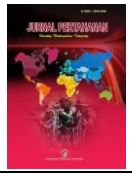

Jurnal Pertahanan: Media Informasi tentang Kajian dan Strategi Pertahanan yang Mengedepankan Identity, Nasionalism dan Integrity
Vol. 10 No. 1 (2024) pp.155-168
https://jurnal.idu.ac.id/index.php/defensejournal

Navigating the Maritime: Technology for the Defense of the Indonesian National Capital City (IKN) in the Makassar Strait

Akmal Azizan[1*], Salma Zahra[2], Sally Sophia[3]
[1,2,3]Universitas Muhammadiyah Jakarta, Indonesia

2016470008@student.umj.ac.id[1*], 2016470011@student.umj.ac.id[2],
2016470010@student.umj.ac.id[3]
*Corresponding Author

Article Info

Article History:
Received: December 11, 2023
Revised: April 3, 2024
Accepted: April 25, 2024

Keywords:
Complete Defense,
IKN,
Maritime,
Makassar Strait,
Virtual Technology

DOI:
http://dx.doi.org/10.33172/jp.v10i1.19420

Abstract

Maritime defense, particularly in critical waterways like the Makassar Strait, is paramount due to its geopolitical significance. This study aims to evaluate the efficacy of virtual maritime technology alongside traditional maritime defense methods. This study seeks to assess virtual maritime technology's efficacy, evaluate existing knowledge gaps regarding maritime defense in Southeast Asia, and propose practical policy measures for enhancing defense in the Makassar Strait region. By employing a comprehensive research design, this study analyzes the strategic importance of the Makassar Strait, the strengths and weaknesses of traditional defensive measures, and potential applications of virtual maritime technology through case studies and comparative analysis. The findings reveal novel insights into utilizing virtual maritime technology as a force multiplier, particularly in the context of the Makassar Strait. Additionally, the study identifies overlooked aspects such as cooperative defense, moral concerns, and the under-researched nature of virtual maritime in Southeast Asia. In conclusion, this study underscores the significance of integrating virtual maritime technology within the comprehensive defense framework to bolster maritime defense. It emphasizes the need for collaborative approaches and offers practical policy proposals for effectively deploying these technologies. The research contributes to bridging knowledge gaps in maritime defense and provides actionable insights for policymakers and military professionals. Advocating for virtual maritime technology offers a promising strategy for safeguarding Indonesia's capital city (IKN) and securing vital maritime routes like the Makassar Strait.

INTRODUCTION

This study addresses the pressing need to improve the defenses of Indonesia's new capital city or IKN (*Ibu Kota Nusantara*) in the Makassar Strait via the strategic deployment of virtual maritime technology. The deliberate combination of state-of-the-art technologies like artificial intelligence, unmanned systems, and high-tech sensors, referred to as "virtual maritime technology (VMT)", is exemplified by the autonomous underwater vehicles (AUVs) developed by organizations such as Ocean Infinity. These AUVs utilize advanced Artificial Intelligence (AI) algorithms and sophisticated sensor arrays to autonomously navigate and survey the ocean floor, providing valuable data for applications such as offshore exploration, environmental monitoring, and underwater infrastructure inspection (Markopoulos & Luimula, 2020).

There may be many threats to international defense, but this study intends to show how its findings differ from others. The relationship between the threats to international defense and the distinction of the study lies in the focus or approach taken by the study to address these threats. The article analyses traditional defense strategies, provides ethical and collaborative frameworks, and explores virtual maritime technology within a comprehensive defense framework. It also looks at the geopolitical importance of the Makassar Strait. Protecting a country's capital is more crucial than ever in today's world due to the constant changes in geopolitical events (Acosta, Maharjan, Peyriere, & Mamiit, 2020). As digital/cyberspace continues to emerge as a critical domain for civilian and military activities, the focus on defending a country's capital city becomes increasingly complex. While traditional defense strategies may prioritize physical security measures, the advent of virtual maritime technology introduces a new dimension to national defense planning. This creates a paradox wherein policymakers must navigate between the tangible threats to physical infrastructure and the intangible but equally significant cyber threats.

The emergence of virtual maritime technology underscores the need for a comprehensive defense strategy encompassing physical and digital domains. Protecting the capital city requires securing physical borders and critical infrastructure and safeguarding against cyberattacks that can disrupt essential services and compromise national security. Moreover, the geopolitical importance of the Makassar Strait adds another layer of complexity to the defense equation. As a crucial maritime passage connecting key regions, any disruption or threat to the security of the Makassar Strait can have far-reaching implications for regional stability and global trade. Therefore, while traditional defense strategies remain essential, the integration of virtual maritime technology offers a proactive approach to addressing contemporary security challenges. By leveraging technological advancements in both physical and digital realms, countries can enhance their defense capabilities and adapt to the evolving geopolitical landscape effectively.

