water transportation industry, it is necessary to take the construction of standard systems as the main entry point and lever for smart shipping, and quickly form a series of practical and highly guiding smart shipping related standards to assist in the construction of the ‘Strong Wealth, Beautiful High’ new Jiangsu.

2. Current Development Status of Smart Shipping

With the continuous development of China's economy, the navigation volume of inland waterways continues to increase, and the total transportation volume has been continuously rising. However, according to investigations, in recent years, the growth trend of China's inland waterway mileage has been relatively slow, and even some regions have shown a downward trend. And due to the dense and complex water network of inland waterways, ship accidents on water continue to occur. To effectively alleviate these conditions, the introduction of digital and intelligent technologies into the construction of inland waterways and shipping, and the construction of intelligent inland waterway shipping, have a significant and intuitive significance for China's waterway engineering. Targeted research has been carried out at the national level and to varying degrees in various provinces, and the main construction tasks for smart shipping during the 14th Five Year Plan period have been planned. Currently, multiple construction projects with smart shipping as the theme have been launched.

The Yangtze River main waterway plans to utilize more advanced intelligent perception, big data, and information technology to empower waterway business, further upgrade basic systems such as dynamic monitoring, maintenance management, and public services, and gradually build a "smart brain" with faster dynamic perception, more accurate maintenance management, and more refined service supply. The construction of the Yangtze River digital waterway has a spatial information infrastructure for the waterway, and on this basis, various information resources (waterway information

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service system and internal waterway management system) are deeply developed and integrated to achieve the interconnection and exchange of dynamic monitoring information such as navigation aids, water conditions, control river sections, and waterway scales in the Yangtze River trunk waterway.

The Jiangsu Jinghang Grand Canal Basin takes the construction concept of smart shipping as the main line, proposes the overall framework of smart waterway construction, focuses on the construction of smart ship locks, digital waterways, service decision-making and support platforms, and formulates a series of support standards such as the "Guidelines for the Construction of Smart Inland Waterways (Provisional)" and the "Technical Guidelines for the Construction of Smart Waterway External Sensing Facilities in Jiangsu Province". Jiangsu digital waterway is oriented towards secondary and lower level channelized waterways with multiple ship locks and bridges, vigorously developing trunk waterways, and achieving significant results in infrastructure construction, management, and maintenance, convenient lock passage, and public transportation services. In addition to the interconnection of technical standards, a sound standard system is conducive to the interconnection of regional standards, promoting regional economic and technological cooperation and development. Taking the Jiangsu region as a pilot, it lays the foundation for the interconnection and interconnection between the Yangtze River Delta and various provinces and cities in the future, promotes the coordinated development of regional smart transportation, and provides smart transportation technology support.

3. European Integrated Service Standard System for Inland Navigation

In terms of inland waterway transportation informatization, the European River Information Service (RIS) system represents the most advanced and complete inland waterway transportation information system in the world. The construction of the comprehensive information service standard system for European inland waterway shipping has gone through a long development process of six years, starting from the establishment of a reference model. From 1998 to 2002 and then to 2004, the European Union launched the INDRIS (Inland Navigation Demonstrator for River Information Services) project, the COMPRIS (Consortium Operational Management Platform River Information Services) project, and the IRIS (Master Plan of Implementation of RIS in Europe) project to establish a reference model, construct an RIS organizational structure, technical system, and standard system. On September 30, 2005, The EU proposed the establishment of a unified RIS and issued the RIS Directive, marking the beginning of the comprehensive implementation phase of RIS [5-6].

The RIS standard system includes five major parts: terminology and definition standards, data classification and exchange standards, information service specifications, subsystem standards, and general standard specifications. Among them, the electronic ship reporting standard, captain notification standard, inland waterway electronic channel chart display and information system standard, and ship tracking and tracking standard in the subsystem standards constitute the four key technical standards of RIS, playing an important role in promoting the development of IRIS projects. The RIS standard architecture diagram is shown as follows Figure 1:

