



RISK MANAGEMENT ANALYSIS ON THE PIER REPAIR CONSTRUCTION PROJECT AT PT. ORELA SHIPYARD GRESIK

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ABSTRACT

This study aims to analyze risk management in the pier repair construction project at PT Orela Shipyard Gresik. Through the risk identification and assessment stage, the study identified twenty-five indicators out of a total of thirty-seven relevant, which were grouped into six main categories: project risk, technical, natural, human, occupational safety and health (OHS), and financial. The results of the analysis show that technical risk is the most dominant, followed by project and financial risk. This study also conducted a validity and reliability test on the measurement instruments used, with results showing that all indicators are valid and realistic. Recommendations for mitigation actions are given to reduce the negative impact of the risks, in order to ensure the smooth implementation of the project.

Keywords: Risk Management, Construction Project, Pier, PT. Orela Shipyard Gresik, Mitigation.

1. INTRODUCTION

The pier repair project at PT Orela Shipyard Gresik is a strategic project to support Indonesia's maritime sector. The wharf plays an important role in the smooth loading and unloading, logistics distribution, and domestic and international trade activities. Increasing the operational capacity of the port through this project is expected to encourage economic growth in Gresik and its surroundings.

Research by Sullivan et al. (2017) shows that the implementation of good risk management can reduce the likelihood of delays by up to 30% and cost overruns by up to 20%. Moreover Green & Sergeeva (2019) revealed that risk identification at an early stage of the project can prevent major problems down the road, including delays and technical failures.

Risk management involves identifying, analyzing, evaluating, and controlling risks to ensure the success of a project. This study aims to analyze the risk of project delays, with interview methods, observations, as well as the study of scientific documents and journals.

The results of the research are expected to contribute to project management at PT Orela Shipyard Gresik and become a reference for other maritime construction sectors. In addition, this study enriches the literature on risk management of construction projects, especially port infrastructure, in order to improve the quality and efficiency of projects in Indonesia.

1.1. Literature Review

a. Construction Projects

A construction project is a temporary activity that aims to build infrastructure within a limited period of time with a predetermined budget and objectives (Setiawati et al., 2017). Planning is a crucial element in a project because it determines the allocation of funds, time, and quality. Each project has a clear scope of work to avoid unplanned changes.

b. Pier Construction

A dock is a structure in a port that is used for ships berthing and loading and unloading goods (Triatmodjo, 1996 deep Tehupuring et al., 2019). The construction of the dock must consider material aspects, structural design, and environmental factors to ensure operational safety and efficiency. Government regulations must also be complied with so that the project runs according to safety and environmental standards.

c. Pier Construction

The construction of the pier involves technical planning, hydrodynamic analysis, and the selection of construction methods such as piles or reinforced concrete (Siliwangi et al., 2014). Environmental factors and ecological impacts also need to be considered to reduce pollution and damage to marine habitats (R. W. Santosa, 2013).

d. Risks

Risk is the possibility of undesirable events occurring and negatively impacting the project (Fraser et al., 2021). Risks can be classified into financial, operational, compliance, environmental, and reputational risks. Good risk management aims to mitigate negative impacts and optimize decision-making.

1) Risk Management

Risk management is a systematic process of identifying, measuring, and managing risks to mitigate negative impacts (B. Santosa, 2009). The main elements of risk management include risk identification, analysis, evaluation, and control. In construction projects, the allocation of responsibilities to the appropriate parties is essential to ensure the effectiveness of risk mitigation.

2) Risk Management Process

The risk management process consists of planning, identification, analysis, and evaluation of risks (PMBOK, 2004). Risk evaluation considers probability and impact to determine the scale of risk from low to high (Fathoni, 2020).

3) Risk Response Planning

Risk response can be carried out through loss control which includes risk avoidance, loss prevention, and loss reduction (Febriana & Alimbudiomo, 2019). In addition, risk financing strategies include risk assumptions, retention, risk transfers, and insurance to mitigate the financial impact of the risks that occur.