Even though, Indonesia’s new capital city (IKN) is located on Kalimantan Island, the Makassar Strait likely holds more importance than Kalimantan's land and sky security for several reasons. The Makassar Strait is a critical chokepoint for global trade, connecting the Pacific and Indian Oceans. Disruptions here could have severe economic repercussions for Indonesia and the world. While important, land and sky security in Kalimantan does not directly impact global trade flows. Indonesia is an archipelago nation, and Kalimantan is an island. Threats like piracy, terrorism, and illegal activities often originate at sea. A secure Makassar Strait strengthens overall national security. The most immediate threats to Indonesia, particularly its capital city, are likely maritime due to the extensive coastline and island geography. Land and sky threats in Kalimantan,

while present, might be less prominent. The economic impact of a compromised Makassar Strait could be significant. This might justify allocating more resources to securing this vital waterway compared to land and sky security in Kalimantan. Securing the Makassar Strait is likely a higher priority due to its strategic importance for global trade and its role in protecting the capital city. However, maintaining land and sky security in Kalimantan remains essential for safeguarding resources and territorial integrity.

The Indonesian National Capital City (IKN) is integral to the Republic of Indonesia's political, economic, and cultural fabric. It is vital to the country's long-term viability (Sun et al., 2023). Protecting nearby regions and incorporating virtual maritime technology capabilities into Indonesia's capital city's defense apparatus is of the utmost importance in this age of unprecedented technological advancement. Disruptions in this area could have significant economic and geopolitical consequences. Jakarta, the former Indonesia's capital city, while necessary, does not hold the same strategic significance for global trade routes. The new capital city's location near the Makassar Strait makes it more vulnerable to maritime threats than Jakarta, which is located inland on Java Island. Threats to the new capital city are likely primarily maritime due to its proximity to the strait. Jakarta, being inland, may face a broader range of threats, including land-based attacks. Modern threats like piracy, terrorism, and cyberattacks require a constantly adapting defense strategy. VMT can be a valuable tool for addressing these evolving threats in the maritime domain. The Makassar Strait requires a layered defense strategy incorporating traditional methods (patrols) with cutting-edge technologies (VMT) for comprehensive protection. Jakarta's existing defenses might be sufficient for its specific threat landscape. Effectively securing the Makassar Strait necessitates collaboration with neighboring countries due to its international importance. Jakarta's defense may not require the same level of regional cooperation. Due to its location and potential threats, the new capital city and the Makassar Strait require additional defense plans compared to Jakarta. VMT can be a crucial tool for addressing evolving maritime threats in the strait. A comprehensive strategy combining traditional and modern methods is necessary for the Makassar Strait. International collaboration is essential for securing the strategically vital Makassar Strait. The new capital city's proximity to the Makassar Strait creates a unique security landscape compared to Jakarta. The maritime-focused nature of potential threats and the evolving nature of modern warfare necessitate additional defense plans that incorporate VMT and regional cooperation.

The objective of protecting the capital city of Indonesia from the many and ever-changing maritime threats in the Makassar Strait is everything but straightforward (Gani et al., 2022). Even if traditional protections have worked in the past, they may not be enough to handle the defense challenges of today. A comprehensive and adaptive defense plan requires us to find a method to integrate virtual maritime technology into our current conventional operations. By weighing the benefits, drawbacks, and ethical issues of virtual maritime technology, this initiative hopes to assist the Indonesian capital in its conservation efforts of the Makassar Strait.

This study on strengthening the defense of the Indonesian National Capital City (IKN) through integrating virtual maritime technology presents several novel contributions to the field. This study introduces the concept of virtual maritime technology as a force multiplier in the defense of maritime territories. By leveraging cutting-edge technologies such as artificial intelligence, unmanned systems, and advanced sensors, this study explores how virtual maritime technology capabilities can enhance traditional defense measures, exponentially increasing the effectiveness of the

overall defense apparatus. The research tailors the application of virtual maritime technology solutions to the specific challenges and opportunities presented by the Makassar Strait.

By conducting a detailed analysis of the geopolitical landscape and maritime activities in the region, this study provides insights into the customization and optimization of virtual maritime technologies to address the defense concerns of this critical maritime gateway. This study advocates for a holistic defense approach integrating virtual maritime into the broader defense strategy. By combining technological advancements with traditional methods (these include fortifications, radar installations, and other physical infrastructure used to monitor and defend coastlines from potential attacks), the study proposes a comprehensive defense framework that adapts to the evolving nature of maritime threats, offering a more resilient and adaptive defense posture.

This study emphasizes the importance of forging strategic partnerships and collaborations with international entities, private sectors, and neighboring nations. By highlighting successful case studies of collaborative efforts in deploying virtual maritime technology solutions, the study provides a blueprint for creating a collective defense architecture in the Makassar Strait region, contributing to enhancing Indonesia's maritime defense capabilities. Recognizing the ethical implications and potential risks associated with the use of advanced technologies in defense, this research delves into the establishment of robust ethical and regulatory frameworks. The study ensures the ethical use of virtual maritime technology for Indonesian capital and offers policy recommendations.

Quirapas & Taeihagh (2021) researched the application of virtual maritime technologies. Yet, there is no exploration of how these technologies are utilized in Southeast Asia, particularly in the Makassar Strait region. Xing, Li, Jiang, & Jia (2020) also conducted research in this domain, yet there has not been an examination of their implications in this specific geographical area. Therefore, this study endeavors to fill these gaps by delving into the potential of virtual maritime technologies within the Southeast Asian context, focusing on the Makassar Strait region. This research aims to provide a holistic understanding of how these technologies can bolster defense strategies, effectively addressing this pivotal maritime corridor's unique challenges and opportunities. It seeks to reconcile the dichotomy often observed in existing literature, advocating for integrating traditional defense methodologies and emerging technologies.

