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Research Paper

Managing Cost and Schedule Risks in High-Rise Building Projects: A Case Study from Jakarta, Indonesia

Alifia Indra Septiaji[1], Arman Jayady[2], Fitri Suryani[3]
[1,2,3](Post Graduate Program of Civil Engineering, Faculty of Engineering Universitas Persada Indonesia Y.A.I., Jakarta, Indonesia)
Corresponding Author: Alifia Indra Septiaji

ABSTRACT : *Building construction projects are inherently complex and exposed to various risks that may significantly affect project performance, particularly in terms of cost and time. This study investigates risk management practices from the perspective of the contractor on the XY Building Construction Project in Jakarta, Indonesia. A qualitative descriptive methodology was employed, involving literature review, expert interviews, and structured questionnaires to identify potential risks. Risk analysis was conducted using the Probability Impact Matrix (PIM) method, where 32 risk factors were identified and validated by experienced professionals. From the analysis, five dominant risks were categorized as high-priority, including, target production shortfalls, delays in external approvals, late material deliveries, inefficient management coordination, and limited access for heavy equipment. Appropriate mitigation strategies were formulated based on expert responses, including improved on-site management, vendor diversification, and traffic coordination for equipment access. These strategies aim to minimize the impact of critical risks and enhance project delivery efficiency. The findings contribute to a better understanding of risk prioritization and practical response planning in high-risk building construction environments.*

KEYWORDS: *risk management, construction project, cost risk, schedule risk, Probability Impact Matrix, contractor perspective*

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I. INTRODUCTION

Major cities in Indonesia, such as Jakarta, already have high-rise buildings and are expected to continue to grow. These tall buildings in major cities are generally used for residential, institutional, and business purposes. Building construction projects have many development risks, thus mitigation is needed to minimize these risks. Risk factors present in building projects can affect the work execution process. Building construction projects have high complexity, resulting in diverse risks. These risks, if not addressed, can affect contractors or the performance and quality of the project. The XY Building Construction Project in Jakarta is one of the most complex and high-risk construction projects. In its implementation, contractors face various potential risks that can affect project performance, particularly in terms of cost and time. Therefore, an in-depth study of risk management in this project is needed, especially from the perspective of contractors, so that appropriate handling strategies can be formulated to support project success. Risk management activities are expected to reduce negative impacts on work and minimize losses in terms of cost and time of work.

II. LITERATURE STUDY

Vaughan defines risk as a situation in which there is a chance of undesirable deviations from expectations. Uncertainty generates risk, and vice versa. Uncertainty is a significant role in decision-making. Risk is the possibility or probability of something happening that has an impact and is measured based on the law of cause and effect [1]. According to ISO 31000:2018 [2], risk management is a set of coordinated operations used to steer and control an organization's risk exposure. Delays in project development are often caused by unidentified project risk factors, which can lead to project delays and unexpected cost increases [3].

Risk identification is a component of risk management that identifies an organization's objectives that may be influenced by hazards. The risk identification process must identify unexpected occurrences and outcomes, threats posed by risks, and existing opportunities. According to Kassem et al.'s [4] research, the value of a risk is calculated by multiplying its frequency and impact. The method of determining risk levels requires assessments of a risk's frequency and impact. The Likert scale has a numerical range of 1 to 5. Once the frequency and impact levels of a risk are established, they can be plotted on the Probability Impact Matrix. Risk management is a process in which an organization assesses prospective losses and takes action to mitigate or eliminate those threats. Risk management is frequently done as early as feasible since it is more effective than addressing problems that have occurred.

III. RESEARCH METHOD

The research method used in this study is a descriptive qualitative method, which aims to identify and analyze the risks present in the XY Building Development Project in Jakarta regarding cost and time, from the perspective of contractors. Interview methods with questionnaires and literature studies were used in risk identification and analyzed using the Probability Impact Matrix (PIM) method. The respondents for the questionnaire were workers on the Development Project of XY High Rise Building in Jakarta.

