

Article

Research on the Cultivation Model of Decision-Making Ability for Maritime Talents Driven by AIS Data in the Era of Intelligent Shipping

Xiaona Liu ^{1,*}, Genyuan Wang ¹ and Xiaowen Li ¹

¹ Hainan Vocational University of Science and Technology, Haikou, China

* Correspondence: Xiaona Liu, Hainan Vocational University of Science and Technology, Haikou, China

Abstract: To address the strategic need for maritime professionals transitioning to shore-based monitoring and intelligent decision-making in the era of smart shipping, traditional maritime education models exhibit significant structural contradictions in data-driven thinking and advanced decision-making training. Consequently, there is an urgent demand for innovative pedagogical approaches that align with modern technological advancements. This study proposes a novel decision-making competency development model centered on Automatic Identification System (AIS) data analysis, aiming to enhance situational awareness and operational proficiency through data technology empowerment. By integrating Kalman filtering and Douglas-Peucker algorithms to establish a high-availability AIS data foundation, employing deep reinforcement learning (DDPG) for dynamic collision avoidance simulation, and utilizing K-means clustering algorithms for historical trajectory pattern mining, we have developed a comprehensive tripartite teaching pathway encompassing "algorithm validation-scenario implementation-data evaluation." This structured approach ensures that theoretical knowledge is seamlessly translated into practical expertise. Practical assessments demonstrate that trainees achieved an average 22.4% improvement in risk prediction accuracy in complex waters and a 15.8% reduction in dynamic decision response time, effectively bridging the technological gap between traditional training methods and intelligent shipping requirements. Ultimately, this model not only provides a robust quantitative evaluation framework for cultivating high-caliber maritime professionals but also offers critical talent support for the broader transition from a conventional shipping industry to a globally competitive, intelligent maritime powerhouse.

Keywords: intelligent shipping; ais data; maritime education; decision making; teaching model

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1. Introduction

With the deepening of global digital transformation, cutting-edge digital technologies such as cloud computing, big data, artificial intelligence, and digital twins are rapidly permeating the shipping industry, elevating intelligent shipping to the forefront of global maritime competition [1]. Against this backdrop, China has issued various strategic plans and guidelines that emphasize the importance of accelerating talent cultivation as a core guarantee for driving industry transformation. However, while technological advancements are reshaping industrial landscapes, they are also profoundly altering the essence of maritime professions. This shift underscores the need for a comprehensive reevaluation of how the industry prepares its workforce to meet the demands of a rapidly evolving technological environment.

As the global shipping industry accelerates its transition to intelligent operations, maritime professionals are shifting their focus from traditional "physical handling" to "information-driven decision optimization." Automatic Identification System (AIS) data, as the most real-time and comprehensive sensing asset in navigation, serves as a core resource for enhancing future professionals' situation awareness. However, the existing

education system remains deeply anchored in the traditional framework of the STCW Convention, which reveals structural limitations when addressing nonlinear decision-making challenges in complex data environments. Transforming established techniques such as trajectory clustering and collision avoidance modeling into teachable resources is essential for guiding students from "experience-driven" to "evidence-driven" approaches. This transformation represents an urgent challenge in maritime education, requiring innovative methodologies to bridge the gap between traditional practices and modern technological demands [2].

Exploring the deep integration of Automatic Identification System (AIS) data analytics into maritime education systems carries profound theoretical and practical significance. As a critical big data asset in navigation, AIS data contains essential decision-making information, including vessel encounter situations, navigation intentions, and historical trajectories. By harnessing the value of high-availability AIS data, it is possible to significantly enhance navigation safety assessments and collision avoidance decision-making capabilities for future maritime professionals operating in complex waters. Furthermore, this integration can serve as a foundation for driving the evolution of maritime education from a "knowledge-transfer" paradigm to an "innovation-driven decision-making" model. This shift not only aligns with the objective requirements of developing new-quality productivity but also represents a necessary step for advancing from a shipping giant to a shipping powerhouse. Such advancements are critical for cultivating top-tier innovative talents who can lead the industry into a new era of intelligent operations [3].

