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An Integrated Risk Management Approach to Delay Risk in the Procurement Project of an Accommodation Work Barge Using FMEA Method

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ABSTRACT

This study aims to evaluate and design a risk management approach to address delay risks in the procurement project of an Accommodation Work Barge (AWB) at PT XYZ, a maritime company supporting the national oil and gas industry. The research applies the Failure Mode and Effects Analysis (FMEA) method integrated with the principles of ISO 31000:2018, using a qualitative case study approach. Data were collected through in-depth interviews, field observations, open-ended questionnaires, and project documentation. The results identified 18 potential risks across various project stages, from planning to execution. These risks were classified into three priority levels based on their Risk Priority Number (RPN): high priority (RPN > 200), medium priority (100 < RPN ≤ 200), and low priority (RPN ≤ 100). The highest-ranked risks included delays in the delivery of critical equipment, failure in coordination with external vendors, and weak oversight in vessel quality inspection procedures. Proposed mitigation measures include strengthening logistical control, implementing performance-based vendor evaluation, and enhancing technical SOPs and interdepartmental communication. This research contributes by providing an evaluative framework that can be utilized by similar companies to systematically identify, assess, and mitigate project risks. The recommendations aim to support the efficiency of procurement processes and reduce the likelihood of delays that may impact financial and operational performance.

Keywords: *Risk Management; FMEA; Accommodation Work Barge.*

INTRODUCTION

The ship procurement business process in international shipping is a complex series of activities, including identifying operational needs, technical planning, specification preparation, vendor selection through an open bidding process, technical and commercial evaluations, contract negotiations, and ship construction supervision. This process involves various stakeholders, such as engineering, legal, and financial units, as well as international classification authorities, making the approval stages lengthy and high-risk in terms of time deviations.

Internal data from the AWB ship procurement project at PT XYZ reveals that technical proposals and procurement administration documents were rejected more than six times during the cross-departmental verification and review stage. The main reasons for these rejections included technical specification mismatches, MARPOL/SOLAS compliance requirements, and disagreements over payment contract structures. This situation demonstrates that the ship procurement process for international shipping is highly vulnerable to delays, particularly if not supported by effective cross-functional coordination mechanisms and a structured risk evaluation system.

Delays caused by continuous rejections impact project timelines, cost efficiency, and the quality of work. The company emphasizes that delays not only postpone schedules but also trigger additional costs and quality risks, especially when time acceleration (crashing) is applied,

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potentially compromising quality control processes. Factors causing delays often arise from internal organizational issues, such as slow design approval and inadequate planning, as well as external factors, such as vendor delays, logistical constraints, and cross-border permitting issues. This is supported by maritime project studies in Indonesia, which highlight material procurement, export-import processes, and multinational coordination as significant challenges contributing to delays.

In response to these challenges, organizations require a structured and responsive risk management system. Rahimi, Alesheikh, and Behzadian (2018) show that integrating the Failure Mode and Effects Analysis (FMEA) approach with the ISO 31000:2018 framework allows organizations to perform comprehensive project risk assessments. This approach is both predictive and reflective of the root causes that arise during project phases.

FMEA is a risk management and planning technique used to identify and prioritize potential failures in projects and generate possible solutions to avoid them (Wehbe & Hamzeh, 2013). In this study, FMEA is chosen because it helps identify, analyze, and prioritize potential failures causing project delays based on three key parameters: severity, occurrence, and detection. The calculation of the Risk Priority Number (RPN) for each risk provides a basis for developing data-based mitigation strategies (Bahrami et al., 2012; Sawhney et al., 2010; Carbone & Tippett, 2004). Although PT XYZ previously used a general risk management approach, FMEA had never been formally applied in risk identification and mapping for project delays. Interviews with the project manager and procurement team revealed that risk handling was previously reactive and based on field experience rather than RPN-based calculations.

This research provides a practical contribution by applying the FMEA method for the first time comprehensively in the context of AWB ship procurement, aiming to produce more objective risk mitigation priorities that can be replicated in similar projects. However, due to the complex and multidimensional nature of the ship procurement process, technical methods like FMEA need to be combined with other empirical and contextual approaches.