2. METHODOLOGY

This study uses a descriptive quantitative approach with a questionnaire as a data collection tool to analyze risks in the pier repair project at PT Orela Shipyard Gresik. The research location is at the company's shipyard, with implementation from January to December 2024. The data collected consisted of primary data (observation, documentation, survey) and secondary data (project reports, location maps).

The risk analysis refers to the AS/NZS 4360:2004 standard, using the Likert method to assess the degree of likelihood and impact. The risk index is calculated by the formula $\text{risk} = \text{chance} \times \text{impact}$. The validity of the data was tested with SPSS, with the sample selected using purposive sampling on subcontractor workers in the shipyard.

The research schedule includes literature study, proposal preparation, survey and questionnaire distribution, data collection and processing, to the preparation of the results

seminar, which is illustrated in tables and bar charts.

2.1. Research Flow Diagram

The overall flow of research activities is as can be seen in figure 1.

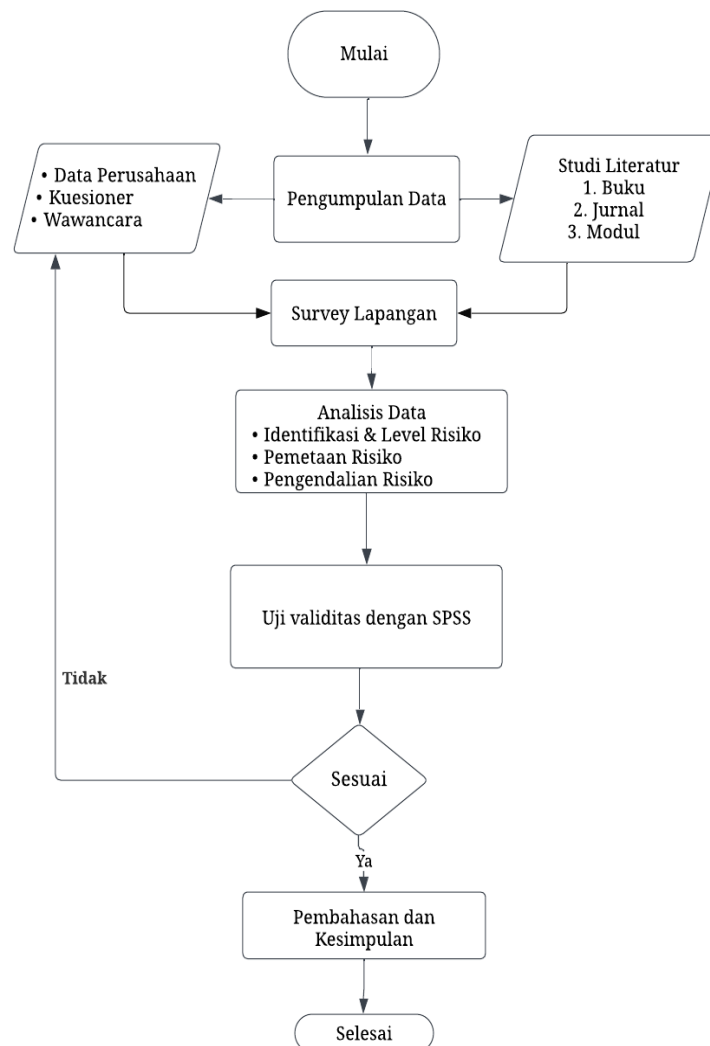


Figure 1. Research Flow Diagram

Source: Processed by researchers

3. RESULT AND DISCUSSION

3.1. Result

3.1.1. Descriptive Respondents

This study analyzed the risk management of the wharf repair project at PT Orela Shipyard Gresik, with 30 respondents from various positions who had an important role in the project as been seen in table 1. The majority of respondents are field workers (13.3%), while managerial positions such as Project Manager and Site Manager are represented by 1 person (3.3%). Most respondents are male (70%), reflecting the dominance of the male workforce in the construction sector. In terms of education, the majority came from the engineering field, especially S1 Civil Engineering (13.3%) and S1 Mechanical Engineering (10%).