2. The Intrinsic Connection between AIS Data and Navigation Decision-Making in the Era of Intelligent Shipping

The emergence of intelligent shipping represents not only a technological leap but also a fundamental shift in maritime navigation practices. Within this transformation, AIS data has transcended its traditional role as a basic navigational tool to become a critical resource for informed decision-making processes. Understanding the intrinsic relationship between AIS data and navigation decisions provides a robust foundation for advancing innovative models of talent cultivation, ensuring the maritime industry adapts effectively to the demands of this new era.

2.1. New Requirements for Talent Decision-Making Capabilities in Intelligent Shipping Development

With the evolution of intelligent ships from manned assistance to remote control and fully autonomous navigation, the professional roles and responsibilities of crew members are undergoing a significant transformation [4]. This shift marks a strategic transition from traditional "physical labor on board" to advanced "intelligent operation from shore." As intelligent shipping progresses through various stages, the required quality structure and skill sets of maritime professionals have fundamentally changed. These changes emphasize the need for adaptability and a deeper understanding of emerging technologies, as well as the ability to integrate these technologies into operational practices effectively.

During the phase of remote or autonomous navigation characterized by "unmanned operation," the role of maritime practitioners evolves from relying on physical spatial intuition to functioning as "shore-based operators" or "system monitors." This transformation necessitates that professionals in the maritime industry develop three essential data literacy competencies. First, they must possess cloud-based analytical and control capabilities to process and interpret massive real-time data streams originating from satellites and base stations. Second, they require remote fault diagnosis skills to reconstruct the operational status of shipboard electromechanical equipment by analyzing data anomalies, even under conditions of physical isolation. Third, an advanced emergency decision-making mindset is critical. In scenarios where algorithms encounter

extreme operational conditions or conflicting data, human operators act as the "last line of defense." Their decision-making ability must be grounded in a profound understanding of system output logic and the capacity to correct errors, rather than relying solely on operational experience. This combination of skills ensures the reliability and safety of intelligent shipping operations [5].

2.2. The Underlying Support Role of High Availability AIS Data in Decision-Making

High-availability AIS data refers to data assets characterized by high signal-to-noise ratios, which have undergone meticulous cleaning, spatiotemporal consistency verification, and noise filtering processes. Original AIS messages often suffer from trajectory drift, position jumps, and uneven sampling frequencies due to factors such as base station coverage limitations, electromagnetic interference, and sensor errors. These issues can lead to inaccuracies if applied directly in teaching decision-making contexts. To address these challenges, this teaching model incorporates Kalman filtering to smooth dynamic position points and employs the Douglas-Peucker algorithm to reduce the dimensionality of extensive trajectory data. This approach preserves critical turning point features while eliminating redundant noise [6]. The underlying principle of this data preprocessing methodology is to foster students' "critical thinking" and "multi-source cross-validation capabilities" within digital environments. By grounding decision-making logic on a robust data foundation, students are better equipped to analyze and interpret complex scenarios effectively, as illustrated in Table 1.

Table 1. AIS Data-Driven Decision-Making Literacy Development Framework

| Data processing phase | Cultivating Decision-Making Literacy | corresponding core competencies |
|--|--|--|
| Data cleaning and parsing | Identification of authenticity and uncertainty of information | Basic data literacy |
| Dynamic Information Feature Extraction | Calculate key collision avoidance metrics such as DCPA/TCPA | perceptual awareness capability |
| Mining of historical trajectory rules | Optimization and Validation of Route Based on Group Experience | macro planning ability |

High-availability AIS data services act as the essential cornerstone of the decision-making chain. Through comprehensive data cleaning processes, such as correcting erroneous coordinates, feature extraction to identify static and dynamic information, and multi-source fusion processing that integrates radar, video, and meteorological data, it becomes possible to reconstruct accurate and continuous ship trajectories. These refined data assets ensure that maritime professionals can rely on precise and consistent information for operational and strategic decision-making [7]. The integration of these processes not only enhances the reliability of AIS data but also establishes a solid foundation for advanced analytical applications in maritime contexts.

