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Maritime Geostrategy: Managing Risks and Opportunities in the Strait of Malacca as a Primary International Supply Chain Route

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Abstract

The This research analyzes the risks, opportunities, management strategies, and the role of maritime geostrategy in the management of the Strait of Malacca as a primary international supply chain route. The findings indicate that the Strait of Malacca faces significant maritime security threats, traffic congestion, and impacts from climate change, which affect the stability of maritime transportation. Risk management strategies through UNCLOS, ReCAAP, and the Malacca Straits Patrol have proven effective but still face operational challenges. Strategic opportunities are identified through the development of port infrastructure and the adoption of modern logistics technology. Geopolitical dynamics between coastal states and major powers, such as the US and China, influence regional stability and the sustainability of the global supply chain. This study recommends multilateral collaboration, sustainable investment in infrastructure, and the adoption of technology to enhance the efficiency and security of maritime transportation. With a holistic approach, the Strait of Malacca can continue to play its role in supporting an efficient and sustainable international supply chain.

Keywords: Maritime Geostrategy, Strait of Malacca, Risk, Opportunity, Supply Chain.

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INTRODUCTION

The Strait of Malacca (SOM) is one of the world's busiest waterways, connecting the Indian Ocean and the Pacific Ocean, with approximately 80,000 vessels transiting it annually (Sumathy and Ravichandran, 2024). The strait stretches over 600 miles and serves as a vital link between the Indian Ocean and the South China Sea, facilitating the movement of goods between the Middle East, Europe, and Asia (Sumathy and Ravichandran, 2024). The strategic importance of the Malacca Strait derives not only from its historical role as a major trade route but also from its value in supporting modern international shipping (Sumathy and Ravichandran, 2024). Historically, the Strait of Malacca has played a pivotal role in international trade, supporting the development of Malay kingdoms and surrounding port cities (Siddhima, 2024). Its strategic significance also made it an object of control by Western maritime powers such as the Portuguese, Dutch, and British (Siddhima, 2024). For coastal states like Indonesia, Malaysia, and Singapore, maritime security governance in the Strait of Malacca is a primary priority to protect their sovereign and economic interests, while also fulfilling international legal obligations under UNCLOS (Siddhima, 2024).

The maritime geostrategic dynamics in the Strait of Malacca create complexities in managing this region as an international supply chain route (Xiaoxue et al., 2023). Coastal states such as Indonesia, Malaysia, and Singapore have strategic interests that often overlap, whether in terms of economy, security, or sovereignty (Xiaoxue et al., 2023). On the other hand, the involvement of major powers like the United States and China in maintaining access to this shipping lane adds an increasingly complex geopolitical dimension (Xiaoxue et al., 2023). Geopolitical tensions arising from competition in this region can disrupt stability and hinder the smooth flow of maritime transportation, thus requiring a strategic approach that includes maritime diplomacy and more effective geopolitical risk management (Xiaoxue et al., 2023).

Furthermore, coastal states face significant challenges in balancing their national interests with the need for international cooperation (Rheny, 2021). The successful management of the Strait of Malacca depends not only on unilateral policies but also on solid multilateral coordination to maintain regional stability and the efficiency of the global supply chain (Rheny, 2021). Maritime diplomacy becomes a critical tool to minimize conflict and maximize interstate cooperation, especially when facing pressure from global actors with significant influence in the region (Rheny, 2021). This research is necessary to provide a deeper understanding of how maritime geostrategy influences the management of the Strait of Malacca and how effective diplomatic approaches can support the sustainability of the international supply chain.

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On the other hand, climate change adds complexity to the issue by threatening marine ecosystems and transport infrastructure, such as sea-level rise and increased storm intensity, which can disrupt operations in the strait (Siddhima, 2024). Climate change risks not only affect coastal states like Indonesia, Malaysia, and Singapore but also have widespread impacts on global economic stability, which is heavily dependent on the smooth functioning of the supply chain in the Strait of Malacca (Wisha et al., 2023; Hendra et al., 2024). Therefore, this research is crucial to identify and analyze these various strategic risks in order to provide relevant management recommendations to support the sustainability and efficiency of the international supply chain.