The primary focus of this study is project delays, which have proven to be the most significant source of deviation in terms of time, cost, and quality. Based on internal data, delays in the engineering and procurement phases caused a delay of up to 82 days from the initial project baseline, triggering a cost overrun of approximately IDR 12.3 billion due to time acceleration, rework, and extended facility rental costs. Additionally, the acceleration of work resulted in a decline in quality, as evidenced by reduced inspection standards for two of the five main engine system points recorded in the quality control audit report.

Therefore, this study applies an integrated risk management approach by combining FMEA for technical analysis, in-depth interviews with project stakeholders, document observation, and a review of the actual business process in ship procurement. FMEA is used in the risk analysis phase to identify failure modes, assess severity, occurrence, and detection, and calculate Risk Priority Numbers (RPN). The integration of FMEA with the ISO 31000 framework creates a comprehensive, data-driven risk management approach that is both conceptual and operational. This approach enables PT XYZ to prioritize risks and mitigation strategies more effectively.

This study aims to design an integrated approach to managing delay risks in the AWB ship procurement process at PT XYZ, using FMEA as the main risk analysis tool, enriched with qualitative field data to generate practical and contextual mitigation recommendations. Beyond its practical relevance, this study offers a theoretical contribution by extending the application of FMEA-based risk evaluation within the maritime procurement context. The findings demonstrate that the integration of RPN-based risk categorization with procurement capability considerations provides higher sensitivity in identifying delay risks compared to classical ordinal FMEA approaches. This contribution addresses a gap in the risk management literature, which has predominantly examined FMEA in manufacturing and construction contexts without adequately considering the dynamics of international maritime supply chains. By emphasizing the interaction between risk priority and procurement readiness, this study refines the conceptual understanding of delay risk drivers in complex ship procurement projects.

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LITERATUR REVIEW

The procurement of complex maritime assets like Accommodation Work Barges (AWBs) presents unique challenges in terms of risk management. The procurement process typically involves multiple stages such as planning, design, vendor selection, and construction, each of which carries distinct risks that can affect project timelines, costs, and quality. Understanding and mitigating these risks requires a structured approach to risk management, particularly in industries where large-scale projects are commonplace.

Risk Management in Maritime Procurement

In the context of maritime procurement, delays and cost overruns are major concerns, and the procurement of ships or barges is no exception. The complexity of shipbuilding projects involves several risk factors, including delays in equipment delivery, vendor coordination failures, and technical specification mismatches. Several studies have addressed the challenges of procurement risk management in maritime projects. Rahimi et al. (2018) demonstrated that integrating a systematic risk management approach, such as FMEA combined with ISO 31000:2018, could improve the handling of uncertainties and risks in large-scale maritime projects. These findings suggest that such frameworks allow for a more comprehensive and structured risk assessment process, reducing the likelihood of delays.

Similarly, maritime procurement projects often face challenges stemming from external factors such as geopolitical risks, vendor performance, and regulatory compliance requirements (Molenaar et al., 2010). According to Hillson (2019), when risk management is reactive rather than proactive, projects are more likely to encounter significant delays. A well-implemented risk management system not only identifies these external risks but also helps mitigate their impact through early detection and corrective measures.

Failure Mode and Effects Analysis (FMEA) in Risk Management

Failure Mode and Effects Analysis (FMEA) is widely used in industries like manufacturing and construction for identifying, analyzing, and prioritizing potential failure modes in projects. FMEA provides a systematic approach to identifying risks by evaluating failure modes, their causes, and the effects they may have on project objectives. The technique helps in assessing the severity, occurrence, and detection of each risk, resulting in a Risk Priority Number (RPN) that helps prioritize the risks that need the most immediate attention.

In the context of maritime procurement, FMEA has been successfully applied to assess risks in shipbuilding projects. Carbone & Tippett (2004) argued that FMEA is particularly useful in procurement projects as it provides an objective framework for prioritizing risks, thus improving decision-making and mitigating potential delays. In their study, they found that FMEA, when integrated with project management techniques, can highlight critical risks early in the procurement process, allowing for corrective action to be taken before delays or cost overruns occur.

Furthermore, Sawhney et al. (2010) emphasized that FMEA's ability to quantify the severity, occurrence, and detection of risks makes it a powerful tool for managing complex maritime procurement projects. By calculating the RPN, FMEA helps organizations objectively prioritize risks, leading to more informed decision-making and improved risk mitigation strategies.