The empowering role of high-availability data in decision-making is evident through two critical dimensions. First, it enables precise navigation state identification and intent inference [1]. High-availability data allows systems to analyze ship navigation details at a micro-level, including turning angular velocity and acceleration variations. By correlating historical trajectories with real-time data patterns, it facilitates predictive insights into navigation intentions, such as vessel turns and decelerations. This capability provides maritime personnel with situational awareness that extends beyond visual range, enhancing operational safety and efficiency. Second, it supports the scientific refinement of decision algorithms. Collaborative decision algorithms leveraging high-availability AIS data can accurately compute dynamic DCPA and TCPA between vessels, combined with azimuth pattern analysis to classify encounter scenarios. This quantitative approach offers a scientific basis for collision avoidance priority sequencing and optimal path planning,

transforming traditional empirical decision-making into data-driven precision decision-making. These advancements significantly improve response efficiency in maritime supervision and vessel operations, ensuring safer and more effective management of maritime activities.

AIS data analysis capability has emerged as a core competitive advantage and a pivotal decision-making engine for maritime professionals in the era of intelligent shipping. The ability to harness high-availability AIS data effectively is increasingly recognized as a critical skill for navigating the complexities of modern maritime operations. The key to cultivating future-ready talents lies in deeply integrating data mining technologies with maritime professional theories [8]. This integration not only enhances the analytical capabilities of maritime professionals but also equips them with the tools necessary to address evolving challenges in intelligent shipping. By fostering a data-centric approach to maritime education, institutions can ensure that graduates are well-prepared to meet the demands of the industry and contribute to its ongoing transformation.

3. The Realistic Difficulties in the Cultivation of Decision-Making Ability of Traditional Navigation Talents

3.1. Inadequate Synchronization between Technological Innovation and Talent Cultivation

The curriculum framework for maritime programs remains deeply rooted in the traditional STCW Convention standards, with core instruction primarily focusing on single-role competencies such as marine pilots and engineers. While this "function-oriented" approach was effective during the conventional shipping era, it now proves insufficient in the age of smart shipping. The curriculum updates have not kept pace with technological advancements, particularly in integrating interdisciplinary knowledge areas such as big data analytics, ship-to-everything networks, and artificial intelligence. As a result, students often excel in operating traditional instruments but lack a comprehensive understanding of the data architecture that underpins intelligent decision-making processes [9]. This disconnect creates significant knowledge gaps, limiting their ability to adapt to the growing demand for hybrid professionals skilled in both navigation and data-driven technologies within the smart shipping industry. Addressing these challenges requires a systematic overhaul of educational frameworks to align with emerging technological paradigms.

3.2. Insufficient Development of Data Thinking and Scientific Research Innovation Capabilities

Traditional maritime education has historically relied on experiential teaching methods, emphasizing the "master-apprentice inheritance" model and strict adherence to established regulations. While this approach has been effective in transferring practical skills, it has inadvertently limited the development of students' ability to engage in data-driven thinking. When faced with large volumes of high-frequency AIS data, students often struggle to analyze underlying patterns or identify correlations, which restricts their capacity to leverage data for independent and innovative problem-solving [10]. This gap highlights the need for integrating modern analytical tools and methodologies into maritime education to foster deeper cognitive engagement with data.

The high entry barriers associated with accessing advanced teaching resources and participating in research projects further exacerbate the issue. Students are often unable to gain exposure to real-world enterprise data projects, such as intelligent system path optimization or navigation assessment in complex water environments. This lack of practical experience prevents them from developing critical thinking skills essential for addressing real-world navigation conflicts. Consequently, their decision-making abilities remain confined to passive execution rather than evolving into proactive innovation and optimization [11]. Bridging this gap requires a systematic overhaul of educational frameworks to incorporate hands-on research opportunities and practical applications that align with industry demands.