Global dependence on the Strait of Malacca entails various significant strategic risks, such as maritime security threats, including piracy, terrorism, and cyber-attacks (Terence, 2015). These threats not only disrupt transport stability but also increase logistical costs and create uncertainty in the international supply chain (Terence, 2015). This condition necessitates effective risk management strategies to maintain the operational fluidity of the global supply chain. In addition to security threats, the high volume of vessel traffic in the Strait of Malacca often causes congestion, which directly impacts the efficiency of maritime transportation (Laode, 2015).

In this context, international regulations such as UNCLOS and regional initiatives like ReCAAP are crucial as legal frameworks and operational guidelines to ensure stability and security in the region. Furthermore, regional collaboration through coordinated patrols among Indonesia, Malaysia, and Singapore has become an important model for addressing these threats, although challenges in implementation and effectiveness still exist. Moreover, technological advancements, such as the use of early warning systems, artificial intelligence-based surveillance technology, and data analytics, offer significant potential to address threats in a more proactive and efficient manner. Therefore, this study is necessary to evaluate existing risk management strategies, identify their weaknesses, and propose innovative measures that can enhance security and transport efficiency in the Strait of Malacca.

The development of port and logistics infrastructure in the Strait of Malacca offers significant opportunities to address current challenges in maritime transport efficiency and capacity. Many ports in the region, despite their strategic locations, still face constraints in terms of technology and the capability to handle increasing trade volumes. The application of logistics digitalization and artificial intelligence (AI) emerges as a potential solution to enhance transparency, speed, and operational efficiency, both in cargo management and navigation. On the other hand, a lack of international coordination in joint management often becomes an impediment to achieving optimal synergy in the global supply chain. Closer cross-border

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collaboration among Indonesia, Malaysia, Singapore, and international stakeholders is necessary to ensure transport security and efficiency in this region. This study is warranted to explore these strategic opportunities and provide practical recommendations that can optimize the role of the Strait of Malacca as a more competitive and sustainable international supply chain route.

BRIEF REVIEW OF PREVIOUS RESEARCH

Research conducted by Sumathy and Ravichandran (2024) performs a comparative analysis of the maritime security governance approaches of Indonesia, Malaysia, and Singapore. The study focuses on maritime security governance in the Strait of Malacca, analyzing the responses of Indonesia, Malaysia, and Singapore to security mechanisms such as the Proliferation Security Initiative, the Malacca Straits Patrol, and ReCAAP. Sumathy and Ravichandran (2024) emphasize the strategic importance of the Strait as a critical trade route and examine how sovereign interests, economic factors, and legal obligations influence the coastal states' approaches to maritime security, highlighting their commitment to upholding obligations under UNCLOS while cooperating with international users.

Siddhima (2024) examines the critical role of the Malacca Strait in global trade and the existential threats posed by climate change, particularly for India. The research investigates sea-level rise, increased storm intensity, and coastal erosion, emphasizing their impacts on ecosystems and communities. Based on qualitative analysis, Siddhima (2024) advocates for adaptive strategies to enhance resilience, ensuring sustainable development amidst climate challenges. Siddhima (2024) also underscores the vulnerability of the littoral states, focusing on India's dependence on this vital waterway for trade, food security, and energy.

Research by Darmawan et al. (2024) focuses on the significance of the Strait of Malacca as a trade hub connecting China's Ming Dynasty with various regions, fostering economic growth and cultural interaction. It highlights the political and trade interdependence between the Malacca Sultanate and the Ming Dynasty during the 15th to 16th centuries, emphasizing diplomatic visits, trade benefits, and military protection. This relationship strengthened Malacca's position as a trade emporium, providing China access to spices while ensuring political security and cultural exchange in the region.

Marjanuddin et al. (2023) examine Indonesia's commitment to maritime governance in the Strait of Malacca, a critical transit corridor plagued by maritime violence and transnational crime. The study highlights the importance of cooperation among coastal states, NGOs, and security actors to combat maritime threats, including terrorism and armed robbery. The research discusses

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coordinated patrols and bilateral agreements among Indonesia, Malaysia, and Singapore, as well as collaboration with the International Maritime Organization (IMO) to enhance preventive and protective measures in the region.

