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RESEARCH ARTICLE

Safety of Navigation and Maritime Communications with Submarines and Artificial Intelligence: Assessment of the Procedures and Requirements in Malaysia

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ARTICLE INFO	ABSTRACT
      *Corresponding Author: manique.cooray@mmu.edu.my	Submarines, in their capacity as underwater vessels with their ability to navigate the depths of the ocean and access remote and inaccessible areas, offer a unique vantage point for gathering real-time data. This data could provide us with information related to the environment, intelligence gathering, mine reconnaissance to name a few. When integrated with Artificial Intelligence this data can be analysed to detect environmental anomalies, assess pollution levels, and monitor the impact of human activities on marine ecosystems. The safety of navigation and marine communications is closely connected to marine risk assessment. With the increasing complexity and scale of environmental challenges, traditional monitoring methods face limitations in effectively monitoring and enforcing environmental regulations, particularly in underwater environments. By employing the capabilities of submarines equipped with Artificial Intelligence and data analytics it is possible to address issues of maritime safety and protection of the marine environment. Therefore, within the ambit of Malaysia's Merchant Shipping Ordinance 1952, Environmental Quality Act 1974 this paper explores the interplay between conservation of the environment, submarines, and artificial intelligence. By employing a doctrinal methodology through an analysis of existing legislation and regulatory frameworks, the objective of this research is to first address the definitional issues of a submarine in the Ordinance and to identify opportunities for enhancing environmental protection through the deployment of submarines and AI technology. The paper concludes by highlighting the emerging issues and recommendations in employing submarines as autonomous vessels via artificial intelligence in safeguarding marine ecosystems and promoting sustainable development.

INTRODUCTION

One of the key characteristics of navigation for maritime vessels, particularly with submarines is ensuring the safety of its vessels which is both a necessity for economic benefits and national security of a country. Murray, S. (2015) in Submarines explains how ensuring the safety of these submarines in the vast depths of the oceans presents a myriad of challenges with one of the main risks associating with the risk of collisions and the heighten risk of accidents under the seas. To avoid collisions, submarines rely heavily on sophisticated communications to interact with other maritime entities. Traditional methods of communications pose challenges to communications on submarines as radio transmission often hindered by the water's conductivity and limitations of securing underwater signals making real-time communication with submarines a daunting task. Such risks pose a threat to the safety of navigation and maritime communications with delays and signal degradation in underwater environments that can impede timely exchange of critical information between submarines and surface vessels increasing room for accidents.

In addition to safety considerations, maritime communication with submarines also plays a crucial role in military operations and strategic defense. Addressing the challenges associated with the safety of navigation and maritime communications with submarines requires a multifaceted approach. The safety of navigation and maritime communications with submarines represents a complex and evolving challenge in today's maritime domain. By recognizing the unique risks and vulnerabilities associated with underwater operations and leveraging technological innovations and international cooperation, stakeholders can work towards enhancing maritime safety and security for the benefit of all.

By employing the capabilities of submarines equipped with Artificial Intelligence and data analytics it is possible to address issues of maritime safety and protection of the marine environment. There are three objectives to this study. Firstly, to examine the provisions of Malaysia's Merchant Shipping Ordinance 1952 ("MSO '52"), Merchant Shipping Ordinance 1960 of Sabah and Sarawak and the Environmental Quality Act 1974 to determine the status of a submarine within the ambit of maritime safety. The question which is addressed is to determine whether a submarine falls within the definition of a category of ship or warship under MSO 1952, MSO 1960 Sabah & Sarawak.

The second objective is to examine the assessment of the Procedures and Requirements in Malaysia within the MSO '52. The third objective is identifying opportunities for enhancing environmental protection through the deployment of submarines and AI technology.

The limitation of this research is that although submarines also fall under the ambit of the Royal Malaysian Navy, the Malaysian National Security Council and the Malaysian Maritime Enforcement Agency in Malaysia this study will confine its discussion within the provisions of Merchant Shipping Ordinance and Environmental Quality Act 1974.

The current literature on the safety of navigation in maritime operations

Safety of navigation in maritime operations is a paramount concern for both global maritime industries and individual nations like Malaysia. With the ever-increasing volume of maritime traffic and the complexity of shipping routes, ensuring safe navigation has become a multifaceted challenge requiring constant vigilance, technological advancements, and effective regulatory frameworks.