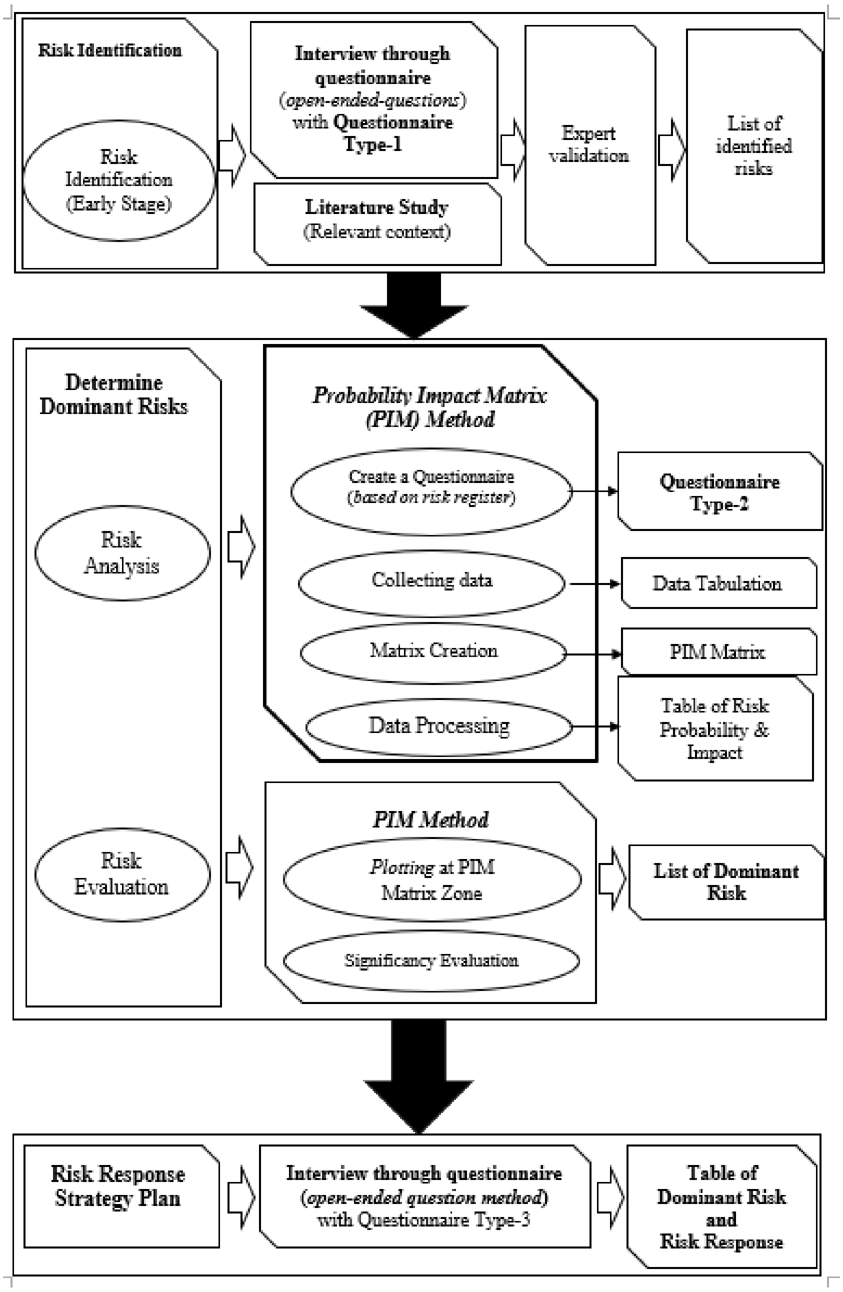

Figure 1 Research Flowchart

The questionnaire data obtained is a Likert scale with a scale of 1-5, as shown in the following table.