Previous studies provide valuable insights into various aspects of the Strait of Malacca. Sumathy and Ravichandran (2024) highlight the maritime security approaches taken by Indonesia, Malaysia, and Singapore, focusing on mechanisms like the Malacca Straits Patrol and ReCAAP within the context of UNCLOS. Siddhima (2024) centers on the impacts of climate change on the Strait of Malacca, particularly for India, emphasizing the need for adaptive strategies for resilience and sustainability. Darmawan et al. (2024) examine the history of the Strait of Malacca as a trade hub during the Ming Dynasty, highlighting the importance of cultural and political interactions for security and economic growth. Marjanuddin et al. (2023) discuss Indonesia's efforts in addressing transnational crime and maritime violence threats through cross-border cooperation and with international organizations.

Although previous research has explored various dimensions of the Strait of Malacca, there remains a need for a more comprehensive analysis that integrates a maritime geostrategy approach with the management of risks and opportunities within the context of the international supply chain. Prior studies have predominantly focused on aspects of maritime security, climate change, trade history, or national policies without deeply exploring the geostrategic implications for the efficiency and sustainability of the global supply chain. With the increasing complexity of geopolitical dynamics, the global supply chain's dependence on the Strait of Malacca, and contemporary challenges such as technology and sustainability, this research is expected to provide new, relevant insights for developing a holistic maritime management strategy.

RESEARCH OBJECTIVES

This study aims to identify and analyze the various strategic risks confronting the Strait of Malacca as a primary international supply chain route, including maritime security threats such as piracy, terrorism, and cyber-attacks that can disrupt maritime transport stability. Furthermore, the research aims to evaluate the risk of vessel traffic congestion resulting from the high volume of trade transiting the strait, as well as to analyze the impacts of climate change on marine ecosystems and transportation infrastructure in the region. Through an in-depth understanding of these risks, this study is expected to provide relevant insights for risk management and mitigation in the Strait of Malacca, thereby supporting the sustainability and efficiency of the global supply chain.

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The study also aims to analyze risk management strategies that can be implemented to enhance security and transport efficiency in the Strait of Malacca. It will evaluate the role of international regulations, such as UNCLOS and ReCAAP, in providing a legal framework and operational guidelines for maintaining stability in this strategic shipping lane. Furthermore, the research intends to examine the importance of coordinated patrols and regional cooperation among coastal states and international users in addressing maritime security threats. The study will also highlight the application of surveillance and threat mitigation technologies, such as early warning systems and artificial intelligence-based surveillance, as innovative measures in risk management within the Strait of Malaka region.

Furthermore, this study aims to identify and explore strategic opportunities that can be leveraged in the Strait of Malacca to enhance international supply chain performance. The research focus includes an analysis of the potential for port and logistics infrastructure development in the region to increase maritime transport capacity and efficiency. Moreover, the study intends to evaluate the role of technological innovations, such as logistics digitalization and artificial intelligence, in optimizing maritime transport management. The research also aims to underscore the importance of international collaboration among coastal states and users of the international waterway to strengthen global supply chain security and efficiency through effective joint management.

Finally, this study aims to analyze the role of maritime geostrategy in influencing the management of the Strait of Malacca as an international supply chain route. The research will explore the geopolitical dynamics involving coastal states such as Indonesia, Malaysia, and Singapore, as well as major powers like the United States and China, in maintaining strategic interests in this region. Furthermore, the study seeks to examine the challenges faced by coastal states in balancing their national interests with the necessity for international cooperation to preserve the stability and efficiency of the shipping lane. The research will also discuss the implications of maritime diplomacy for regional stability, interstate relations, and the sustainability of the global supply chain.