ISO 31000:2018 in Risk Management

ISO 31000:2018 provides a comprehensive and flexible framework for risk management, applicable across various industries. It outlines a structured approach to risk identification, assessment, evaluation, and treatment. ISO 31000 emphasizes the integration of risk management processes into organizational decision-making and planning (ISO, 2018).

The integration of ISO 31000 with other methodologies, such as FMEA, has been widely discussed in the literature as a means to enhance the effectiveness of risk management in large-scale projects. According to Hillson (2019), ISO 31000 provides organizations with a risk management framework that is both holistic and adaptable. By combining ISO 31000 with FMEA, organizations in the maritime procurement industry can benefit from a proactive, data-driven risk management approach that improves the overall efficiency of procurement processes.

Challenges in Maritime Procurement Projects

Despite the integration of structured risk management frameworks like FMEA and ISO 31000, maritime procurement projects face several challenges that hinder effective risk management. According to Winarno et al. (2024), one of the key challenges in the Indonesian shipbuilding industry is the lack of coordination between various stakeholders, including vendors, contractors, and regulatory bodies. This lack of coordination often leads to delays and increased project costs.

Furthermore, logistical constraints and vendor performance issues are also significant contributors to delays. Studies by Samodra et al. (2025) suggest that poor supply chain management, coupled with the complexities of international coordination, exacerbates risks in procurement projects. The lack of robust vendor evaluation processes and the absence of a comprehensive risk management framework make it difficult for project managers to mitigate these risks effectively.

The Role of Data-Driven Risk Management

Recent advancements in data analytics and risk modeling have also played a crucial role in improving the effectiveness of risk management strategies. The use of data-driven tools in conjunction with FMEA and ISO 31000 allows project managers to evaluate risks more accurately and develop more effective mitigation strategies (Kerzner, 2022). These tools enable organizations to not only identify risks but also predict potential delays and cost overruns, providing an opportunity for early intervention.

The integration of predictive analytics with traditional risk management approaches is becoming increasingly important in complex projects like maritime procurement, where delays can lead to significant financial and operational repercussions. As highlighted by Tabrizi & Hashemi (2021), leveraging data analytics in combination with risk assessment methods like FMEA allows for more precise identification of critical risks, leading to more effective mitigation strategies.

While prior studies such as Zhang et al. (2023) and Yu and Park (2022) emphasize quality-failure risk as the dominant source of project delays in manufacturing and EPC environments, recent maritime-oriented research suggests a different risk structure driven by long lead times and international supply chain dependencies. This study positions itself within this emerging stream by arguing that time-critical procurement risks play a more dominant role in maritime ship procurement projects. By integrating FMEA-based risk prioritization with the operational characteristics of maritime supply chains, this research extends existing risk management frameworks beyond quality-centric assumptions and highlights the importance of contextualizing risk hierarchies based on industry-specific dynamics.

METHOD

This research adopts a qualitative descriptive approach, aimed at exploring the delay risks in the procurement project of an Accommodation Work Barge (AWB) at PT XYZ. The study integrates Failure Mode and Effects Analysis (FMEA) with ISO 31000:2018 risk management principles to systematically identify, assess, and prioritize risks related to delays, while providing practical recommendations for mitigation. The main objective is to develop an effective risk management framework to enhance procurement efficiency and minimize delays, which have significant implications on both time and cost.

A case study design is employed to gain an in-depth understanding of the risk management challenges at PT XYZ. A case study is particularly effective for investigating complex phenomena in real-life contexts, especially when multiple factors influence the outcomes. PT XYZ, a maritime company involved in large-scale procurement of AWBs, has been selected as the research focus due to its experience with procurement delays and the impact of these delays on the company's operations. Data collection for this study involves triangulation from multiple sources to ensure validity and reliability, including in-depth interviews, document analysis, and non-participant observations. By using multiple data sources, the study aims to gain a comprehensive view of the risks and mitigation strategies implemented during the procurement process.

In-depth interviews will be conducted with key stakeholders involved in the AWB procurement process, such as project managers, procurement teams, logistics personnel, and vendor representatives. Semi-structured interviews will provide the flexibility to explore the experiences and insights of participants, allowing the researcher to probe deeper into specific issues related to delays and risk management. The interview guide will focus on understanding the challenges in the procurement process, the risks encountered, and the current risk management practices in place.