3.3. Insufficient Depth of School-Enterprise Collaborative Education

While maritime colleges have widely implemented industry-academia partnerships, most collaborations remain superficial, limited to introductory internships on training vessels and corporate expert lectures. This cursory approach creates a significant disconnect between classroom instruction and real-world intelligent shipping management environments. Advanced decision-support tools, such as big data shore-based monitoring platforms and intelligent collision avoidance systems, which are widely adopted in industry, are rarely integrated into school training programs. The lack of deep resource sharing and data interoperability prevents students from accessing authentic industry big data during their studies. Consequently, when graduates enter emerging roles such as shore-based monitoring center operations, they face prolonged adaptation periods and decision-making skill gaps [7]. Addressing these challenges requires a more robust integration of industry technologies into academic curricula, fostering practical exposure and bridging the gap between theoretical knowledge and industry demands.

The asynchronous nature of technological advancement, the limitations in cultivating critical thinking, and the superficiality of collaborative education collectively form the current barriers to enhancing decision-making capabilities among maritime professionals. To overcome this predicament, it is imperative to explore new teaching approaches and empowerment pathways. These approaches should emphasize the incorporation of advanced industry tools and real-time data into educational frameworks, enabling students to develop practical competencies alongside theoretical understanding. By fostering deeper collaboration between schools and enterprises, including shared access to technological resources and data, institutions can better prepare graduates for the complexities of modern maritime operations. Such initiatives would not only reduce adaptation periods but also enhance the overall decision-making proficiency of future professionals in the field.

4. Core Application Scenarios of AIS Data Analysis in Decision-Making Capability Development

4.1. Ship Collision Avoidance Decision and Behavior Extraction Based on Spatiotemporal Data

In traditional teaching, the understanding of collision avoidance rules often relies heavily on theoretical memorization. However, through the application of AIS data analysis, these abstract rules can be transformed into dynamic and interactive decision-making processes. This approach enables learners to engage with real-world scenarios, fostering a deeper comprehension of the principles and their practical implications [12].

Quantitative collision scenario training involves guiding students to develop algorithms that calculate critical parameters such as relative distances, relative bearing angles, closest collision point (DCPA), and closest collision time (TCPA) between vessels [13]. These calculations utilize dynamic AIS data, including coordinates, speed, and heading. By analyzing extensive historical collision data, students are trained to accurately assess typical collision scenarios, such as head-on, crossing, and overtaking, under diverse environmental conditions. This method enhances their ability to predict collision risks and strengthens their situational awareness, ultimately improving their decision-making capabilities in complex maritime environments.

In collision avoidance decision-making simulation training, the reward function R derived from deep reinforcement learning is introduced to guide students in exploring the optimal balance between safety and efficiency. This reward function is meticulously constructed to incorporate multiple factors, ensuring a comprehensive evaluation of decision-making outcomes. By engaging with this framework, students can better understand the dynamic interplay between safety considerations and operational efficiency, fostering a more nuanced approach to maritime navigation [14].

$$R = w_1 \cdot R_{safe} + w_2 \cdot R_{eff} + w_3 \cdot R_{rule}$$

The safety $R_{safe} \Delta dw_i$ reward term is typically defined as a nonlinear function based on DCPA and TCPA, assigning maximum negative values when the distance falls below

the safety threshold. The Reff term, which represents efficiency, is constrained by range increments and rudder angle variation frequency. Rrule integrates the logic of the "collision avoidance rule," allowing students to observe and analyze the drift phenomena in agent decision-making behaviors under varying orientations, such as economic priority versus safety supremacy [11]. By adjusting weight parameters, students gain a profound understanding of the underlying decision-making logic in dynamic games, enabling them to critically evaluate and refine their strategies in real-world applications.

