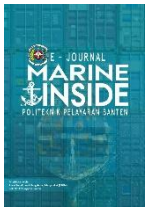

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Assessing the role of the Automatic Identification System (AIS) in navigational safety: A case study of the General Cargo Vessel MV Guhi Mas

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ABSTRACT

Shipping safety is fundamental to the maritime industry, and navigational systems are central to safe operations. In line with IMO/SOLAS requirements, the Automatic Identification System (AIS) supports collision avoidance, ship traffic services, navigational aids, search and rescue, and accident investigation. AIS continuously broadcasts a vessel's identity, position, course, speed, and navigational status, enabling other ships and coastal stations to track targets and anticipate risk. Integrated with ECDIS, radar, and ARPA, AIS enhances situational awareness in meeting, crossing, and overtaking situations by providing parameters such as CPA (Closest Point of Approach) and ETA (Estimated Time of Arrival). This study analyzes the role of AIS in navigational safety on a general cargo vessel (MV Guhi Mas). The findings indicate that AIS is critical to safe navigation: it improves target identification around the vessel, facilitates real-time data exchange with VTS, strengthens decision-making on the bridge, and contributes to incident prevention and post-event analysis. Regulatory carriage requirements further underscore AIS as an essential instrument for reducing maritime accidents.

Keywords: *Automatic Identification System (AIS), navigational safety, collision avoidance, MV Guhi Mas.*

ABSTRAK

Keselamatan pelayaran merupakan fondasi industri maritim, dan sistem navigasi berperan sentral dalam operasi yang aman. Selaras dengan persyaratan IMO/SOLAS, Automatic Identification System (AIS) mendukung pencegahan tubrukan, layanan lalu lintas kapal, sarana bantu navigasi, pencarian dan penyelamatan (SAR), serta investigasi kecelakaan. AIS menyiarkan secara kontinu identitas kapal, posisi, haluan, kecepatan, dan status navigasi, sehingga kapal lain dan stasiun pantai dapat melacak target dan mengantisipasi risiko. Terintegrasi dengan ECDIS, radar, dan ARPA, AIS meningkatkan kesadaran situasional pada situasi berhadapan, bersilangan, dan menyalip dengan menyediakan parameter seperti CPA (Closest Point of Approach) dan ETA (Estimated Time of Arrival). Studi ini menganalisis peran AIS dalam keselamatan navigasi pada kapal general cargo (MV Guhi Mas). Temuan menunjukkan bahwa AIS krusial bagi navigasi aman: meningkatkan identifikasi target di sekitar kapal, memfasilitasi pertukaran data waktu nyata dengan VTS, memperkuat pengambilan keputusan di anjungan, serta berkontribusi pada pencegahan insiden dan analisis pascakejadian. Persyaratan pemasangan wajib dalam regulasi semakin menegaskan AIS sebagai instrumen esensial untuk menurunkan kecelakaan maritim.

Kata Kunci: *Automatic Identification System (AIS), keselamatan navigasi, pencegahan tubrukan, MV Guhi Mas.*

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INTRODUCTION

In Indonesia, maritime transport is long-established. As stated in Chapter I, General Provisions, Article 1(1) of Law Number 17 of 2008 on Shipping, the sector is a unified system that encompasses port and waterborne transportation, safety and security, and protection of the marine environment [1]. Internationally, key safety frameworks include the International Ship and Port Facility Security (ISPS) Code, the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs), the International Safety Management (ISM) Code, and the Standards of Training, Certification and Watchkeeping (STCW). Nationally, these are complemented by the Minister of Transportation Regulation Number 45 of 2012 on Ship Safety Management.

Across the shipping industry, safety is paramount. Insufficient understanding of transport safety can lead to material losses, medical harm, environmental contamination, and fatalities. Maritime safety therefore warrants sustained attention given the persistent death toll and recurring accident rates each year [1]. Safe navigation hinges on effective navigational systems [2]. In line with safety and security requirements for collision avoidance, vessel traffic services, navigational aids, search and rescue, and accident investigation, IMO resolutions regulate the use of the Automatic Identification System (AIS) [3].