Table 1 Likert scale of risk probability and risk impact

	Scale				
Probability	1	2	3	4	5
Impact	1	2	3	4	5

Table 2 Probability risk scale

Scale	Evaluation	Explanation
1	Very rarely	Rarely occurs, only under certain conditions
2	Rarely	Sometimes occurs under certain conditions
3	Common	Occurs under certain conditions
4	Often	Often occurs in every condition
5	Very often	Always occurs in every condition

Table 3 Impact risk scale

Scale	Evaluation	Explanation
1	Very low	No impact on project quality
2	Low	Rarely impact on project quality
3	Medium	Sometimes impact on project quality
4	High	Often impact on project quality
5	Very high	Always impact on project quality

The discovered risks can be categorized by plotting the level values collected from the respondents on a probability impact matrix.

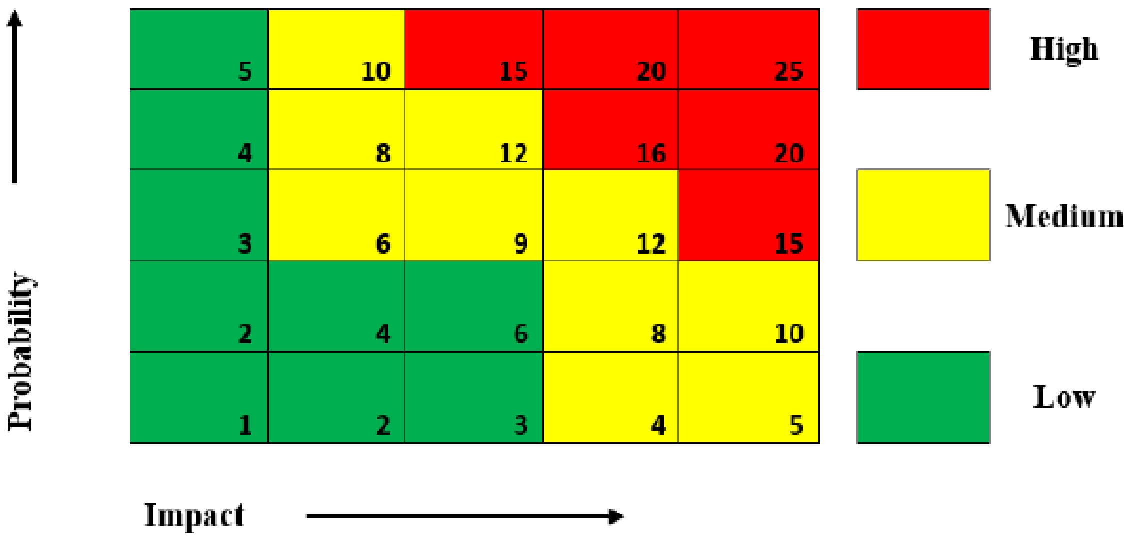

Figure 2 Probability Impact Matrix

IV. RESULT AND DISCUSSION

Based on the risk identification results, the identified hazards in the XY Building Development Project in Jakarta are 10 risks based on questionnaires and 30 risks based on literature studies, totalling 32 different types of risk. The list is shown on table below

Table 4 List of risk identification based on questionnaires

No	Risk
1	Target production shortfalls
2	Delays in external approvals
3	Shop drawings are late and incomplete
4	Changes in government regulations
5	Extreme weather
6	Late material deliveries
7	Low labor productivity and worker strikes
8	Design changes
9	Inefficient management coordination
10	Work accidents