LITERATURE REVIEW

The Concept of Maritime Geostrategy

Maritime geostrategy refers to the strategic approaches adopted by nations concerning their maritime interests, focusing on the sea's importance in national security, trade, and power projection (Xu, Qi et al., 2006). Maritime geostrategy encompasses the analysis of geographical

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factors, naval capabilities, and the interaction between land and sea power (Xu, Qi et al., 2006). Historically, major powers have prioritized maritime strategies to secure trade routes, project military power, and maintain dominance over rival nations, reflecting the pivotal role of the oceans in global geopolitical dynamics (Xu, Qi et al., 2006).

Maritime geostrategy pertains to the strategic considerations and policies related to the control and navigation of maritime routes, particularly in the context of resource distribution, such as petroleum (Rodrigue, 2005). It includes the geographical, political, and economic factors that influence maritime circulation, including the importance of chokepoints, straits, and passages (Rodrigue, 2005). As global trade and energy demand expand, maritime geostrategy becomes increasingly vital for ensuring the safe and efficient transport of resources, highlighting the interaction between geography and international relations (Dwi et al., 2024).

Maritime Risks and Opportunities

Maritime risks and opportunities encompass the challenges and potential benefits associated with the maritime domain (Zaili et al., 2016). Effective management of these elements is critical for advancing and protecting a nation's interests, both domestically and internationally (Zaili et al., 2016). By actively addressing risks, nations can enhance their security and resilience, while also leveraging opportunities to promote prosperity. This dual focus helps to shape a stable world, ensuring that maritime activities contribute positively to national and global interests (Zaili et al., 2016).

The maritime industry also faces significant risks, including economic volatility, regulatory compliance burdens, and sustainability pressures (Indah et al., 2024). These challenges necessitate strategic responses for financial resilience (Indah et al., 2024). However, opportunities exist through enhanced risk management strategies, investment in technological innovation, and the adoption of sustainable practices (Indah et al., 2024). Collaborative industry partnerships and talent development are also essential for navigating these complexities. By addressing these risks and leveraging opportunities, maritime stakeholders can advance towards sustainable growth and competitiveness in the global maritime economy (Indah et al., 2024).

The Role of Maritime Geostrategy in the Supply Chain

Maritime geostrategy plays a pivotal role in shaping global supply chains by influencing the flow of goods, particularly through strategic routes and chokepoints (Wenjie et al., 2021). The global maritime system forms the backbone of logistics operations, facilitating international trade

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and ensuring the efficient movement of containerized and bulk cargo. This strategic importance is underscored by the need to navigate through critical maritime pathways, which are essential for the distribution of key resources like petroleum (Wenjie et al., 2021). The integration of maritime supply chains and the implementation of security measures further enhance network resilience and efficiency (Rodrigue, 2005). While maritime geostrategy is critical in maintaining the flow of goods, it also presents vulnerabilities, especially at chokepoints where disruptions can have significant impacts (Rodrigue, 2005). The strategic importance of these routes requires continuous monitoring and adaptation to geopolitical changes, ensuring that supply chains remain resilient in the face of potential crises (Wenjie et al., 2021).

METHODS

Research Design

This study employs a qualitative research design utilizing a literature review methodology. The objective is to explore and analyze relevant information from various scholarly sources concerning the risks and opportunities in the Strait of Malacca as a primary international supply chain route. The qualitative approach provides a comprehensive overview of the Strait of Malacca's role within the context of geostrategy and the international supply chain, facilitating the exploration of novel strategies that can enhance the efficiency and sustainability of maritime transportation. Furthermore, the literature review enhances the study's credibility by grounding arguments in established and in-depth knowledge, enabling the researcher to build upon prior research effectively (Setiyo et al., 2023). Diverse types of literature reviews are employed to tailor the knowledge synthesis approach to the specific needs of this research, ensuring a relevant analysis of the challenges and opportunities in the Strait of Malacca (Setiyo et al., 2023).

Data Collection

Data collection for this study was conducted using a literature review methodology, which encompasses the identification, analysis, and synthesis of various relevant information sources. Primary data sources included scholarly journals, policy reports, documents from international organizations such as UNCLOS and ReCAAP, and academic articles addressing issues related to maritime geostrategy, security, and the international supply chain in the Strait of Malacca. This process commenced with a literature search via academic databases such as Scopus, Web of Science, and Google Scholar, using specific keywords, including "Strait of Malacca," "maritime geostrategy," "international supply chain," "maritime security," and "maritime risk management."