By proposing a holistic defense strategy that combines the strengths of traditional maritime defense measures with cutting-edge virtual maritime technologies, this study provides a more nuanced and adaptive solution to the defense needs of the Indonesian National Capital City. The sentence points out a gap in current maritime defense research. Existing research on maritime defense often focuses on broad principles and strategies applicable to various maritime environments. The research by Bueger, Edmunds, & McCabe (2020) likely highlights the unique characteristics of the Makassar Strait that necessitate a more tailored defense strategy. These unique features could include geography, which is the specific shape, depth, and currents of the strait. Traffic Volume is the high density of commercial and military vessels passing through. The Geopolitical Landscape is the complex relationship between Indonesia and neighboring countries bordering the strait. Threat Landscape is the prevalence of specific maritime threats in this region (e.g., piracy, terrorism). Due to the unique characteristics of the Makassar Strait, existing general maritime defense strategies might not fully address the specific challenges and opportunities this region presents. A lack of research delves into how

these general principles can be adapted and implemented considering the specific context of the Makassar Strait. The current research on maritime defense focuses on broad ideas that might not be enough for a complex and strategically important waterway like the Makassar Strait. More research is needed to understand the unique challenges of this region and develop tailored defense strategies that effectively address them. This study addresses this gap by conducting a detailed analysis of the Makassar Strait's geopolitical and maritime characteristics, offering insights into the customization of virtual maritime technology solutions to suit the defense challenges posed by this strategic waterway.

Existing maritime defense literature, according to Rubin & Eiran (2019), often emphasizing individual nation-state strategies. This might neglect the inherent interdependence of maritime security. The security of one nation's waters is usually linked to the security of its neighbors. For example, threats in the Makassar Strait could impact countries beyond Indonesia. Collaborative frameworks encourage information sharing where nations can share intelligence on potential threats, suspicious activities, and best practices. Joint operations, such as coordinated patrols, exercises, and threat responses, can be more effective. Resource sharing is when countries can share resources like technology, expertise, and manpower to strengthen their collective defense posture. By examining successful examples of collaboration in other regions and proposing mechanisms for collective defense in the Makassar Strait, this study aims to address this gap. This could involve establishing protocols for communication, information sharing, and coordinated actions among nations bordering the strait.

Current research on VMT might primarily focus on its technical capabilities and potential benefits for defense. Siebels (2020) highlights the need to address the ethical implications of deploying VMT. These concerns could include privacy which VMT systems might collect vast amounts of data, raising questions about privacy rights and potential misuse. Autonomy and decision-making, which rely on autonomous VMT systems raise concerns about who is ultimately responsible for decisions made by these systems. Weaponization is the potential for using VMT for offensive purposes requires careful consideration and ethical guidelines. Regulatory challenges, as VMT is a relatively new technology, there might be a lack of clear regulations governing its development, deployment, and use. This could lead to inconsistencies and raise concerns about accountability and international cooperation. While this specific point does not mention a direct contribution, it suggests future research needs to explore these ethical and regulatory challenges alongside the benefits of VMT. This ensures a responsible and ethical implementation of VMT for maritime defense. These points highlight areas where current maritime defense literature might be lacking. The first emphasizes the importance of collaborative frameworks to address the interconnected nature of maritime security. The second encourages considering the ethical and regulatory implications of deploying new technologies like virtual maritime technology.

This research recognizes the importance of ethical considerations and regulatory frameworks, thoroughly examining these aspects. This study contributes to a more responsible and accountable integration of advanced technologies into maritime defense strategies. While some studies discuss theoretical concepts and frameworks, there is often a gap in providing practical and actionable policy recommendations for implementing new defense strategies. This study aims to fill this void by offering specific and realistic policy recommendations that can guide policymakers, defense experts, and stakeholders in effectively incorporating virtual maritime technology into the defense infrastructure of the Indonesian National Capital City (IKN) and the Makassar Strait. By

addressing these gaps in the existing literature, this study provides a more nuanced, region-specific, and practically applicable analysis of defense strategies, leveraging virtual maritime technologies for the IKN and the critical maritime passage of the Makassar Strait. The research problem involves identifying and effectively addressing the distinctive threats within the Makassar Strait. This necessitates a focus on enhancing Indonesia's maritime defense strategy through virtual maritime technology.

METHODS

Literature reviews are the backbone of maritime defense research, covering knowledge gaps in defensive methods, virtual maritime technology, and overall maritime defense. A deep understanding of the topic's theoretical underpinnings, real-world applications, and the historical backdrop is ensured by carefully analyzing academic publications, reports, and other sources. This study's data analysis is based on a literature synthesis. The systematic organization and evaluation of pertinent data may achieve insights, patterns, and well-informed judgments.

This study primarily used the literature review approach to research and assess the most current results about defense methods, virtual maritime technology, and maritime defense. This approach was chosen because it was necessary to understand the philosophy, history, and reasons for the use of virtual maritime technology in the Makassar Strait defense strategy. The sample used several relevant published works, including scholarly articles and reports from various internet sources, including academic databases like Google Scholar. Google Scholar and comparable databases were searched for various academic articles to ensure a thorough and current comprehension of the issue.