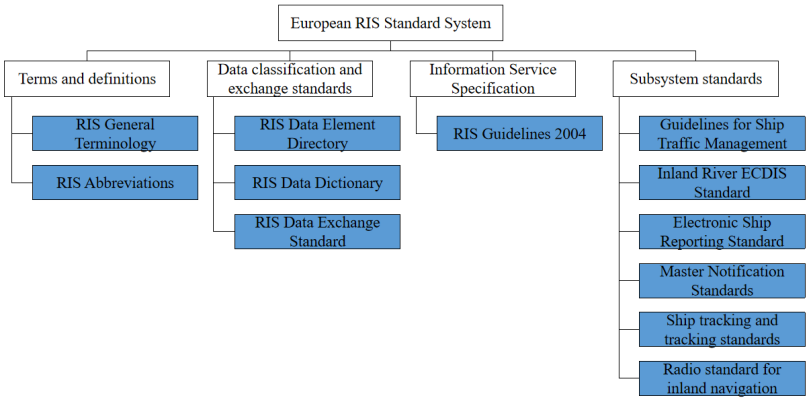

Figure 1: RIS Standard Architecture

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4. Research on Smart Shipping Standard System

4.1 Definition and coverage of smart shipping standard system

The accurate positioning and coverage of the standard system for smart shipping construction is an important foundation for formulating the standard system. Developing a standard system based on the characteristics and technical composition of smart shipping construction is an important basis and starting point for the preparation of this part of the standard system. The standard system for smart shipping construction focuses on the characteristics and content of smart shipping construction in Jiangsu Province, with a focus on aviation protection (waterway), ports, and service content; The standard system needs to cover new infrastructure, operation management, information services and other sectors, which can not only meet future development trends and needs, but also fully reflect the technological and industrial characteristics of Jiangsu Province; In the standard system, relevant standards such as ship shore collaboration and remote centralized control during construction should be incorporated into the standard system in conjunction with practical applications; Standards unrelated to the construction of smart shipping are not within the scope of this standard system.

4.2 Design of Intelligent Shipping Standard Architecture

The hierarchical division of the standard system structure is based on the principles of system engineering and the methods of system analysis, which arranges various standards within the standard system to generate a structural hierarchy. The structural hierarchy division includes two parts, namely horizontal professional or subsystem division and vertical technical hierarchy division.

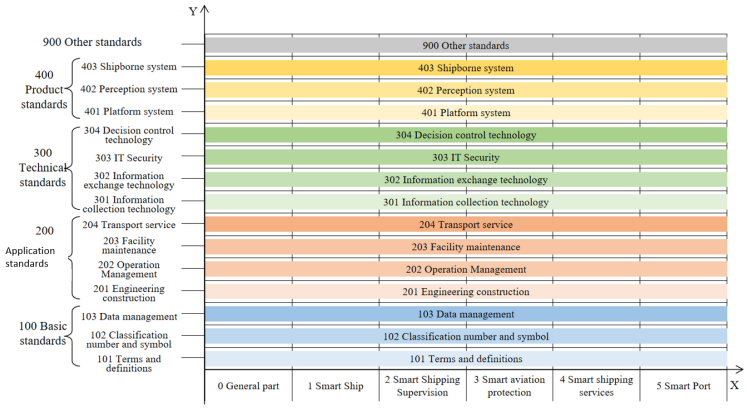

Figure 2: A two-dimensional diagram of the framework structure of the smart shipping standard system

Referring to the intelligent transportation system standard system, the framework of the intelligent shipping standard system is divided into horizontal technical level dimensions (Y-axis) and vertical professional field dimensions (X-axis) based on the hierarchical technical architecture of intelligent shipping, as shown in the figure 2.

4.3 Construction of smart shipping standard system

The framework of smart shipping standard system is based on the characteristics of smart shipping construction, highlighting user service and technology development, fully considering the development and application of new technologies in smart shipping construction. A systematic analysis of standardization objects and elements has been conducted, forming a smart shipping construction standard system framework. The standard system framework includes: basic standard layer, application standard layer, information technology standard layer. There are five levels of infrastructure standard layer and related standard layer. The standard system is shown in the following figure 3.

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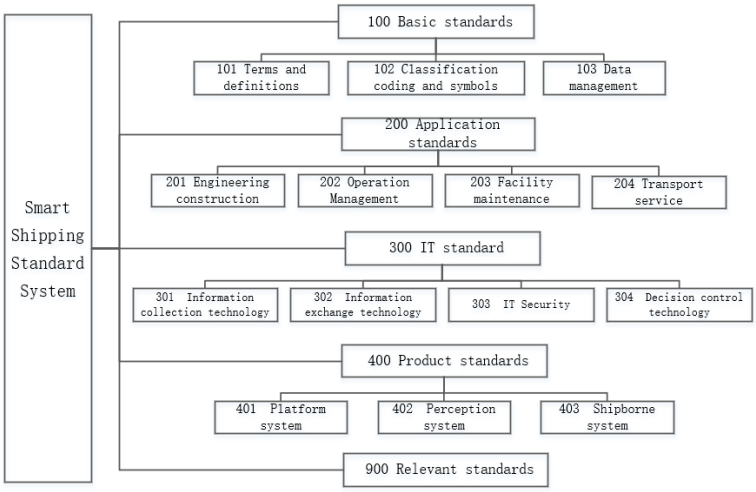