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This approach ensured a broad and relevant scope of data to support the research objectives.

Once relevant literature was identified, a selection process was undertaken to prioritize the most credible and recent sources, particularly those published within the last five years. An in-depth analysis was conducted to evaluate key findings, identify patterns and trends, and link the existing literature to the research objectives, such as risk management, leveraging strategic opportunities, and the implications of maritime geostrategy for the international supply chain. The collected data were systematically synthesized to provide a comprehensive understanding of the risks and opportunities in the Strait of Malacca. This literature review method not only permitted a critical evaluation of prior research but also aided in identifying research gaps that this study aims to fill, thereby providing theoretical and practical contributions to the management of the Strait of Malika.

Data Analysis

Data analysis in this study was conducted through a systematic qualitative approach using the thematic analysis method. After the data from the literature review were collected, the initial step involved categorizing the information into primary themes corresponding to the research objectives, such as maritime security risks, strategic opportunities in infrastructure development, and the geostrategic implications for the international supply chain. This process involved an in-depth reading of the selected literature to identify patterns, trends, and relevant interrelationships among the findings. Subsequently, each theme was critically analyzed to evaluate its suitability within the Strait of Malacca context, integrate diverse perspectives, and identify gaps that this study could address. The analysis also encompassed the synthesis of arguments from multiple sources to generate a more comprehensive understanding of the management of risks and opportunities in the Strait of Malacca. The results of this analysis were subsequently used to answer the research questions, support the conclusions, and provide strategic recommendations for the management of the international supply chain route in the Strait of Malacca.

RESULTS AND DISCUSSION

Results

The analysis of the literature review indicates that the Strait of Malacca faces several significant strategic risks as a primary international supply chain route (Laode, 2021; Terence, 2015). Maritime security threats constitute one of the main risks, with incidents of piracy, armed

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robbery, and terrorism threats that can disrupt the smooth flow of sea transportation (Laode, 2021; Terence, 2015). Furthermore, cyber-attacks on vessel navigation and communication systems have emerged as a new risk, potentially affecting operational efficiency in this region (Laode, 2021; Terence, 2015). Maritime traffic congestion, resulting from the high volume of international trade transiting the Strait of Malacca, represents another strategic risk, which not only increases shipping times but also contributes to higher logistics costs (Laode, 2021; Terence, 2015). This risk is exacerbated by the limited capacity of port infrastructure and logistics facilities in the coastal states (Laode, 2021; Terence, 2015).

In addition to security and congestion risks, climate change has also been identified as a significant threat affecting maritime transport stability in the Strait of Malacca (Siddhima, 2024). Rising sea levels and increased storm intensity can damage port infrastructure and disrupt goods shipment operations. These environmental impacts also contribute to the degradation of marine ecosystems in the region, which ultimately affects the sustainability of maritime activities (Wisha et al., 2023; Hendra et al., 2024).

Overall, these risks demonstrate the complexity of the challenges facing the Strait of Malacca as a primary international supply chain route, demanding more comprehensive mitigation strategies to ensure the smooth flow of global transportation (Siddhima, 2024).

UNCLOS (United Nations Convention on the Law of the Sea) provides a comprehensive legal framework for managing the security and efficiency of transportation in the Strait of Malacca (Sumathy and Ravichandran, 2024). This convention regulates the rights and obligations of coastal states as well as users of international shipping lanes, including the obligation to ensure maritime safety and security (Nanik et al., 2020). States such as Indonesia, Malaysia, and Singapore, which manage the Strait of Malacca, have utilized guidance from UNCLOS to align their national policies with international law (Nanik et al., 2020). This is evident in the regulation of the Transit Passage system, which allows international vessels to transit safely without infringing upon the sovereignty of coastal states (Nanik et al., 2020). However, the implementation of UNCLOS in the Strait of Malacca still faces challenges in terms of on-the-ground law enforcement, particularly concerning transnational crimes like piracy and smuggling (Femmy et al., 2018).