By including reputable sources like government records and peer-reviewed books, the literature review improved its credibility and validity. Makassar Strait experts combed through reams of research on maritime defense, virtual maritime technologies, and defensive strategies. The method iterated by checking that sources were relevant to the study's aims, evaluating abstracts, and refining search queries. Results, analyses, and supporting evidence from the literature were reviewed to gather the data. The research questions were painstakingly developed to guide the literature review and cover all the bases. This study aimed to learn more about the Makassar Strait's geopolitical importance, assess the efficacy of traditional defense strategies, weigh the pros and downsides of virtual maritime technology, and suggest ethical and collaborative ways to integrate them.

RESULT AND DISCUSSION

This section discusses the problem of national defense, including those of society, economics, politics, and technology defense is complicated and needs a comprehensive strategy to address any threats. The following components of a comprehensive defense framework may be used to evaluate the military strategy of the Indonesian National Capital City (Joshi, Mazumdar, & Dey, 2020). The military's assets need to be upgraded and deployed correctly. The prosperity of a country determines the defense of its inhabitants. Economic factors, such as resource allocation, industrial capacity, and resistance to economic shocks connected to defense, would be included in the theory's examination of defense. An analysis of the political atmosphere, diplomatic ties, and internal stability is required to ensure that the government can respond cohesively to defense concerns. There has to be an awareness of the social fabric, national unity, and

preparations to ensure that the people can endure and overcome defense challenges (Stoeckl, 2022).

Given the modern nature of defense challenges, technology is essential. This calls for cutting-edge innovation like AI, virtual maritime technology capabilities, and improved monitoring systems to fortify the military strategy. The emphasis in today's defense landscape is on managing perceptions and protecting data. Information warfare, cyber defense, and communication tactics are necessary to combat misinformation and preserve public confidence. Prioritizing the protection of essential infrastructure should be the first concern. Data centers, transit hubs, and power plants are all examples of such facilities. According to this point of view, protecting these essential parts of the country's infrastructure should be the top priority.

It is critical to stress the importance of global and regional relationships and cooperation (Chica, Imbachi, & Vega, 2020). Forming coalitions and establishing cooperative defense frameworks are two potential means of fortifying the defenses. Analysts and lawmakers could better grasp these interdependent parts by using the comprehensive defense paradigm. This gives the impression that the Indonesian National Capital City's defense plan may be all-encompassing and adaptable. This strategy addresses the country's many difficulties in today's defense context by merging virtual maritime technology capabilities into a more comprehensive framework. This condition supports and strengthens previous research conducted by Elonheimo (2021). This research proposes a more robust and flexible maritime defense strategy for Indonesia by incorporating virtual maritime technologies into their existing plans. This approach is seen as a way to address the various security challenges the country faces today. By potentially building upon previous research (Elonheimo's work), this study aims to strengthen existing knowledge and propose practical solutions.

Makassar Strait as a Maritime Corridor

The strategic importance of the Makassar Strait as a maritime corridor is enhanced by its placement between Borneo and Sulawesi (Rahman, Noor, & Kosandi, 2023). Because of its strategic location, it serves as a link in the international maritime linkages between the Celebes Sea and the Java Sea. A comprehensive analysis of the complex features of the Makassar Strait is necessary for understanding the effects on geopolitics, economy, and defense. The Makassar Strait has emerged as a worldwide political flashpoint due to the claims of several nations to it (Hapsari, Syamsuddin, Riyantini, & Sunarto, 2021). The Makassar Strait is contested due to its strategic location near economic centers and abundant natural resources. The easing of shipping commodities over the Makassar Strait has a multiplier effect on economic activity. It is critical to implement a defense plan that decreases defense concerns while ensuring the ongoing flow of products, considering its importance in enabling maritime trade. For the entire military position to be strengthened, an examination of the economic aspects of the Makassar Strait is necessary.

The importance of regional security issues and computer-based tools, particularly virtual maritime technology, cannot be overstated in today's dynamic geopolitical landscape. This section delves into the intricacies of regional defense issues, aiming to provide a comprehensive understanding of the evolving threats. With the Makassar Strait emerging as a strategically vital maritime corridor, it becomes imperative to scrutinize its challenges' complexities. The study lays the groundwork for leveraging virtual maritime technology, recognizing its potential to address the multifaceted security concerns prevalent in the region. Integrating digital and computer-based tools, such as

simulations and systems, with maritime operations marks the essence of virtual maritime technology. This innovative approach offers many benefits, ranging from providing realistic training environments for maritime personnel to facilitating the practice of essential skills like navigation, ship handling, and crisis management in a safe and controlled setting. Such immersive training environments not only enhance the capabilities of maritime professionals but also contribute to the overall readiness and preparedness of maritime forces operating in the Makassar Strait.