Table 1. Characteristics of Respondents

Respondent's Position	Frequency	Percentage
Field Workers	4	13,30%
Construction Supervisor	2	6,70%
Project Manager	1	3,30%
Other	23	76,70%
Total	30	100%
Gender		
Man	21	70,0 %
Woman	9	30,0%
Total	30	100%
Education		
S1 Civil Engineering	4	13,33 %
S1 Mechanical Engineering	3	10,00%
Mechanical Engineering Vocational	2	6,67%
School	21	70,00%
Other	30	100%
Total		

3.1.2. Hazard Identification

Risk identification in this study began with a literature study to determine risk variables and indicators in the pier repair construction project at PT Orela Shipyard Gresik. Risks are categorized into six main groups: project, technical, natural, human, occupational safety and health (OSH), and financial. A preliminary questionnaire was distributed to 10 respondents to identify key risks based on their experiences. The collected data was tabulated using Microsoft Excel and analyzed with the Guttman scale to evaluate the relevance of the risks. These results are the basis for formulating mitigation measures to ensure effective and efficient risk management, as well as minimize negative impacts on projects.

Table 2. Risk indicators used in the study

Group	Information	Number of Indicators	Wearable Indicators
A Project Risk	Risks directly related to project implementation	9	5
B Technical Risks	Risks related to the technical implementation and operation of the project	9	6
C Environment Risks	Risks derived from environmental or nature conditions	4	3
D Human Risk	Risks resulting from human error or shortcomings	5	3
E Occupational Safety and Health Risks (K3)	Risks associated with accidents or occupational health	5	4
F Financial Risk	Risks related to financial	5	4

	management		
	Total	37	25

The pier repair construction project at PT Orela Shipyard Gresik as been seen in table 2, faces six main risk categories: project, technical, natural, human, occupational safety and health (K3), and financial. Of the 37 indicators submitted, 25 were considered relevant for further analysis. Technical risk became the most dominant with six indicators, followed by project and financial risk. The main risks include non-conformity of technical drawings, damage to heavy equipment, bad weather, labor conflicts, lack of implementation of OSH, and non-smooth project funding. This analysis emphasizes the importance of an integrated mitigation strategy to ensure that projects run smoothly, on time, and within budget.

3.1.3. Risk Assessment

The risk assessment in this study aims to determine the level of risk in the dock repair project at PT Orela Shipyard Gresik. The questionnaire was compiled based on the results of previous risk identification and distributed to 30 respondents. The assessment uses a scale of 1-5 to measure the likelihood of risk (likelihood). Validity and reliability tests are carried out to ensure the accuracy of respondents' responses.

Risks are classified into three categories: low (average value 1-4), medium (5-11), and high (12-25). High and medium risk require control measures, while low risk is acceptable without additional control.

Table 3. Main Risks Faced in the Pier Repair Construction Project at PT Orela Shipyard

Indicators	Information	Total Value	Average Score	Category
A1	The inconsistency of measurements in the field with technical drawings in determining the position, point, line, and height of the pier.	226	7.533	Moderate
A3	The access to the heavy equipment used during the dock repair project is difficult to reach.	333	11.100	Moderate
A5	Rejection from local residents to the activities of the pier construction project.	170	5.667	Moderate
A6	Loss of materials or equipment of dock repair projects.	252	8.400	Moderate
A8	Heavy equipment is damaged or collapsed due to overload.	431	14.367	High
B1	The pier construction materials received in the field are different from those ordered.	255	8.500	Moderate