Globally, organizations such as the International Maritime Organization (IMO) play a crucial role in establishing standards and regulations to enhance maritime safety. The IMO's International Convention for the Safety of Life at Sea 1974 (SOLAS) sets forth comprehensive requirements for the construction, equipment, and operation of vessels, emphasizing the importance of safe navigation practices. Compliance with SOLAS provisions are mandatory for all vessels engaged in international voyages, contributing significantly to the overall safety of maritime operations worldwide (IMO, 1974). Ross, David in The World's Most Powerful Submarines explains the implementation of advanced navigational technologies has revolutionized the safety landscape in maritime operations. In the context of Malaysia, a nation with a robust maritime industry and extensive coastline, ensuring the safety of navigation is of paramount importance. The Malaysian Maritime Enforcement Agency (MMEA) plays a pivotal role in enforcing maritime regulations, conducting surveillance, and responding to maritime incidents within Malaysian waters within the ambit of Malaysian Maritime Enforcement Agency Act 2004. Collaborative efforts between the MMEA, the Royal Malaysian Navy, and other relevant agencies are essential for safeguarding Malaysia's maritime interests and protecting its marine environment (MMEA, n.d.). Malaysia's strategic location in the busy maritime trade routes of the Malacca Strait underscores the significance of safety measures to prevent navigational hazards and maritime accidents. The country's commitment to implementing international maritime standards, coupled with investments in navigational infrastructure and human resource development, reflects its dedication to ensuring safe and efficient maritime operations within its territorial waters (Malaysia Marine Department, n.d.). Thus, the safety of navigation in maritime operations is a global imperative that requires concerted efforts from all stakeholders, including international organizations, national governments, and industry players in line with Part V of the Merchant Shipping Ordinance 1952.

MATERIALS AND METHODS

Material referred to in this research are with reference to existing legislation including the Merchant Shipping Ordinance 1952 ("MSO '52"), Merchant Shipping Ordinance 1960 of Sabah and Sarawak and the Environmental Quality Act 1974 to determine and other relevant provisions and international conventions.

RESULTS

The research focused on evaluating the safety of navigation and maritime communications in Malaysia, aiming to identify key challenges, assess current practices, and propose recommendations for improvement. Through a comprehensive analysis of relevant data, the study yielded valuable insights into the state of maritime safety and communication infrastructure in the Malaysian context. In Malaysia, the definition of a "vessel" under the law is typically provided in maritime legislation and regulations. Historically, a vessel in Malaysian law has been broadly defined as any watercraft or craft capable of being used as a means of transportation on water, including ships, boats, and other floating structures used for navigation or transport of goods and people. A "vessel" under section 2 of the MSO '52 "includes any ship or boat or any other description of vessel used in navigation." A "ship" in the same provisions includes every description of vessel used in navigation not propelled by oars." Whether a submarine would fall under this definition of a vessel or a ship would depend on how the term "vessel" is specifically interpreted within the relevant legal framework. Submarines are indeed capable of transportation on water, albeit in a submerged state, and they are used for various purposes including defense, research, and exploration. However, a lack of the inclusion of submarines in the legal definitions of "vessel" may explicitly exclude submarines due to their unique characteristics and operational purposes. This in turn may hinder any operation or the application of relevant law as the definitional dilemma is not addressed in the Malaysian legal framework. One significant finding of the research pertains to the adequacy of navigational aids and communication systems in Malaysian waters. While Malaysia boasts a well-developed maritime infrastructure, including lighthouses, buoys, and VHF communication networks, there are areas for enhancement, particularly in remote or high-traffic regions. Addressing gaps in coverage and improving the reliability of communication networks emerged as crucial priorities to ensure the safety of vessels navigating Malaysian waters. Furthermore, the research highlighted the importance of technological advancements in enhancing maritime safety and communication efficiency. Modern navigational technologies, such as Electronic Chart Display and Information System (ECDIS) and Automatic Identification System (AIS), were identified as valuable tools for enhancing situational awareness and facilitating real-time vessel tracking. However, there is a need for continued investment in updating and maintaining these systems to keep pace with evolving industry standards and technological advancements.

In conclusion, the research provides valuable insights into the state of safety of navigation and maritime communications in Malaysia, highlighting both strengths and areas for improvement. By addressing challenges related to infrastructure, technology, and human factors, Malaysia can further enhance its maritime safety standards, ensuring the continued security and efficiency of maritime operations within its territorial waters with the inclusion of AI in its operation via communications on submarines.