In formulating a technologically sophisticated defense strategy tailored to the regional context, it is imperative first to grasp the geopolitical, economic, and defense risks inherent in the Makassar Strait. This foundational understanding serves as the cornerstone for crafting effective security measures that are responsive to emerging threats and aligned with broader national and international security objectives. The insights gleaned from this analysis are crucial for policymakers, military strategists, and maritime stakeholders alike in navigating the complex security landscape of the Makassar Strait and safeguarding its strategic significance. Recognizing virtual maritime technology as a strategic enabler for enhancing maritime security underscores the importance of integrating cutting-edge technological solutions into defense planning and operations. This assertion finds support and reinforcement in prior research by Ahmad, Abdulah, Pujarama, & Juniftha (2023), further substantiating the relevance and significance of leveraging advanced digital tools to pursue maritime security objectives. For a long time, traditional naval defense strategies have supported the defense of the maritime environment (Dipua, Harahap, Puspitawati, Aminuddin, & Prakoso, 2021). However, these traditional answers need a complete reassessment since modern defense threats constantly change. The need for creativity and flexibility is shown by assessing the pros and cons of conventional defensive tactics. This study also acknowledges the historical relevance of these techniques. Naval troops, coastal patrols, and monitoring systems have long been vital in safeguarding the maritime environment. Preventing maritime accidents and protecting territorial integrity are the primary goals of these activities (McCabe, Sanders, & Speller, 2019). However, the section delves into the issues with these standard approaches, mainly when dealing with the non-traditional and asymmetrical threats becoming more common in the sea.

Traditional maritime defense systems have been around for quite some time, and their dependable performance in past conflicts is based on their designs and proven usefulness in different battles. Dependability in traditional maritime defense systems is attributed to their established designs and demonstrated effectiveness in previous conflicts (Mohan, Dixit, Gyaneshwar, Chadha, Srinivasan, & Seo, 2022). Enhancing naval capabilities may enhance the capacity to respond to and evade external threats. On the other hand, non-state actors, new technologies, and unconventional defense threats are complicated and ever-evolving, so these steps may not be enough. The ever-changing nature of global crime, including piracy, needs a new strategy for defense. The study acknowledges these dynamics, which emphasizes the necessity of new ideas to complement traditional techniques.

Protecting the Makassar Strait will soon be possible thanks to cutting-edge virtual maritime technology. It is necessary to assess the pros and cons of this strategy given the evolving character of defense threats and the limitations of relying only on traditional maritime defense tactics. Incorporating virtual maritime technology as an integral and supplemental component of the contemporary defense strategy for the Makassar Strait, this study lays the groundwork for executing state-of-the-art technological solutions. This study underscores the need to adapt defense strategies to meet the challenges of modern

threats, recognizing the transformative potential of virtual maritime technology in enhancing maritime security. It builds upon previous research on virtual maritime technology, such as the work by Xing et al., (2020), which explored the potential applications of these technologies to strengthen further the argument for leveraging advanced technological solutions in safeguarding the Makassar Strait. This research lays the groundwork for effectively utilizing virtual maritime technology as a vital component of the defense framework for protecting this critical maritime route.

The present status of maritime defense is complicated, making integrating state-of-the-art technologies critical. Explaining its theoretical underpinnings demonstrates that virtual maritime technology is significant and practical. This opens the door to a paradigm shift in maritime defense strategies and enhances defense in the Makassar Strait. By incorporating many cutting-edge technologies, virtual maritime technology enhances conventional defensive strategies. The combination of several technologies results in a more extensive and flexible framework than conventional maritime defense measures. When conventional approaches to countering asymmetric threats, illegal operations, and non-state actors are ineffective, virtual sailing becomes a game-changer.

Any current defense strategy must include it because it can adapt to changing threat situations, operate autonomously, and give real-time data. Theoretically, virtual maritime technology will be explored to comprehend its relevance to the Makassar Strait better. Incorporating the best of both traditional and contemporary knowledge into a complete defense strategy is emphasized in this section. Future studies will use this theoretical framework to show how virtual maritime technology might help Indonesia fortify its defenses in the strategically vital Makassar Strait, home to the country's capital. This argument aligns with previous research conducted by Liu et al., (2020), further reinforcing the importance of incorporating virtual maritime technology into defense strategies for maritime security enhancement.

Integration of Makassar Strait Virtual Maritime Technology

The concept of this study is a challenge to traditional defense measures in the Makassar Strait via the integration of virtual maritime technology solutions (Fauville, Queiroz, Hambrick, Brown, & Bailenson, 2021). This part will examine the benefits and drawbacks of using virtual maritime technology, utilizing the Makassar Strait as an example. Reviewing past case study data and incorporating knowledge gained from comparable maritime situations sheds light on the revolutionary possibilities of virtual maritime technology. Concerns about piracy, illegal fishing, and smuggling in the Makassar Strait may be best addressed in this manner (Zulkifli, Ibrahim, Rahman, & Yasid, 2020). The technical preparedness, infrastructural needs, and adaptation of virtual maritime technology solutions to the Makassar Strait will be assessed to ascertain the practicability of deploying virtual maritime technology. This entails taking stock of technological resources, such as AI expertise, the number of high-tech sensors at disposal, and unmanned systems. Before deciding on the virtual maritime technology potential of the area, it is crucial to assess the current infrastructure and consider the logistical obstacles. Directly using virtual maritime technology has its difficulties, which are discussed in this piece (Julian, Hadinata, Prakoso, Prihantoro, & Putra, 2023).