B4	The shortage of heavy equipment causes the productivity of dock repair work to be not optimal.	344	11.467	Moderate
B6	Work delays due to inappropriate implementation methods.	170	5.667	Moderate
B7	Damage to heavy equipment or work equipment slows down the implementation of the dock project.	327	10.900	Moderate
B8	Damage to roads around the dock project due to heavy equipment such as dump trucks or truck mixers.	168	5.600	Moderate
B9	The inconsistency of the volume of work in the contract with the real conditions in the field of the dock project.	252	8.400	Moderate
C1	Unpredictable weather hampered the pier repair work.	199	6.633	Moderate
C3	The occurrence of natural disasters during the implementation of the pier repair project.	336	11.200	Moderate
C4	The geological condition of the dock soil is not in accordance with construction standards.	226	7.533	Moderate
D2	Lack of teamwork in the work of the dock repair project.	289	9.633	Moderate
D4	Conflicts between workers during the implementation of the dock project.	252	8.400	Moderate
D5	The workforce is exhausted due to the large amount of overtime work.	252	8.400	Moderate
E2	Lack of implementation of K3 aspects, such as not using masks or gloves.	426	14.200	High
E3	Do not use work safety equipment when working on the dock.	424	14.133	High
E4	The occurrence of work accidents during the pier repair project.	254	8.467	Moderate
E5	Injuries to the workforce due to the use of materials or equipment.	249	8.300	Moderate
F1	Non-smooth funding from the project	256	8.533	Moderate

	owner (owner).			
F3	Increase in fuel oil (BBM) prices during the project.	260	8.667	Moderate
F4	The increase in the price of dock construction materials.	234	7.800	Moderate
F5	Delays in the project schedule lead to additional costs.	578	19.267	High

Table 3 shows the main risks in the dock repair project at PT Orela Shipyard Gresik. Most of the risks are classified as moderate, but four risks are categorized as high and require mitigation priority. The highest risk is project delay (F5) with a value of 19,267, which has the potential to increase operational costs and damage the contractor's relationship with the project owner. Overloading the machine (A8) with a value of 14,367 can cause equipment damage and work accidents, so operator supervision and training are required. Lack of implementation of OSH (E2) and non-use of occupational safety equipment (E3) were valued at 14,200 and 14,133 respectively, which increase the risk of occupational injuries and diseases, requiring safety training and strict supervision.

Risks in the medium category (5,600–11,467) include non-conformance of technical measurements (A1), difficulty in accessing heavy equipment (A3), materials not on order (B1), unpredictable weather (C1), and labor conflicts (D4). Although the impact is smaller than the high risk, it still needs to be managed so that it does not develop into a bigger problem. Companies must focus on managing high risks to prevent major losses and maintain moderate risk management so that the project runs smoothly.

3.1.4. Risk Control

The risk control stage in this study aims to reduce or manage high and medium risks in the pier repair project at PT Orela Shipyard Gresik. The process began with the preparation and distribution of a risk control questionnaire to three respondents. Control is carried out based on the risk control hierarchy, namely elimination, substitution, engineering, administration, and the use of personal protective equipment (PPE). The results of the questionnaire were analyzed using Microsoft Excel to formulate recommendations for mitigation actions to minimize the negative impact on the project.

A. Project Risk

Identified as "Moderate":

1. Technical measurement discrepancies (A1): Mitigation through coordination with consultants, the use of modern measuring instruments, and elevation adjustments based on field surveys.
2. Difficult access for machines (A3): Solutions in the form of special lane creation, traffic management, and machine scheduling.
3. Citizen rejection (A5): Elimination approach with education, communication with community leaders, and licensing.
4. Loss of materials/equipment (A6): Installation of CCTV, security team, and recording of materials and tools.

Identified as "High":

1. Equipment damage due to overload (A8): Mitigation by regular checks, ensuring soil carrying capacity, and strengthening the foundation.