From a business and operational standpoint, shipping safety remains critical [1]. Attitudes, values, and compliance with safety and security standards in ports and at sea are integral to the system. Deficiencies in human resource management—spanning education, competence, work environment, hours of work, and managerial procedures—can undercut safety performance and drive financial losses, healthcare costs, unnecessary energy consumption, and pollution [4].

Shipping safety encompasses all measures undertaken to ensure that waterborne transportation protects life, property, and the environment. The International Maritime Organization (IMO) codified core requirements in the Safety of Life at Sea (SOLAS) Convention; notably, Chapter V, Regulation 19 mandates the carriage of navigational equipment, including AIS, as part of broader efforts to improve navigational safety.

High-intensity maritime activity inevitably increases traffic density and, with it, accident exposure. Records from the National Transportation Safety Committee (KNKT) show that collisions, fires, sinkings, and groundings featured prominently in 2018 and 2019, with 39 and 25 cases respectively [4]. This underscores the central role of AIS in meeting safety and security requirements across collision avoidance, ship traffic services, navigational aids, search and rescue, and accident investigation [5].

As floating structures operating at varying speeds across diverse navigational areas, ships face multiple hazards. Accidents are often unpredictable and may occur anywhere [13]. Human error, mechanical failures, and a mix of internal and external factors are primary causes—commonly manifesting as (1) collisions, (2) excessive speed, (3) weather-related sinkings, (4) fires, (5) engine or power failures, and (6) other collision scenarios.

An illustrative case occurred in 2019: MV Segara Mas, en route from Jakarta to Singapore, experienced a blackout that disabled all navigational equipment, including AIS. Under normal conditions, AIS broadcasts a vessel's identity and integrates with ECDIS, radar, and ARPA, thereby supporting the assessment of other vessels' movements. According to P2TL regulations, when two vessels are on reciprocal courses, the officer on watch must monitor movement and alter course to starboard or pass port-to-port; exceptions may apply in areas with restricted maneuverability. AIS also communicates a ship's identity to nearby traffic [6]. With AIS inactive, nearby ships and the Vessel Traffic Service (VTS) could not determine the position of MV Segara Mas. Furthermore, the requirement to transmit data to VTS West every four hours could not be fulfilled. Consequently, the lack of AIS data exchange reduced situational information and complicated timely decision-making to avert potential hazards.

AIS can electronically and automatically transmit or receive the ship's name, type, time, date, speed, position, course, route, and other information necessary to enhance maritime safety and security [7]. The system operates on very high frequency (VHF) channels in the 156–162 MHz band. Two primary classes exist: Class A and Class B. Class A equipment (IMO Resolution A.917(22)) meets IMO standards and uses the Self-Organized Time Division Multiple Access (SO-TDMA) protocol, whereas Class B equipment typically uses Carrier-Sense Time Division Multiple Access (CS-TDMA) [8].

Given these functions, AIS is indispensable for officers on watch. The system provides key identifiers (ship name, IMO number, MMSI, call sign), position (latitude/longitude), and speed—data that enable accurate vessel tracking and support collision prevention, particularly in high-traffic areas. In line with regulations mandating AIS carriage to reduce shipping accidents, this study aims to analyze the role of the Automatic Identification System (AIS) in navigational safety on general cargo vessels.

RESEARCH METHODOLOGY

This study employs a qualitative descriptive design. As explained by Margono (2005), descriptive research seeks to reveal actual facts systematically and carefully within a group sharing specific characteristics, producing information that is then organized, interpreted, and reported. In line with this, the qualitative approach emphasizes an in-depth, contextual understanding of the phenomenon under study [9]. Data were collected through documentation, interviews, and observation. Observation captured real conditions on board and the practical use of the Automatic Identification System (AIS) in supporting navigational safety, providing firsthand evidence from multiple sources. To obtain further insight into AIS use, message-delivery procedures, and its perceived importance on board, interviews with ship's crew were conducted to complement and clarify the observational findings. Documentation consisted of written notes, photographs, drawings, and electronic materials relevant to the inquiry. Together, these techniques enabled triangulation and supported well-grounded conclusions about the role of AIS in enhancing shipping safety [9-10].