Support from the public, regulatory frameworks, and the involvement of stakeholders are all factors that might act as roadblocks. Recognizing these challenges provides a realistic evaluation of the complexity to aid in informed planning and decision-making. Case studies demonstrate that illegal activities have been reduced, maritime defense has been increased, and reaction times have been shortened through virtual

maritime technology. Some possible uses in the Makassar Strait demonstrating the revolutionary impacts of virtual maritime technology (Prayoga, 2022). Modern sensors allow virtual maritime technologies to keep a closer eye on vital maritime routes, while autonomous gadgets allow quick responses and predictive analysis powered by artificial intelligence. This study's crucial claim, demonstrated in this part, is that virtual maritime technology may affect the Makassar Strait. According to our comprehensive feasibility study, virtual maritime technology should form the basis of the defensive plan for the Indonesian National Capital City in the Makassar Strait, supported by data from previous case studies (Shen, Zhang, Yang, & Jia, 2019).

To secure the Makassar Strait effectively, it is necessary to work together and form strategic alliances since maritime defense is inherently interdependent. This cooperation mechanism is crucial to integrating virtual maritime technology into the broader military structure. No country can ignore its joint responsibility to safeguard the maritime environment. By exchanging data, resources, and knowledge, nations may strengthen their naval defense capabilities. This condition supports and strengthens previous research conducted by Tan, Niu, & Zhang (2020), this approach emphasizes the importance of collaboration among nations to address shared security threats. The basis of this research is formed by collaborations that have proved fruitful in a variety of maritime environments throughout the globe. Collaboration between public and commercial sectors and non-governmental organizations (NGOs) has been demonstrated via case studies of joint ventures in the maritime industry. Studying these methods is essential to create collaborative strategies for the Makassar Strait. Collaboration and strategic alliances can potentially improve maritime defense in the Makassar Strait. If information sharing, synchronized patrols, and coordinated response systems are encouraged, countries in the area can work together to face maritime threats.

This passage highlights the potential benefits of collaboration and strategic alliances in enhancing maritime defense capabilities, particularly in protecting the Makassar Strait. By bringing together various stakeholders, including defense agencies, research institutions, and other relevant entities, current defense protocols can be strengthened, creating an environment conducive to introducing cutting-edge virtual maritime technologies. Strategic partnerships with research institutions offer the opportunity for better integration and utilization of these advanced technologies, addressing regulatory obstacles, unreliable deployment methods, and underutilized capabilities.

Pooling the skills and resources of multiple individuals and organizations enhances the comprehensiveness and coordination of the defensive plan. The study advocates for collaborative defense concepts, drawing on successful deployments observed in previous instances. Recognizing the interconnected nature of maritime threats, the coordinated effort aims to establish a framework for seamlessly integrating virtual maritime technology into the overall defensive architecture of the Indonesian National Capital City. This argument aligns with previous research by Putri et al. (2021), further reinforcing the importance of collaborative defense strategies and the integration of advanced technologies in safeguarding critical maritime routes like the Makassar Strait. By emphasizing collaboration and coordination among various stakeholders, the paper advocates for a holistic approach to maritime defense, laying the groundwork for effectively utilizing virtual maritime technology in enhancing security measures.

The Makassar Strait Cyber-Maritime Cooperation

As mentioned in the previous section, the defense plan for the Makassar Strait must follow strict regulatory frameworks and standards for all maritime technology to navigate uncharted seas effectively. By addressing privacy concerns, increasing transparency, and adhering to international norms, this study offers a future vision for virtual seafaring that prioritizes its ethical and responsible usage. This section lays the groundwork for ethical deployment before getting into the nitty-gritty of rules and regulations. Protecting individuals' rights, privacy, and adherence to existing ethical norms might help allay fears about the possible moral consequences of defense-related technology. This study contends that thorough regulations are required to guarantee the moral application of virtual sailing. These standards would establish virtual maritime technology's capabilities, restrictions, and defense features for appropriate usage. To ensure the deployment does not go against national values or ethical norms, we are trying to provide decision-makers with a clear framework. To alleviate privacy problems, users of virtual maritime technology need robust legal frameworks. This article will examine several legislative suggestions that limit data collection and storage, promote responsible use of surveillance technologies, and safeguard individuals' privacy rights.

By directly addressing privacy issues, the legislative framework aims to gain public approval and confidence in integrating virtual maritimes into military strategy. Ethical deployment requires transparency. One way to make virtual maritime technology's deployment procedures, operating rules, and evaluations more transparent would be to make them publicly available. Additionally, an examination is undertaken concerning the ethical considerations surrounding the administration and implementation of virtual maritime technology. This examination underscores the necessity of updating regulatory frameworks to align with contemporary standards in maritime defense, a matter of global relevance impacting diverse populations. Within the broader context of global initiatives to ensure maritime defense while upholding principles of sovereignty and international law, virtual maritime technology is employed in the Makassar Strait. This development corroborates and reinforces prior investigations by Moshiul, Mohammad, & Hira (2023).

In keeping with established protocols, international collaboration among various stakeholders is necessitated. The research addresses ethical dilemmas, privacy implications, and adherence to international norms through advocacy for implementing legal frameworks and regulations to ensure that the integration of modern technology aligns with current ethical benchmarks. This framework may be instrumental in policymakers and other vested parties guiding decision-making processes. Subsequently, the fundamental aspects of the defensive strategy for the Makassar Strait will be delineated, focusing on utilizing virtual maritime technology.