DISCUSSION

In Malaysia, the legal framework and regulations governing submarines are primarily established within the broader maritime laws and defense legislation. Specific regulations related to submarines may encompass aspects such as procurement, operation, maintenance, safety, and environmental protection. These regulations are likely to be overseen by relevant governmental bodies, including the Royal Malaysian Navy and other defence agencies. While specific details of submarine regulations may not be publicly available due to their sensitive nature, they are designed to ensure compliance with international maritime standards while addressing the unique operational requirements and security concerns associated with submarine activities in Malaysian waters. Currently, the Malaysian Marine Department (MMD) is responsible for the application and enforcement of international instruments and standards in Malaysian waters, except in inland waters. A major objective of MMD

is to ensure the safety of navigation and the effectiveness of aids to navigation are adequate as outlined under Part V of MSO 52', including their availability and reliability, to meet the standards of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA). Malaysian Maritime Enforcement Agency Act 2004 (MMEA) was enacted to increase maritime security in Malaysian waters, including the Malaysian side of the Strait of Malacca. As a result of Sections 7(4), 7(5) and 7(6) of the MMEA, the provisions of Article 19(2) of Part II of the United Nations Convention on the Law of the Seas regarding innocent passage are incorporated into Malaysian domestic law. Section 7(4) of the MMEA Act states that any ship or vessel sailing within Malaysian waters may not be stopped if they exercise their right to innocent passage. As described, the Malaysian Maritime Enforcement Agency (MMEA) may suspend the right of innocent passage only if these vessels cease to exercise their right by engaging in specific illegal activities, which include any acts of pollution.

Assessment of procedures and requirements in Malaysia

The Royal Malaysian Navy (RMN) has established comprehensive procedures and requirements for the management and utilization of submarines in Malaysia. The acquisition process involves thorough evaluations, negotiations with manufacturers, and contract agreements covering technology transfer, maintenance support, and crew training. Extensive training programs and operational procedures are in place for submarine crews, including simulator training facilities and collaborations with foreign navies for advanced training. Adherence to maintenance protocols, including regular refits conducted by the Boustead DCNS Naval Corporation, is essential to maintain operational readiness and enhance the capabilities of Malaysia's submarine fleet. A key component of the Royal Malaysian Navy's maritime defence strategy is the submarine, according to the Strategy Document for RMN 15 to 5. This new Armada will include 4 submarines, bolstering the Navy's combat capabilities. The document emphasizes the importance of submarines such as the RMN SCORPENE class submarine in Malaysia's conventional warfare capabilities. In addition, it acknowledges the challenges posed by the aging fleet, including submarines, which are struggling to meet operational needs. With the transformation programme, the local shipbuilding and defence industry will be supported in addition to submarine capabilities being enhanced.

With the "15 to 5" Transformation Plan, which will expand Malaysia's submarine fleet by 2040, strategic planning is a key component of Malaysia's submarine strategy, especially in light of maritime claims in the South China Sea. This includes budget allocations, capability assessments, and alignment with national security objectives. Aside from this, Malaysia's submarine capabilities and regional security are enhanced through international cooperation with naval forces like the Royal Australian Navy, the United States Navy, and the Indian Navy.

Although the 15to5 Transformation Programme does not explicitly outline the use of Artificial Intelligence (AI) in submarines, Malaysia may explore AI applications for submarines given the global trend towards AI integration in naval operations. Artificial intelligence may enhance submarine performance, improve situational awareness, and enhance decision-making processes. AI could be used for autonomous navigation, predictive maintenance, and mission planning. Embracing AI technologies will enhance Malaysia's submarine capabilities, operational effectiveness, and competitiveness.

Author's contribution

Both authors have contributed to this research in an equitable manner in the research design, data collection and the writing of the manuscript. The research area is an off shoot of an area which both authors have been working on previously. Specifically, the data collection and literature review was carried out by both authors. The main author looked into the discussion on the submarines in general and the safety of navigation and maritime communications, particularly concerning submarines and artificial intelligence (AI), while the co-author examined the assessment of procedures and requirements within Malaysia's maritime domain. In this discussion by the co-author the data analysis indicated the assessment of procedures should encompasses a multifaceted approach, evaluating factors such as submarine maintenance, crew training, and compliance with international maritime laws. Rigorous scrutiny of safety protocols and communication systems ensures the effective management of submarine operations and mitigates navigational risks in Malaysian waters.

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