4.2. Route Planning and Navigation Safety Evaluation

Route planning is a critical decision-making process aimed at ensuring both the efficiency and safety of navigation. Historical AIS data serves as an invaluable reference for this purpose, as it provides comprehensive insights into past navigation patterns and behaviors. By analyzing this data, navigators can identify optimal routes that minimize risks and enhance operational efficiency [11]. This approach not only supports safer navigation but also contributes to the development of more reliable and effective maritime strategies.

Global static path planning involves the application of advanced clustering algorithms, such as K-means, to preprocess extensive historical AIS trajectory datasets. This preprocessing step is essential for removing noise and isolating key feature trajectories, which represent the most commonly recognized safe routes in specific maritime regions. By engaging in this process, students gain practical experience in identifying and planning global static safe routes. This hands-on approach fosters their analytical skills and equips them with the ability to design navigation strategies that prioritize safety and efficiency.

Macro navigation assessment and performance evaluation are integral components of maritime safety management. Through the analysis of practical engineering scenarios, such as assessing the feasibility of bridge navigation or selecting offshore construction sites, students apply AIS cross-sectional flow analysis techniques. This involves a detailed statistical examination of vessel flow distribution, ship dimensions, and navigation density within specific waters. By independently preparing navigation environment assessment reports and performing quantitative calculations on collision prevention effectiveness, students develop a comprehensive understanding of navigation management risks. This process enhances their decision-making capabilities, enabling them to evaluate and mitigate risks from a macro perspective effectively [4].

4.3. Early Warning of Abnormal Ship Behavior and Decision-Making for Maritime Smart Supervision

Smart maritime supervision necessitates that practitioners derive meaningful insights from vast amounts of data while identifying and mitigating potential risks. This approach emphasizes the importance of integrating advanced analytical techniques with practical maritime operations to ensure safety and efficiency in maritime activities.

Anomaly Path Recognition and Boundary Demarcation: This module utilizes real-world AIS data cases involving activities such as smuggling, illegal fishing, or irregular navigation behaviors, including unusual drifting patterns or speed violations. Students are trained to identify distinctive movement patterns of vessels and employ geo-fencing technology to establish scientifically validated route boundaries. When deviations from standard operational patterns are detected, learners are expected to demonstrate the ability to rapidly identify these anomalies and propose actionable early-warning solutions. The detailed content of the relevant scenarios is presented in Table 2, which provides a comprehensive refinement of scenarios for recognizing abnormal behaviors and implementing decision-making interventions.

Table 2. Deep Refinement of Scenarios for Abnormal Behavior Recognition and Decision Intervention

| deviant behaviour | Recognition Method (Teaching Aids) | Key areas for policy intervention |
|--------------------------|---|---|
| course deviation | geofencing algorithm | assessing the safety margin of navigation |
| abnormal drift | state machine model (FSM) | Fault diagnosis of auxiliary power system |

Predictive Early Warning Model Development: Students are guided to construct multidimensional correlation models by integrating historical accident data with meteorological and environmental data. These models are designed to forecast potential collision risks or regulatory violations, transforming static rule-based systems into dynamic early-warning mechanisms [15]. This initiative significantly enhances students' proactive decision-making skills in maritime management. By bridging algorithmic logic with operational judgment, this training prepares students to contribute effectively to the development of future smart regulatory platforms, ensuring a seamless integration of technology and practical maritime oversight.

Through comprehensive practice in these three scenarios, maritime students evolve from being mere operators to becoming proficient data analysts and intelligent decision-makers. This transformation equips them with the ability to make informed decisions supported by robust data analysis and scientific reasoning, thereby fostering a new generation of professionals adept at addressing the complexities of modern maritime management.