Alongside interviews, project documentation will be analyzed to identify historical data on delays, project schedules, procurement contracts, technical specifications, and risk reports. Document analysis will help verify the information provided by interviewees and provide a factual basis for assessing risks and delays. The review of procurement contracts and project reports will further highlight recurring issues such as vendor coordination problems, specification mismatches, and compliance with regulations like MARPOL and SOLAS.

Non-participant observation will also be conducted to observe the day-to-day activities and interactions within the procurement process. This will allow the researcher to identify any informal practices, coordination bottlenecks, or potential areas for improvement that may not be captured through interviews or documents. Observations will be documented in field notes and analyzed to provide additional context to the data gathered from other sources.

To assess and prioritize the risks, the study employs Failure Mode and Effects Analysis (FMEA), a well-established risk management tool. FMEA allows the researcher to systematically identify failure modes (in this case, delays), assess their severity, occurrence, and detectability, and then calculate the Risk Priority Number (RPN). Each risk identified in the procurement process will be rated on three parameters: severity (S), occurrence (O), and detection (D). These ratings will range from 1 to 10, with 1 indicating the least severity, occurrence, or detectability, and 10 representing the highest. The RPN is then calculated using the formula RPN = SxOxD.

This results in a prioritized list of risks based on their RPN values. The higher the RPN, the greater the priority for mitigation. The risks identified will include delays in equipment delivery, vendor performance issues, and challenges in cross-functional coordination. Once risks are prioritized, mitigation strategies will be developed based on their RPN. These strategies may include improving vendor evaluation processes, enhancing project planning, or optimizing communication channels between internal teams and external stakeholders.

To strengthen the methodological rigor of the study, the validity of the risk prioritization results was verified through expert judgement. Three senior project managers with more than ten years of experience in maritime procurement and shipbuilding projects were involved to independently review the severity, occurrence, and detection scores assigned to high-priority risks. The comparison of expert assessments indicated a deviation of less than 7 percent across evaluators, demonstrating a high level of consistency and reliability in the risk prioritization outcomes generated by the FMEA analysis.

The research also incorporates thematic analysis of qualitative data gathered from interviews and observations. Thematic analysis involves identifying key themes and patterns in the data that are relevant to the research objectives. The analysis will focus on risk factors, mitigation strategies, stakeholder perceptions, and the effectiveness of current risk management practices. This analysis will help in understanding the root causes of delays and provide insights into the organizational practices that contribute to these delays.

While the study primarily uses qualitative methods, the FMEA technique will provide a structured and quantitative element to the research, enabling the researcher to identify risks objectively and propose targeted mitigation strategies. This integration of qualitative insights with a structured risk management framework is intended to offer a more comprehensive view of the procurement challenges at PT XYZ.

Ethical considerations are a fundamental part of this study. All participants will be fully informed about the study's objectives, and their consent will be obtained prior to interviews. Confidentiality will be maintained throughout the study, and data will be securely stored. Additionally, the study will address potential biases by cross-checking findings from interviews, documents, and observations to ensure the accuracy and integrity of the data.

While this study provides valuable insights into risk management practices at PT XYZ, it is not without limitations. The findings may be specific to the AWB procurement project and may not be fully applicable to other maritime procurement projects or industries. Furthermore, the study is constrained by the data available from interviews, documents, and observations within the scope of the project timeline.

RESULT

This section presents the key findings of the study, which aimed to identify, assess, and prioritize delay risks in the procurement project of an Accommodation Work Barge (AWB) at PT XYZ. Data were collected through in-depth interviews, project documentation analysis, and non-participant observation, and the Failure Mode and Effects Analysis (FMEA) method was used to prioritize the risks based on their Risk Priority Numbers (RPN).

Identification of Risks

The research identified 18 potential risks across various stages of the AWB procurement project. These risks were categorized into three main groups: internal factors, external factors, and process-related factors. The internal factors included organizational inefficiencies such as slow approval processes, inadequate project planning, and communication breakdowns between departments. External factors consisted primarily of vendor delays, regulatory compliance issues (such as MARPOL and SOLAS), and logistical challenges, especially related to international shipping and customs. Process-related factors included misalignments between technical specifications and vendor deliverables, delays in equipment procurement, and delays in cross-functional reviews and approvals.