Figure 3: Smart shipping standard system

4.4 Research on the Revision of Key Standards for Smart Shipping

Focusing on promoting the construction of new infrastructure, the application of next-generation information and communication technology, and building a smart shipping innovation system, we prioritize the digital twin waterway system that urgently needs to be built in our province, refine the indicators and requirements for platforms, applications, network security systems, and security systems, and form the "Digital Twin Waterway Guidelines".

The construction of digital twin waterways is an integral part of smart waterway construction, and should meet the requirements of service expansion and smart waterway application extension, providing good expansion space for future development. The data base should be constructed at two levels, L1 and L2, based on factors such as channel level, channel traffic flow, and navigation environment. The L1 level is constructed by the provincial port and waterway management department, and the construction content includes L1 level geospatial data, basic data, monitoring data, business management data, and cross industry shared data. The L2 level is constructed by the municipal port and waterway management department, and the construction content includes L2 level geospatial data, basic data, monitoring data, business management data, and cross industry shared data.

The core goal of the digital twin channel should be safety and efficiency, ensuring the synchronization and consistency of the digital twin and physical conditions and their responses. The forward-looking preview role of the digital twin should be highlighted, problems should be identified, solutions optimized, and decision-making should be ensured to be safe, scientific, and effective. The principle of "overall planning and intensification, advanced practicality, safety and reliability, and iterative upgrading" should be followed, as shown in Figure 4.

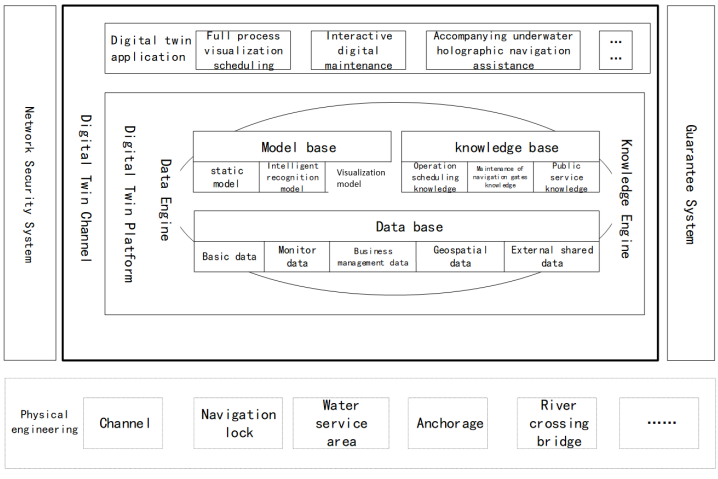

Figure 4: Framework for the construction of digital twin waterways

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The digital twin channel includes a digital twin platform. The digital twin application provides data, algorithms, and other resources through the digital twin channel, supporting the entire process of visual scheduling, interactive digital maintenance, and accompanying water holographic navigation assistance services. The network security system and guarantee system support the digital twin channel, and typical applications continue to play a reliable role. The physical engineering of digital twin waterways includes elements such as waterways, ship locks, water service areas, anchorages, river crossing bridges, and their management scope. The digital twin platform includes a data base, model library, knowledge base, twin engine, etc. Digital twin applications include full process visualization scheduling, interactive digital maintenance, and accompanying water holographic navigation assistance. The network security system includes network security organization management, security technology, security operation, supervision and inspection, and data security. The guarantee system includes management systems, operation and maintenance guarantees, standards and specifications, etc.

5. Conclusion

This article studies the current situation, existing problems, and development trends of the smart shipping standard system in Jiangsu Province, explains the connotation of the smart shipping standard system, defines the scope of the smart shipping standard system, and constructs a framework for the smart shipping standard system. This standard system clarifies the key directions for the development of smart shipping standards. In the future, smart shipping related standard projects can be proposed based on the framework of this standard system, and standard development work can be scientifically planned to lead the development of shipping with standards.

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