B. Technical Risk

Identified as "Moderate" risks:

1. Non-conforming construction materials (B1): Substitutions with materials that meet specifications, strict verification, and selection of trusted suppliers.
2. Disadvantages of heavy equipment (B4): Additional rentals, use of multifunctional tools, and priority-based work scheduling.
3. Improper work method (B6): Periodic evaluation of work methods and application of modular construction for efficiency.
4. Machine breakdown (B7): Regular inspections, spare equipment rental, and availability of spare parts on site.
5. Road damage due to heavy equipment (B8): The use of heavy equipment according to the capacity of the pier, immediate road repair, and temporary strengthening of the pier.

C. Environment Risk

Identified as "Moderate" risk:

1. Unpredictable weather (C1): Adjusts work schedules based on weather forecasts, stops work during extreme weather, and provides temporary protection in the work area.
2. Natural disasters (C3): Strengthening pier structures to make them earthquake and flood resistant, adjusting project schedules to safer seasons, and preparing mitigation and evacuation procedures.
3. Unsuitable soil geology (C4): Adjusting construction methods and materials, modifying dock structures, and piling up rocks for soil reinforcement and breakwaters.

D. Human Risk

Identified as "Moderate" and the key risks and mitigation measures are:

1. Lack of teamwork (D2): Engineering work systems through clear division of tasks, project management tools, integrated communication, and a conducive work environment.
2. Labor conflicts (D4): Resolution through discussion/mediation forums, substitution of problematic labor with more competent ones, and elimination of conflict triggering factors.
3. Fatigue due to overtime (D5): Engineering work schedules with a balanced division of shifts, substitution of additional workers, and administration of overtime policies according to regulations.

E. OHS Risk

Key risks and mitigation measures are:

1. Lack of implementation of OSH ("High" Risk Level): Substitution through regular training, strict supervision of the use of PPE, and sanctioning violators.
2. Not using occupational safety equipment ("High" Risk Level): Surprise inspections, direct reprimands, and provision of standard PPE.
3. Work accidents ("Medium" Risk Level): Hazard elimination through routine

inspections, equipment arrangement, use of automated technology, and administration of training and OSH protocols.

4. Material/equipment injuries ("Moderate" Risk Level): Elimination by replacing risky materials, engineered work protection such as anti-injury gloves, and intensive training.

F. Financial Risk

Key risks and mitigation measures are:

1. Non-liquidity of funds ("Medium" Risk Level): Administration of a clear payment schedule, regular evaluation, and intensive communication with the project owner.
2. Fuel price increase ("Medium" Risk Level): Budget administration with reserve funds, fuel consumption efficiency engineering, and alternative fuel substitution.
3. Rising material prices ("Moderate" Risk Level): Market surveys, bulk purchases for discounts, and substitution of standard-compliant alternative materials.
4. Project schedule delays ("High" Risk Level): Acceleration of work, regular progress evaluation, and optimization of resources without compromising quality.

4. CONCLUSION

This study identified 25 out of 37 risk indicators in the pier repair project at PT. Orela Shipyard Gresik, which is classified into six main categories: project risk, technical, environment, human, occupational safety and health (K3), and financial. Some of the high-level risks that have the potential to disrupt projects include damage or collapse of heavy equipment due to overload (14,367), lack of implementation of OSH such as not using PPE (14,200), non-compliance with work safety equipment (14,133), and delays in project schedules that cause additional costs (19,267). To control risks, it is recommended to regularly check heavy equipment, strengthen the work track, and ensure sufficient soil carrying capacity. K3 training, strict supervision of the use of PPE, sanctions for violating workers, and surprise inspections to ensure compliance are also recommended. In addition, it is necessary to accelerate work schedules, evaluate routine progress, and optimize resources to avoid project delays. Moderate risks will be managed periodically to maintain the smooth running of the project.

4.1 Further Research

This research is expected to be further developed with more varied sampling to obtain more diverse results. In addition, future research may focus on long-term risk analysis, such as the impact on structural resilience and the effects of climate change on repaired docks.

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