Robust legal and regulatory frameworks are necessary to address the ethical challenges of using innovative technologies to protect the seas. Regulatory frameworks could include guidelines from maritime governing bodies, industry standards, and protocols for the ethical use of technology. Recognizing the need for appropriate deployment was the first step in our investigation into the ethical concerns raised by virtual maritime technology. Adherence to global standards is essential for promoting collaboration and adhering to established norms. This research studied the current ethical context, national norms, and international regulations, with significant effort dedicated to examining the integration of virtual maritime technologies in the Makassar Strait. Emphasis is placed on how implementing modern innovation necessitates moral ideals and suitable leadership styles. This condition is supported and reinforced by previous research by Hofman, Walters, & Hughes (2022).

CONCLUSIONS, RECOMMENDATIONS, AND LIMITATIONS

In conclusion, Indonesia can tailor its maritime defense strategy to address threats in the Makassar Strait by enhancing its virtual maritime technology. These AUVs utilize advanced AI algorithms and sophisticated sensor arrays to autonomously navigate and survey the ocean floor, providing valuable data for applications such as offshore exploration, environmental monitoring, and underwater infrastructure inspection. By leveraging these advanced technologies, Indonesia can strengthen its maritime surveillance, response capabilities, and overall defense posture.

The development of new technologies often outpaces creating and updating legislation, resulting in a lag between technological innovations and regulatory responses. Due to their inherent flexibility, it may be challenging to develop static regulations that adequately oversee the varied uses of virtual maritime technology capabilities. While carefully watching new technical and ethical concerns, legislators should evaluate and amend legislative frameworks regularly. The possible ethical concerns of bringing virtual maritime technology into the Makassar Strait can be addressed among the suggested regulations and restrictions. The research primarily focuses on the Makassar Strait region, potentially limiting the generalizability of findings to other maritime areas.

REFERENCES

Acosta, L. A., Maharjan, P., Peyriere, H. M., & Mamiit, R. J. (2020). Natural Capital Protection Indicators: Measuring Performance in Achieving the Sustainable Development Goals for Green Growth Transition. *Environmental and Sustainability Indicators*, *8*, 1–21. https://doi.org/10.1016/j.indic.2020.100069

Ahmad, T., Abdulah, R., Pujarama, R. A., & Juniftha, D. Y. (2023). The Impact of Seaport Activities on Growth: Evidence from Indonesia. *Economics Development Analysis Journal*, *12*(3), 355–369. https://doi.org/10.15294/edaj.v12i3.46580

Bueger, C., Edmunds, T., & McCabe, R. (2020). Into The Sea: Capacity-Building Innovations and The Maritime Security Challenge. *Third World Quarterly*, *41*(2), 228–246. https://doi.org/10.1080/01436597.2019.1660632

Chica, J. C. C., Imbachi, J. C., & Vega, J. F. B. (2020). Security in SDN: A Comprehensive Survey. *Journal of Network and Computer Applications*, *159*(4). https://doi.org/10.1016/j.jnca.2020.102595

Dipua, A., Harahap, N., Puspitawati, D., Aminuddin, F., & Prakoso, L. Y. (2021). Sea Defense Strategy The Indonesian Navy in Dealing With The South China Sea Conflict. *Italienisch*, *11*, 120–126. Retrieved from https://www.researchgate.net/publication/351152737_sea_defense_strategy_the_indonesian_navy_in_dealing_with_the_south_china_sea_conflict

Elonheimo, T. (2021). Comprehensive Security Approach in Response to Russian Hybrid Warfare. *Strategic Studies Quarterly*, *15*(3), 113–137. Retrieved from https://www.airuniversity.af.edu/portals/10/ssq/documents/volume-15_issue-3/elonheimo.pdf

Fauville, G., Queiroz, A. C., Hambrick, L., Brown, B. A., & Bailenson, J. N. (2021). Participatory Research on Using Virtual Reality To Teach Ocean Acidification: A Study in The Marine Education Community. *Environmental Education Research*, *27*(2), 254–278. https://doi.org/10.1080/13504622.2020.1803797

Gani, I., Auliansyah, A., Gaffar, E. U. A., Muliati, M., Aprianti, Y., & Rachmadi, R. F. R., Agustina, N. I. (2022). Makassar Strait Area Development in Indonesia Based on the Marine Economy Sector. *Economies*, *10*(8), 1–18.

https://doi.org/10.3390/economies10080195

Hapsari, S. N., Syamsuddin, M. L., Riyantini, I., & Sunarto, S. (2021). Seasonal Variations of Sea Surface Temperature and Sea Current in the Celebes Sea. *World News of Natural Sciences*, *35*, 135–143. Retrieved from https://bibliotekanauki.pl/articles/1031483.pdf

Hofman, K., Walters, G., & Hughes, K. (2022). The Effectiveness of Virtual Vs Real-Life Marine Tourism Experiences in Encouraging Conservation Behaviour. *Journal of Sustainable Tourism*, *30*(2), 742–766. https://doi.org/10.1080/09669582.2021.1884690

Joshi, M., Mazumdar, B., & Dey, S. (2020). A Comprehensive Security Analysis of Match-In-Database Fingerprint Biometric System. *Pattern Recognition Letters*, *138*, 247–266. https://doi.org/10.1016/j.patrec.2020.07.024

Julian, J., Hadinata, T., Prakoso, L. Y., Prihantoro, K., & Putra, D. (2023). Utilization of AIS Satellite Data as Behavior Information Towards Interruption Violations in the Makassar Straits. *Jurnal Keamanan Nasional*, *9*(1), 1–16. Retrieved from https://ejurnal.ubharajaya.ac.id/index.php/kamnas/issue/view/129/41