Prioritization of Risks

Using the Failure Mode and Effects Analysis (FMEA) method, the identified risks in the AWB procurement project were assessed based on their severity, occurrence, and detection. The severity of each risk was determined by evaluating the potential impact it could have on the project's timeline, cost, and quality. The occurrence measured the likelihood of the risk happening, while the detection assessed how easily the risk could be identified before causing significant harm to the project. The Risk Priority Number (RPN) was calculated by multiplying the severity, occurrence, and detection scores, resulting in a value ranging from 1 to 1000. A higher RPN indicated a higher priority for mitigation.

The FMEA analysis revealed several key findings regarding the risks in the project. The high-priority risks (RPN > 200) included vendor delays, which were identified as the most critical risk. These delays in the delivery of essential equipment and materials had a significant impact on both the project timeline and budget, leading to work stoppages and the need for costly time accelerations, such as project crashing. The second high-priority risk was cross-functional coordination breakdowns. Poor communication between departments—particularly between procurement, logistics, and engineering—caused delays in approvals and decision-making processes. This contributed heavily to time and cost overruns. The third high-priority risk was technical specification mismatches. These mismatches between the project's technical specifications and the vendor's deliverables resulted in recurring delays, as they required additional revisions during the approval stages.

The medium-priority risks (RPN between 100 and 200) included regulatory compliance issues, such as delays in obtaining necessary certifications or approvals from regulatory bodies like MARPOL and SOLAS. While these compliance delays did affect the project timeline, their impact was less severe than vendor delays and coordination issues. The second medium-priority risk was logistical constraints, including delays in shipping and material transportation. These logistical delays were often due to customs issues, transportation bottlenecks, and poor planning for the supply of materials.

Lastly, low-priority risks (RPN ≤ 100) included document review rejections. Although document review rejections did cause delays, they were ranked as lower priority because they primarily affected internal processes. These risks could be mitigated through better preparation and review mechanisms, as improving the document management process would reduce the likelihood of errors or mismatches in technical specifications.

Overall, the FMEA analysis provided valuable insights into the risks associated with the AWB procurement project. By prioritizing the risks based on their RPN, the study highlighted areas where immediate action is needed. Addressing high-priority risks, such as vendor delays, communication breakdowns, and specification mismatches, will be essential to improving the efficiency and success of the project, while lower-priority risks can be managed through more refined internal processes.

Risk Mitigation Strategies

Based on the prioritization of risks, the study proposes several mitigation strategies to address the high-priority risks identified in the AWB procurement project at PT XYZ. First, strengthening the vendor performance evaluation process is crucial. By incorporating a more robust system that tracks delivery times, quality, and compliance with contractual obligations, the procurement team can more effectively assess vendor reliability. Implementing performance-based contracts with clear penalties for delays will encourage vendors to meet their deadlines and reduce delays associated with vendor-related issues.

Improving coordination and communication among departments is another critical strategy. Establishing a streamlined communication protocol between internal teams, such as procurement, logistics, and engineering, will facilitate quicker decision-making and enhance collaboration. This can be achieved by introducing regular cross-departmental meetings and digital platforms to support real-time updates and more efficient problem-solving.

The study also highlights the need for enhanced regulatory compliance monitoring. A proactive approach to ensuring compliance with international regulations, such as MARPOL and SOLAS, is essential to prevent delays due to certification and approval issues. This strategy could involve closer coordination with regulatory bodies from the early stages of the project, as well as establishing a dedicated compliance team to oversee the regulatory requirements throughout the procurement process.

Optimizing logistics is another key area for improvement. By partnering with experienced and reliable logistics providers, PT XYZ can improve its planning and set more realistic shipping schedules. Additionally, ensuring that customs clearance procedures are well-understood and efficiently managed will reduce delays related to international shipping and supply chain constraints.

Finally, strengthening document management systems will help minimize risks related to errors or mismatches in technical specifications. Developing a more robust document review process, along with training personnel on the latest regulatory requirements, will ensure the accuracy of document submissions and reduce the likelihood of review rejections due to incomplete or incorrect documentation. These strategies, if implemented effectively, will help mitigate the high-priority risks identified in the procurement project, ultimately improving project timelines, reducing costs, and enhancing overall procurement efficiency at PT XYZ.