Table 5 List of risk identification based on literature study

No	Types of Risk
1	Low worker productivity [3]
2	Unsupportive owner [5]
3	Delayed payments by the owner [5]
4	Limited access for heavy equipment [5]
5	Vandalism of project facilities [5]
6	Damage to project equipment [5]
7	Procurement of materials not meeting technical specifications [5]
8	Design changes due to adjustments to field conditions [5]
9	Differences in document interpretation between the owner and contractor [5]
10	Failure to follow work instructions/procedures [6]
11	Weak supervision on site [5]
12	Labor strikes [5]
13	Discrepancies between the plan drawings and the actual conditions at the project site [3]
14	Delays in the delivery of building materials [6]
15	Contractor's cash flow disrupted due to late installment payments [3]
16	Incomplete drawings and technical specifications [7]
17	Differences between the measured volume of work and the actual conditions on site [7]
18	Unpredictable weather [3]
19	Damage to machinery and project equipment [8]
20	Damage during the maintenance period [8]
21	Difficulty using new technology [8]

No	Types of Risk
22	Rejected work from owner [8]
23	Changes in the scope of work [9]
24	Inappropriate selection of construction methods [9]
25	Damage/loss of materials [9]
26	Lack of material storage space [9]
27	Changes in materials from the owner [9]
28	Lack of control over the project schedule [9]
29	Change order (changes in a construction project that include replacement, reduction, addition, or deletion of work after the contract is signed) [9]
30	Poor site conditions [9]

This list of risks was then validated by experts with more than ten years of experience, yielding a validated list of 32 different types of risks, as shown in the table below.

Table 6 List of risk identification based on expert validation

No	Risk
1	Target production shortfalls
2	Delays in external approvals
3	Shop drawings are late and incomplete
4	Changes in government regulations
5	Extreme weather
6	Late material deliveries
7	Low labor productivity and worker strikes
8	Design changes
9	Inefficient management coordination
10	Work accidents
11	Delayed installment payments by the owner
12	Damage to project equipment and facilities
13	Material procurement not meeting technical specifications
14	Differences in document interpretation between owner and contractor
15	Limited access for heavy equipment
16	Failure to follow work instructions/procedures
17	Weak supervision on site
18	Discrepancies between plan drawings and site conditions
19	Cash flow disrupted due to late installment payments
20	Differences between volume measurement results and actual site conditions
21	Damage to machinery and project equipment
22	Damage during the maintenance period
23	Difficulties in using new technology
24	Rejected work from owner
25	Changes in the scope of work
26	Inappropriate selection of construction methods

No	Risk
27	Damage/loss of materials
28	Lack of material storage space
29	Changes in materials by the owner
30	Insufficient control over the project execution schedule
31	Change orders (changes in construction projects including replacement, reduction, addition, or elimination of work after the contract is signed)
32	Poor site conditions

The outcomes of the risk identification validation serve as the foundation for additional questionnaire data collection aimed at identifying the most prevalent dangers. Using a Likert scale from 1 to 5, the information gathered from this survey shows the probability and impact values. The average for each risk list that the respondents had previously specified was then computed in order to tabulate this data. The results of these risk value assessments are provided in the table below.

Table 7 Risk value assessments analysis result

No	Risk	Impact		Probability	
		Score	Category	Score	Category
1	Target production shortfalls	3,14	High	3,29	Often
2	Delays in external approvals	2,86	Medium	3,14	Often
3	Shop drawings are late and incomplete	2,57	Medium	2,43	Common
4	Changes in government regulations	2,29	Medium	1,86	Rarely
5	Extreme weather	2,43	Medium	2,57	Common
6	Late material deliveries	3,43	High	3,29	Often
7	Low labor productivity and worker strikes	2,71	Medium	2,29	Common
8	Design changes	2,86	Medium	2,86	Common
9	Inefficient management coordination	3,14	High	2,71	Common
10	Work accidents	2,86	Medium	2,29	Common
11	Delayed installment payments by the owner	2,86	Medium	2,71	Common
12	Damage to project equipment and facilities	2,29	Medium	2,57	Common
13	Material procurement not meeting technical specifications	2,57	Medium	2,14	Common
14	Differences in document interpretation between owner and contractor	2,43	Medium	2,71	Common
15	Limited access for heavy equipment	3,14	High	2,57	Common
16	Failure to follow work instructions/procedures	2,71	Medium	2,29	Common
17	Weak supervision on site	2,71	Medium	2,14	Common
18	Discrepancies between plan drawings and site conditions	2,71	Medium	2,14	Common
19	Cash flow disrupted due to late installment payments	3,00	Medium	2,57	Common