Liu, Y., Lan, Z., Cui, J., Krishnan, G., Sourina, O., Konovessis, D., & Mueller-Wittig, W. (2020). Psychophysiological Evaluation of Seafarers to Improve Training in Maritime Virtual Simulator. *Advanced Engineering Informatics*, *44*, 101048. https://doi.org/10.1016/j.aei.2020.101048

Markopoulos, E., & Luimula, M. (2020). Immersive Safe Oceans Technology: Developing Virtual Onboard Training Episodes for Maritime Safety. *Future Internet*, *12*(5), 1–12. https://doi.org/10.3390/fi12050080

McCabe, R., Sanders, D., & Speller, I. (2019). *Europe, Small Navies And Maritime Security: Balancing Traditional Roles and Emergent Threats in the 21st Century*. London: Routledge. https://doi.org/10.4324/9780429286636

Mohan, P. V., Dixit, S., Gyaneshwar, A., & Chadha, U., Srinivasan, K., Seo, J. T. (2022). Leveraging Computational Intelligence Techniques For Defensive Deception: A Review, Recent Advances, Open Problems and Future Directions. *Sensors*, *22*(6), 1–26. https://doi.org/10.3390/s22062194

Moshiul, A. M., Mohammad, R., & Hira, F. A. (2023). Alternative Fuel Selection Framework Toward Decarbonizing Maritime Deep-Sea Shipping. *Sustainability*, *15*(6), 1–37. https://doi.org/10.3390/su15065571

Prayoga, P. (2022). The Indonesian Political-Economy: Maritime Development in Fisheries and Commerce. In *ASEAN Maritime Security* (pp. 43–63). Singapore: Springer. Retrieved from https://www.springerprofessional.de/the-indonesian-political-economy-maritime-development-in-fisheri/23233366

Putri, A. R. S., Zainuddin, M., Musbir, Mustapha, M. A., Hidayat, R., & Putri, R. S. (2021). Spatial Distribution of Potential Fishing Grounds for Skipjack Tuna Katsuwonus Pelamis in the Makassar Strait, Indonesia. *Aquaculture, Aquarium, Conservation & Legislation-International Journal of the Bioflux Society*, *14*(3), 1171–1180. https://www.proquest.com/openview/2e924410415d81e657874105ef47a67a/1?pq-origsite=gscholar&cbl=2046424

Quirapas, M. A. J. R., & Taeihagh, A. (2021). Ocean Renewable Energy Development in Southeast Asia: Opportunities, Risks and Unintended Consequences. *Renewable and Sustainable Energy Reviews*, *137*, 1–15. https://doi.org/10.1016/j.rser.2020.110403

Rahman, A. R., Noor, F., & Kosandi, M. (2023). New Capital City's Geopolitical Landscape. In *Assembling Nusantara: Mimicry, Friction, and Resonance in the New Capital*

Development (pp. 215–229). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-99-3533-8_15

Rubin, A., & Eiran, E. (2019). Regional Maritime Security in The Eastern Mediterranean: Expectations and Reality. *International Affairs*, *95*(5), 979–997. https://doi.org/10.1093/ia/iiz146

Shen, H., Zhang, J., Yang, B., & Jia, B. (2019). Development of an Educational Virtual Reality Training System for Marine Engineers. *Computer Applications in Engineering Education*, *27*(3), 580–602. https://doi.org/10.1002/cae.22099

Siebels, D. I. R. K. (2020). *Maritime Security in East and West Africa*. London: Springer.

Stoeckl, K. (2022). Russia's Spiritual Security Doctrine as a Challenge to European Comprehensive Security Approaches. *The Review of Faith & International Affairs*, *20*(4), 37–44. https://doi.org/10.1080/15570274.2022.2139536

Sun, N., Ding, M., Jiang, J., Xu, W., Mo, X., Tai, Y., & Zhang, J. (2023). Cyber Threat Intelligence Mining for Proactive Cybersecurity Defense: A Survey and New Perspectives. *IEEE Communications Surveys & Tutorials*, *25*(3), 1748–1774. https://doi.org/10.1109/comst.2023.3273282

Tan, Y., Niu, C., & Zhang, J. (2020). Head-Mounted, Display-Based Immersive Virtual Reality Marine-Engine Training System: A Fully Immersive and Interactive Virtual Reality Environment. *IEEE Systems, Man, and Cybernetics Magazine*, *6*(1), 46–51. https://doi.org/10.1109/msmc.2019.2948654

Xing, K., Li, A., Jiang, R., & Jia, Y. (2020). A Review of Apt Attack Detection Methods And Defense Strategies. *In 2020 IEEE Fifth International Conference on Data Science in Cyberspace (DSC)*, 67–70. https://doi.org/10.1109/dsc50466.2020.00018

Zulkifli, N., Ibrahim, R. I. R., Rahman, A. A. A., & Yasid, A. F. M. (2020). Maritime Cooperation In The Straits Of Malacca (2016-2020): Challenges and Recommend for A New Framework. *Asian Journal of Research in Education and Social Sciences*, *2*(2), 10–32. Retrieved from https://myjms.mohe.gov.my/index.php/ajress/article/view/9601