5. Implementation Strategies for Enhancing Decision-Making Competence of Maritime Professionals through AIS Data Analysis

To fully integrate AIS data analysis with navigation decision-making capabilities, a comprehensive and systematic restructuring is essential across three critical dimensions: the curriculum system, the practical training platform, and the industry-education mechanism [16]. This transformation seeks to convert advanced data technologies into educational resources that are not only teachable but also operable and assessable. By aligning these dimensions, maritime professionals can be better equipped to utilize AIS data effectively, fostering enhanced decision-making competence in real-world scenarios.

5.1. Restructuring the Curriculum System to Promote Interdisciplinary Integration of "navigation + Data Intelligence"

The traditional navigation education curriculum system has historically emphasized the operation of physical equipment and the comprehension of collision avoidance protocols. However, with the advent of intelligent shipping technologies, this singular knowledge framework is increasingly inadequate for addressing the complexities of digital decision-making processes. The integration of interdisciplinary approaches is essential to equip students with the skills necessary to navigate the challenges posed by modern maritime operations, which demand proficiency in both traditional navigation techniques and advanced data-driven methodologies.

Integrating digital and intelligent core courses into the maritime curriculum is crucial for adapting to the evolving demands of intelligent shipping. Traditional courses should be supplemented with advanced subjects such as "Introduction to Intelligent Shipping," "Maritime Big Data Management and Applications," and "Cloud Analytics and Remote Control." These additions must go beyond basic computer knowledge, ensuring alignment with practical maritime operations. For example, in "Data Management and Applications," students should gain a comprehensive understanding of AIS message structures and the logical correlations between static and dynamic data. This foundational

knowledge enables them to analyze and interpret data effectively, fostering critical skills for real-world applications in intelligent shipping environments.

Developing semantic practical projects is an effective method for enhancing students' analytical and decision-making capabilities. By engaging in hands-on projects that involve parsing AIS raw messages and converting them into semantic data, students acquire the ability to transform complex hexadecimal codes into clear navigation intentions. These projects also teach students to identify and clean outliers, such as "drift" and "jumps" in raw AIS data, thereby cultivating essential data mining skills. This process not only prepares students to extract actionable insights from uncertain environments but also establishes a solid foundation for advanced decision-making in future maritime applications, ensuring they are well-equipped to handle the demands of intelligent shipping systems.

5.2. Innovating Teaching Platforms: Building a High-Availability AIS-Data-Based Training Environment

The development of decision-making abilities relies heavily on the availability of a high-fidelity practical environment. Traditional navigation simulators often suffer from limitations such as their closed, static, and preset nature, which restrict their adaptability to evolving industry needs [4, 8]. To address these shortcomings, it is essential to establish a digital teaching platform that integrates advanced technological solutions and aligns with contemporary maritime practices. Such platforms can provide students with a more dynamic and interactive learning experience, fostering their ability to adapt to real-world challenges and enhancing their overall competency in navigation and decision-making processes.

Introducing high-availability real-time data flow into training environments represents a significant advancement in maritime education. By utilizing high-availability AIS data services, laboratories can incorporate real-time AIS data streams sourced from active ports and congested waterways to create a digital twin training environment. This approach replaces fictional scenarios traditionally used in simulators with real-time maritime traffic conditions that mirror actual waters. Students are required to engage with dynamic, randomly disturbed real traffic flows, performing collision avoidance assessments and navigation evaluations under authentic conditions. This hybrid training model significantly enhances the realism of decision-making processes, allowing students to develop critical skills in analyzing and responding to complex maritime scenarios with greater accuracy and confidence.

Building an algorithm-driven simulation platform offers students the opportunity to explore advanced computational methods for maritime navigation. By leveraging open-source platforms or collaborating with university-industry computing centers, students can conduct experiments on vessel path planning using deep reinforcement learning techniques. This hands-on approach encourages them to independently develop or optimize collision avoidance algorithms, observing the dynamic impacts of various decision-making commands on DCPA/TCPA within simulation environments. The iterative process of transitioning from "rule memorization" to "algorithm validation" enables students to gain a deeper understanding of decision-making logic in complex encounter scenarios. This progression facilitates the transformation of theoretical knowledge into practical engineering decision-making, equipping students with the skills necessary to address real-world maritime challenges effectively.