No	Risk	Impact		Probability	
		Score	Category	Score	Category
20	Differences between volume measurement results and actual site conditions	2,86	Medium	2,86	Common
21	Damage to machinery and project equipment	3,00	Medium	2,86	Common
22	Damage during the maintenance period	2,71	Medium	2,43	Common
23	Difficulties in using new technology	2,29	Medium	2,14	Common
24	Rejected work from owner	2,57	Medium	2,29	Common
25	Changes in the scope of work	2,57	Medium	2,43	Common
26	Inappropriate selection of construction methods	2,57	Medium	2,14	Common
27	Damage/loss of materials	2,43	Medium	2,43	Common
28	Lack of material storage space	2,57	Medium	2,43	Common
29	Changes in materials by the owner	2,71	Medium	2,71	Common
30	Insufficient control over the project execution schedule	3,00	Medium	2,71	Common
31	Change orders (changes in construction projects including replacement, reduction, addition, or elimination of work after the contract is signed)	2,71	Medium	2,57	Common
32	Poor site conditions	2,29	Medium	2,14	Common

The risk list can be displayed into a probability and impact matrix based on the calculation findings, providing an excellent visual tool to aid in the risk appraisal and management process. The PIM matrix image for this investigation is presented in the figure below.

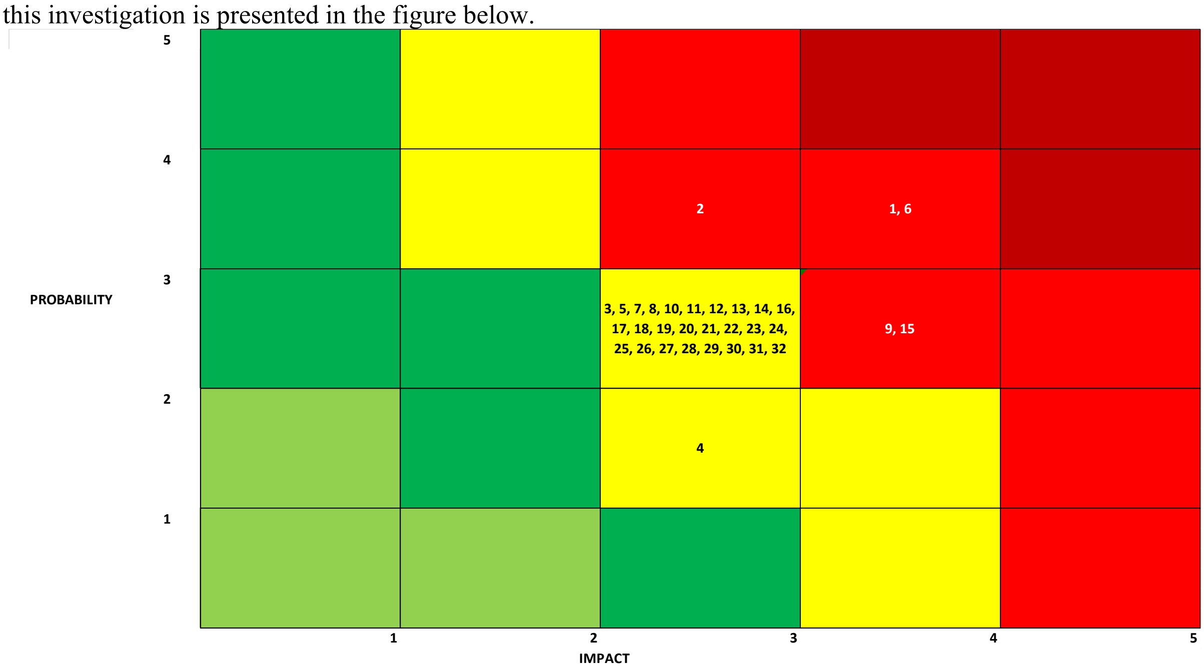

Figure 3 Probability Impact Matrix Plot

The results of plotting the risk list into a probability and impact matrix show that there are nine risks that fall into the dominant risk category. The list of dominant risks is shown in the following table.

Table 8 List of dominant risk

No	Risiko	Impact		Probability	
		Score	Category	Score	Category
1	Target production shortfalls	3,14	High	3,29	Often
2	Delays in external approvals	2,86	Medium	3,14	Often
3	Late material deliveries	3,43	High	3,29	Often
4	Inefficient management coordination	3,14	High	2,71	Common
5	Limited access for heavy equipment	3,14	High	2,57	Common

In order to collect feedback on risk mitigation, a questionnaire was given to seasoned practitioners after nine major risks were identified from the results of the prior analysis. The respondents' responses to the previously determined dominant risk response measures are shown in the table below.

Table 9 Risk response strategy

No	Risk	Response Strategy
1	Target production shortfalls	- Periodic evaluation - Strengthen field management - Real-time monitoring - Adjust work methods and resources - Create contingency plans - Increase staff, workers, subcontractors, and optimizing everyone's performance - Increase working hours - Enhance supervision and quality control
2	Delays in external approvals	- Plan work submissions to external party earlier. - Communicate proactively and carefully with external parties. - Create a flexible project schedule. - Conduct initial planning. - Prepare complete submission documents.