Besides UNCLOS, regional initiatives such as ReCAAP (Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia) have played a crucial role in supporting risk management in the Strait of Malacca (Sumathy and Ravichandran, 2024). ReCAAP provides a regional collaboration mechanism to address threats of piracy and armed robbery in the region (Rahmadani et al., 2019). The ReCAAP reporting system and its analysis of maritime

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security incidents have helped enhance awareness and response to threats in the Strait of Malacca (Rahmadani et al., 2019). Coastal states have also adopted operational measures such as coordinated patrols through the Malacca Straits Patrol (MSP) program, which involves cooperation among the navies and coast guards of Indonesia, Malaysia, Singapore, and Thailand (Rahmadani et al., 2019). Nevertheless, the effectiveness of ReCAAP and the MSP still requires improvement, particularly in terms of technological system integration and adequate logistical support (Rahmadani et al., 2019).

The research findings indicate that the Strait of Malacca possesses significant strategic opportunities to enhance international supply chain performance, especially through the development of port and logistics infrastructure (Nanik et al., 2020). Coastal states like Indonesia, Malaysia, and Singapore have demonstrated commitment to expanding and modernizing their main ports, such as Port Klang in Malaysia, the Port of Singapore, and Tanjung Priok in Indonesia, to increase cargo handling capacity and operational efficiency. Furthermore, the implementation of modern logistics technologies such as digital-based port management systems, cargo handling automation, and the utilization of artificial intelligence for transport flow optimization has been identified as a key step in strengthening the region's competitiveness (Catherine et al., 2024). Other opportunities include the development of regional logistics centers that can function as international trade hubs, facilitating better integration of the global supply chain. These findings suggest that investment in infrastructure and technology will not only increase transport capacity in the Strait of Malacca but also reinforce its position as a strategic shipping lane supporting global trade growth (Catherine et al., 2024).

The research results show that the maritime geostrategic dynamics in the Strait of Malacca are influenced by the strategic interests of the coastal states namely Indonesia, Malaysia, and Singapore as well as the involvement of major powers such as the United States and China. The coastal states prioritize their sovereignty and national interests in managing this shipping lane, yet they also face pressure to meet the demands of international cooperation to maintain regional stability. On the other hand, the United States and China, as the two largest economic and military powers in the world, leverage the strategic position of the Strait of Malacca to support their trade and defense interests. Geopolitical tensions between these two nations, particularly regarding influence in Southeast Asia, have added challenges for the coastal states in managing the strait in a balanced manner.

In addition to geopolitical dynamics, maritime diplomacy plays an essential role in maintaining regional stability and the sustainability of the global supply chain. Cooperative

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initiatives like the Malacca Straits Patrol and coordination through international organizations such as the IMO (International Maritime Organization) have assisted coastal states in addressing common threats, such as piracy and transnational crime (Yoshua et al., 2024). However, the findings also indicate that balancing national interests with international demands remains a primary challenge (Yoshua et al., 2024). This imbalance is evident in the differing approaches to resource management and security priorities among the coastal states (Yoshua et al., 2024). The implications of these dynamics affect the efficiency of the global supply chain, which is highly dependent on the smooth flow of transport in the Strait of Malacca, while also highlighting the need to strengthen more inclusive multilateral diplomacy and cooperation mechanisms (Yoshua et al., 2024).

DISCUSSION

Strategic risks in the Strait of Malacca are not only multidimensional but also have a significant impact on the fluidity of the international supply chain. Maritime security threats, such as piracy and cyber-attacks, reflect the urgent need for enhanced surveillance and security coordination among coastal states. Currently, efforts like the joint patrols under the Malacca Straits Patrol and initiatives such as ReCAAP have shown positive results, yet challenges in terms of coverage and operational effectiveness persist. The risk of maritime traffic congestion also serves as a critical reminder of the importance of investing in port infrastructure and modern logistics technology, especially given the continuously increasing trade volume in this strategic route. With limited capacity, coastal states face pressure to ensure transport efficiency while maintaining regional economic sustainability.