RESULTS AND DISCUSSION

The Automatic Identification System (AIS) is widely used across Indonesian waters and serves as a core navigational aid on MV Guhi Mas. The vessel is a general-cargo ship built in 2008 by Lian Yungang Wuzhuo Shipping Industry, registered at Tanjung Priok with call sign PMSA, IMO 9549334, and MMSI 525 091 416. Its principal characteristics include a gross tonnage of 3,127 MT, net tonnage of 1,928 MT, approximate dimensions of 96.5 m (LOA/LBP 90.8 m), 15.8 m breadth, 7.4 m depth, a summer deadweight of 5,200 MT, four cargo holds with two lifting-pontoon hatch covers, and a summer displacement of 6,213 T (vessel dossier).

On-board observations show that AIS plays a central role in day-to-day navigation by identifying traffic in the vicinity and enabling two-way data exchange with VTS and AIS-equipped ships. Interviews with crew members underscore that AIS improves decision-making and accident prevention, especially at night or in restricted visibility, by supplying near-real-time information such as position, speed, heading, CPA (Closest Point of Approach), ETA (Estimated Time of Arrival), and vessel identity. A practical limitation is inherent to the technology: AIS can only detect targets that are transmitting, which is why it must be paired with vigilant visual lookout, radar, and ECDIS for comprehensive situational awareness [5-6, 11].

In routine operations, AIS–VTS interaction follows a two-way workflow. Vessels broadcast AIS messages that VTS ingests for traffic analysis and, in return, VTS issues port and traffic advisories—such as speed/course recommendations, pilotage, berthing windows, and weather—supporting safe and orderly movements. The 2019 blackout on MV Segara Mas illustrates the risk when AIS becomes unavailable: the loss of AIS transmission degraded positional awareness for nearby ships and VTS, disrupted scheduled reporting (e.g., four-hourly submissions to VTS West), and complicated timely decisions to mitigate hazards [6].

Crew feedback also highlights several operational constraints that can momentarily interrupt AIS service, including power transitions (e.g., generator change-over) and, naturally, full blackouts. These findings reinforce established good practice: navigators should integrate AIS readings with radar (VRM, EBL, parallel indexing), ECDIS overlays, and continuous visual observation to validate targets and trajectories, particularly in high-density traffic or poor visibility [6-7].

The empirical evidence aligns with prior studies that position AIS as a powerful medium for sending and receiving dynamic and static data—course, type, speed, status, destination, and proximity—thus enabling traffic monitoring and target tracking within VHF range (Matrutty et al., 2022; Masmilah et al., 2019). Technically, AIS operates on VHF channels in the 156–162 MHz band and is available in Class A and Class B configurations; Class A equipment (per IMO Resolution A.917(22)) uses SO-TDMA, while Class B commonly uses CS-TDMA—differences that affect reporting intervals and slot access priority [7-8].

Taken together, the results indicate three immediate implications for MV Guhi Mas and similar general-cargo vessels. First, assure AIS availability through robust electrical reliability and routine equipment health checks to avoid data gaps during critical maneuvers. Second, embed AIS into bridge routines by continuously verifying targets, checking CPA/ETA, and cross-validating with radar and visual cues. Third, sustain crew competence with procedures for power transitions, prompt AIS reactivation, and disciplined integration with VTS.

Implementing these steps translates AIS's technical capabilities into measurable safety gains, consistent with crew experience and the broader literature [5-6, 11].

CONCLUSION

Based on the research findings, the Automatic Identification System (AIS) plays a pivotal role in shipping safety. AIS helps prevent accidents and enhances situational awareness at sea by providing key information on a vessel's position, speed, heading, CPA (Closest Point of Approach), ETA (Estimated Time of Arrival), and identity. Its carriage and use are governed by statutory requirements, underscoring AIS as an essential instrument in reducing maritime accidents. A practical limitation, however, is that AIS can only detect vessels that are themselves equipped and transmitting.

To ensure accurate situational assessment, a navigator must maintain and operate all navigational equipment efficiently and in concert. Core tools include binoculars, radar, AIS, and the Electronic Chart Display and Information System (ECDIS). Effective radar use—particularly of VRM (Variable Range Marker), EBL (Electronic Bearing Line), and parallel indexing—supports precise observation and target tracking, while AIS contributes identification and motion data when available. ECDIS further aids route monitoring and timely maneuvering in the presence of navigational hazards. In sum, skilled, integrated use of these aids—anchored in vigilant visual lookout—is critical to preventing collisions and safeguarding cargo.

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