3	Late material deliveries	- Vendor diversification - Scheduling procurement earlier - Maintain minimum stock of crucial materials - Using a logistics tracking system - Select suppliers with a good reputation and on-time delivery - Monitoring material shipments - Evaluate vendors - Create contingency plans
4	Inefficient management coordination	- Establish a clear organizational structure - Conduct regular coordination meetings - Utilizing integrated management software - Defining responsibilities and targets for each team - Monitoring every message delivered - Enhance supervision of each team
5	Limited access for heavy equipment	- Conduct a thorough access survey - Selecting heavy equipment with appropriate dimensions and capacity - Coordinate with residents and local authorities for traffic management - Create access routes - Develop contingency plans - Schedule strategically

V. CONCLUSION

This study highlights the importance of effective risk management in building construction projects, especially from the perspective of contractors who are directly exposed to operational uncertainties. Through a combination of literature review, expert interviews, and quantitative analysis using the Probability Impact Matrix (PIM), a total of 32 risks were identified on the XY Building Project in Jakarta.

Among these, five were categorized as dominant risks with significant potential to disrupt project cost and time performance. These include issues such as target production shortfalls, delays in material delivery, and inefficient management coordination. To address these critical risks, this research formulated specific response strategies such enhancing on-site management and diversifying vendors. These responses are expected to improve project efficiency and reduce the likelihood of cost overruns and time delays. The study reinforces the role of structured risk identification and response planning in ensuring successful project delivery within high-risk urban construction environments.

VI. RECOMMENDATION

Practically, it is recommended that contractors foster stronger collaboration with project owners, especially in areas of scheduling, permitting, and financial flows, to pre-emptively resolve administrative and technical obstacles. Ensuring that all permits and legal documents are complete and compliant with regulations is also crucial to avoid delays and disputes.

For future academic research, it is suggested to expand the study across multiple building projects with varying scales and complexities to enhance the generalizability of the findings. Moreover, incorporating more advanced quantitative methods, such as Monte Carlo simulation or Fuzzy-PIM, could enrich the risk analysis and provide deeper insights into risk prioritization under uncertainty.

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