The impacts of climate change add complexity to risk management in the Strait of Malacca. Rising sea levels and intensifying storms not only threaten maritime infrastructure but also create new challenges in long-term planning for the sustainability of this waterway. In this context, a collaborative approach involving coastal states, international users, and global organizations is imperative for developing effective adaptation strategies (Wisha et al., 2023; Hendra et al., 2024). This study indicates that a combination of enhanced infrastructure capacity, adoption of risk mitigation technologies, and maritime diplomacy could be a potential solution for managing risks in a more integrated manner. Thus, this discussion affirms the importance of holistic risk management to maintain the stability and efficiency of the international supply chain in the Strait of Malacca.

Risk management strategies in the Strait of Malacca have been facilitated by international

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legal frameworks such as UNCLOS (Sumathy and Ravichandran, 2024) and regional initiatives like ReCAAP (Rahmadani et al., 2019), which provide a foundation for maintaining security and transport efficiency in this shipping lane. Although efforts like the Malacca Straits Patrol have helped reduce maritime security threats, challenges in law enforcement and operational integration still require further attention.

The use of modern surveillance technology such as satellite-based early warning systems, maritime surveillance radar, and artificial intelligence is an integral part of the risk management strategy in the Strait of Malacca. These technologies enable more accurate monitoring of vessel activities, early detection of security threats, and more efficient traffic management. Several coastal states have integrated these technologies into their operational systems to improve transport efficiency and prevent security disruptions. Nonetheless, the adoption of these technologies remains limited in some areas, thereby creating gaps in risk management across the entire Strait of Malacca region. This finding underscores the need for better coordination among coastal states to comprehensively integrate advanced technologies and enhance the effectiveness of risk management strategies in this international shipping lane.

The research findings indicate that the development of port and logistics infrastructure in the Strait of Malacca offers significant opportunities to improve the efficiency of the international supply chain. Investments made by coastal states, such as the modernization of Port Klang, the Port of Singapore, and Tanjung Priok, demonstrate tangible efforts to increase cargo handling capacity and speed. More advanced infrastructure not only reduces vessel waiting times but also lowers logistics costs, which ultimately enhances the region's competitiveness in international trade. However, the success of this development requires closer collaboration among nations to integrate their logistics networks, ensure smoother connectivity between ports, and create synergy in managing the global supply chain.

In addition to physical infrastructure, the use of advanced technologies such as the digitalization of port management, automation of cargo handling, and artificial intelligence for maritime transport optimization provides significant added value (Catherine et al., 2024). These technologies enable ports in the Strait of Malacca region to enhance operational efficiency, transparency, and accuracy in supply chain management (Catherine et al., 2024). However, the adoption of such technologies still requires attention to the readiness of digital infrastructure in some ports and the training of the workforce to manage more complex systems (Catherine et al., 2024). This discussion asserts that to fully capitalize on strategic opportunities, a holistic approach is necessary encompassing infrastructure investment, technology application, and regional

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coordination to establish the Strait of Malacca as a more robust and sustainable global logistics and supply chain hub.

The research findings demonstrate that the role of maritime geostrategy significantly influences the management of the Strait of Malacca as an international supply chain route. Geopolitical dynamics between coastal states like Indonesia, Malaysia, and Singapore, and major powers such as the United States and China, create complex challenges in maintaining a balance between national sovereignty and the need for international cooperation (Xiaoxue et al., 2023). Coastal states bear the responsibility of managing this strait efficiently while maintaining control over their maritime territories. However, pressure from international actors, such as the United States advocating for freedom of navigation and China expanding its influence through initiatives like the Belt and Road Initiative, often creates strategic dilemmas. These geopolitical tensions can affect regional stability and potentially disrupt the smooth flow of the global supply chain (Xiaoxue et al., 2023).