5.3. Deepening Industry-Education Integration and Establishing Multi-Dimensional Collaborative Education and Evaluation Mechanisms

The development of decision-making skills for maritime professionals should not occur in isolation but must be deeply integrated into the broader industry ecosystem to establish a closed-loop system. Traditional assessment methods, such as written examinations, should evolve into a multidimensional evaluation framework that

encompasses algorithm validation, operational stability, and the rationality of decision-making processes. This approach ensures that maritime professionals are evaluated on their ability to apply theoretical knowledge in practical, real-world scenarios, fostering a more comprehensive skill set aligned with industry demands.

The "Engineer + Scientist" dual-mentor system is implemented through strategic collaboration between maritime regulatory authorities and shipping companies. This system engages senior captains with extensive frontline experience alongside algorithm engineers as external mentors. Real-world operational challenges faced by enterprises, such as identifying abnormal vessel behavior in specific waters or predicting ship routes under complex weather conditions, are incorporated into the curriculum as teaching cases or topics for graduation projects. By addressing these practical problems, students are equipped to develop robust decision-making skills that are essential for both maritime supervision and intelligent business operations, bridging the gap between theoretical learning and industry application (As shown in Figure 1).

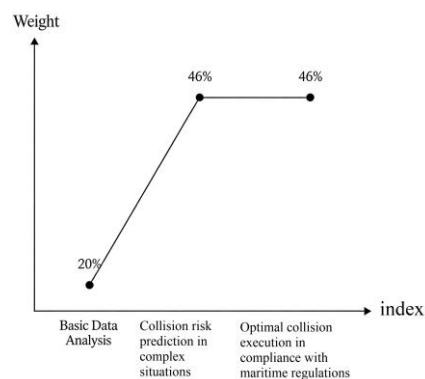


Figure 1. Evaluation Indicators for the decision-making ability of maritime talents.

Refining phased talent evaluation criteria is essential to align with the progressive evolution of intelligent ships, transitioning from manned remote-controlled systems to fully autonomous navigation. Stage-specific training pathways should be explored to ensure the development of interdisciplinary professionals capable of excelling in diverse roles. A comprehensive evaluation framework should be established, encompassing basic operations, data analysis, system monitoring, and emergency decision-making. Assessment standards must shift from traditional written examinations to a multidimensional evaluation system that integrates algorithmic performance, operational stability, and decision-making rationality. This ensures that maritime professionals are proficient in both traditional navigation skills and advanced competencies required for shore-based operations and intelligent supervision, preparing them for the challenges of the digital era.

Through the implementation of these strategies, AIS data will evolve beyond its conventional role as a navigation aid to become a dynamic teaching resource. This transformation empowers maritime professionals to transition from mere operators to strategic decision-makers in the digital era. By leveraging AIS data as an educational tool, the industry can cultivate a new generation of maritime talents equipped with the skills necessary to navigate complex operational environments and contribute to the advancement of intelligent maritime systems [3].

6. Conclusion

As the technological cornerstone of intelligent shipping, AIS data analysis plays a pivotal role in revolutionizing maritime operations by transitioning professionals from "experience-based navigation" to "data-driven decision-making." This transformation is achieved through the integration of high-availability AIS data, advanced collision avoidance algorithms, and realistic navigation demonstration scenarios into educational

frameworks. Such practices address the limitations of traditional maritime training, particularly in developing complex decision-making skills. Looking ahead, fostering deeper collaboration between industry and educational institutions is crucial for building interdisciplinary systems that align with the rapid advancements in digital-intelligent technologies. By synchronizing maritime training standards with these technological upgrades, the sector can cultivate elite interdisciplinary talents who possess exceptional decision-making capabilities and digital literacy. These efforts will significantly contribute to the establishment of a robust maritime powerhouse, ensuring sustainable growth and innovation in the global shipping industry.

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