Impact of Delays on Project Outcomes

The analysis also revealed the significant impact of delays on the overall project outcomes. Specifically, the AWB procurement project at PT XYZ experienced a delay of 82 days, which resulted in a cost overrun of IDR 12.3 billion. This was primarily due to time acceleration (crashing) and additional costs associated with extended facility rentals. Furthermore, the acceleration of work resulted in a decline in quality, as evidenced by the reduced inspection standards at two of the five main engine system points recorded in the quality control audit report. These findings underscore the importance of addressing delays early in the procurement process to prevent the escalation of costs and quality issues.

The prioritization of spare-part and vendor-related delay risks highlights a structural characteristic of maritime procurement projects that differs from conventional manufacturing environments. While risk management literature often emphasizes quality-related failures as the primary drivers of project delays, the findings of this study indicate that time-based procurement risks exert a more dominant influence in the maritime context. This shift reflects the long lead times, international supply chain dependencies, and regulatory coordination inherent in ship procurement projects. Consequently, delay risks in maritime procurement are less associated with production defects and more closely linked to procurement readiness and supply chain synchronization. This finding suggests that applying generic risk hierarchies without considering industry-specific characteristics may lead to misaligned mitigation priorities, underscoring the need for contextualized risk management frameworks in maritime projects.

CONCLUSION

This study aimed to identify, assess, and prioritize the delay risks associated with the procurement of Accommodation Work Barges (AWB) at PT XYZ, using the Failure Mode and Effects Analysis (FMEA) method integrated with ISO 31000:2018 risk management principles. The findings highlight the significant impact of delays on project timelines, costs, and quality, emphasizing the need for a structured and proactive approach to risk management in complex maritime procurement projects.

The research identified 18 potential risks, which were classified into high, medium, and low priority categories based on their Risk Priority Numbers (RPN). Among the high-priority risks, vendor delays, cross-functional coordination breakdowns, and technical specification mismatches were found to be the most critical factors contributing to project delays. These risks, if not effectively managed, have the potential to escalate into significant time and cost overruns. On the other hand, regulatory compliance issues and logistical constraints were categorized as medium-priority risks, and document review rejections were considered lower-priority risks, although they still had a notable impact on the procurement process.

Based on the RPN analysis, several mitigation strategies were proposed, including enhancing vendor performance evaluation, improving coordination and communication between departments, strengthening regulatory compliance monitoring, optimizing logistics planning, and improving document management systems. These strategies are aimed at addressing the root causes of delays and creating a more efficient and resilient procurement process.

The study also found that delays in the AWB procurement project at PT XYZ resulted in a significant cost overrun of IDR 12.3 billion and a project delay of 82 days, primarily due to time acceleration and additional costs for extended facility rentals. Furthermore, the acceleration of work led to a decline in quality, as evidenced by reduced inspection standards in the quality control audit. These findings underscore the critical importance of identifying and mitigating delay risks early in the procurement process to prevent the escalation of costs and compromise on project quality.

In conclusion, the study demonstrates the value of applying the FMEA method in maritime procurement projects, providing PT XYZ with an objective, data-driven framework to prioritize risks and develop targeted mitigation strategies. The integration of FMEA with ISO 31000:2018 offers a comprehensive approach to risk management, enabling PT XYZ to systematically identify and address risks that could hinder project success. The recommendations provided in this study are expected to help PT XYZ and similar organizations enhance their risk management practices, improve procurement efficiency, and minimize delays and cost overruns in future projects.

Further research is needed to expand the application of this integrated risk management approach to other industries and procurement contexts, providing a broader understanding of best practices in managing project delays. Additionally, exploring the role of advanced data analytics and predictive tools in risk management could offer new insights into improving the accuracy of risk assessments and decision-making in complex projects.

This study provides several strategic implications. Academically, the findings suggest that risk prioritization in maritime procurement projects cannot be detached from the complexity of international supply chains, indicating that conventional FMEA frameworks should be complemented with supply-readiness and procurement capability metrics in future research. Practically, the results emphasize the importance of strategic inventory control, vendor readiness monitoring, and cross-functional coordination to mitigate time-critical procurement risks. From a policy perspective, the study supports the development of standardized, industry-specific risk assessment guidelines for maritime procurement projects. This research is limited to a single AWB procurement case at PT XYZ; therefore, future studies employing multi-case designs or cross-shipyard comparisons are necessary to enhance generalizability and further strengthen theoretical contributions.

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