Maritime diplomacy has become a critical instrument in addressing these challenges, but its effectiveness is highly dependent on the extent to which coastal states can align their interests. Initiatives like the Malacca Straits Patrol demonstrate success in handling shared maritime threats, such as piracy and transnational crime (Yoshua et al., 2024). However, this cooperation is still limited in operational scope and sometimes faces political hurdles, especially in harmonizing domestic policies with international demands (Yoshua et al., 2024). For instance, maritime security priorities in Indonesia may differ from the approach taken by Singapore, which is more focused on trade efficiency. This imbalance highlights the need for more inclusive diplomatic mechanisms to reduce conflicts of interest and strengthen cross-national coordination (Yoshua et al., 2024).

Furthermore, the stability of the Strait of Malacca region has direct implications for the sustainability of the global supply chain. The world's reliance on this shipping lane demands management that focuses not only on security but also on economic and environmental sustainability. The research results suggest that coastal states can leverage maritime diplomacy to build more structured cooperation mechanisms, for example, through the establishment of a regional maritime alliance that integrates security efforts with supply chain management. Consequently, this discussion affirms that a holistic maritime geostrategy approach—which includes diplomacy, geopolitical risk management, and international collaboration—is key to ensuring the efficiency and stability of the Strait of Malacca as a primary international supply chain route.

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CONCLUSIONS

This study identifies that the Strait of Malacca confronts various strategic risks, including maritime security threats such as piracy, terrorism, and cyber-attacks, which can disrupt the fluidity of the international supply chain. Furthermore, traffic congestion resulting from high trade volumes, as well as the impacts of climate change, such as sea-level rise and extreme storms, constitute significant threats to maritime transportation stability. These risks underscore the need for more comprehensive and sustainable management to ensure the efficiency of the global supply chain in this strategic waterway.

Risk management strategies in the Strait of Malacca entail the critical role of international regulations, such as UNCLOS, and regional initiatives, like ReCAAP, in providing a framework for safeguarding transportation security. Coordinated patrols via the Malacca Straits Patrol have helped mitigate security threats, although challenges in coordination and resources persist. The application of modern technology, such as artificial intelligence-based radar and early warning systems, represents a vital step in enhancing surveillance efficiency and risk management in this region.

The development of port and logistics infrastructure in the Strait of Malacca offers significant opportunities to enhance international supply chain performance. Port modernization and the adoption of technologies, such as logistics digitalization and automated cargo management, are capable of increasing maritime transport efficiency and capacity. However, to fully capitalize on these opportunities, sustained investment, digital infrastructure integration, and stronger regional cooperation are required to ensure the region's competitiveness in global trade.

The role of maritime geostrategy in the management of the Strait of Malacca is shaped by geopolitical dynamics between the coastal states and major powers, such as the United States and China. Maritime diplomacy and cooperative initiatives like the Malacca Straits Patrol contribute to maintaining regional stability, yet challenges in aligning national interests with international requirements persist. A more coordinated approach, encompassing inclusive diplomacy and geopolitical risk management, is necessary to ensure the sustainability and efficiency of the global supply chain via the Strait of Malacca.

Recommendations

Based on the research findings, it is recommended that the coastal states of the Strait of Malacca namely Indonesia, Malaysia, and Singapore strengthen regional cooperation to manage

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strategic risks and capitalize on opportunities in this region. Enhanced coordination through initiatives such as the Malacca Straits Patrol must be accompanied by the adoption of advanced technologies, such as artificial intelligence-based surveillance systems and big data analytics, to improve maritime transport efficiency and security. Furthermore, investment in the modernization of port and logistics infrastructure should be expanded, with a focus on digital technology integration to enhance the region's capacity and competitiveness in the global supply chain.

A further recommendation is to strengthen maritime diplomacy to address geopolitical challenges and foster synergy between national interests and international requirements. Coastal states need to reinforce cooperation mechanisms through international organizations such as the IMO and ReCAAP, as well as forge more inclusive regional maritime alliances. This strategy will not only enhance regional stability but also ensure the sustainability of the international supply chain. Through a combination of infrastructure investment, technology adoption, and effective diplomacy, the Strait of Malacca can continue to fulfill its strategic role as a primary route for global trade.

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