Journal of Mechanical, Civil and Industrial Engineering
ISSN: 2710-1436
DOI: 10.32996/jmcie
Journal Homepage: www.al-kindipublisher.com/index.php/jmcie

JMCIE
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Identification of Dam Construction Risks to Job Owners: A Case Study of Dam Construction in East Java, Indonesia

Firman Yudi Pratama[1] ✉ Achfas Zacoeb[2] and Ming Narto Wijaya[3]
[123]Faculty of Engineering, Department of Civil Engineering, Universitas Brawijaya, Indonesia
Corresponding Author: Firman Yudi Pratama, **E-mail**: Firmanyudi77@gmail.com

| ABSTRACT
Approach to risk management, knowing the potential risks in realizing the construction of a dam construction on the side of the work owner in the East Java area. in the construction of a dam construction on the job owner has a potential effect on the success of the project. To achieve schedule, cost, quality, and service an effective risk management approach is carried out. The purpose of this research is to identify risks and provide a priority order of risks for the owner of the dam construction project in East Java that are most likely to occur to minimize the consequences arising from these risks. The identified risks will then be carried out by research using the Failure Mode and Effect Analysis (FMEA) method and then the highest risk priority sequence will be obtained so that the appropriate risk response can be determined in addressing these potential risks. It is hoped that in the next dam construction, the work owner will already know the biggest potential risks to minimize cost overruns, time, and quality.

| KEYWORDS

Risk Identification, Risk Potential, Owner, FMEA

| ARTICLE INFORMATION

ACCEPTED: 16 May 2023 **PUBLISHED:** 22 May 2023 **DOI:** 10.32996/jmcie.2023.4.2.4

1. Introduction

Construction projects have the primary objective of meeting functional requirements. The parties involved in construction are work owners, service providers, and work supervisors. The parties involved in construction have their respective roles and functions, in fulfilling the construction development activities will pose potential risks for each party.

Olsson in Serpella (2014) argues that there is uncertainty in everyday life in the organization of a project. There is a relationship between uncertainty to risk but risk is a measured uncertainty and uncertainty is a risk that cannot be measured (Hillson. 2011). To minimize the risks that will occur, it is necessary to make risk management which includes steps related to risk planning, risk identification, risk assessment, risk analysis, risk response, risk monitoring, and recording the risk management process (ISO, 2009).

The challenge of effective risk management is to convert as many unknown risks as possible into known risks through risk identification, assessment, and control, the purpose of risk management itself is to increase positive events and reduce negative events (threats) in the project according to Mulcahy in Hosny et al (2018).

Dam construction is a construction that functions for the wider community. Development has three (3) financing structures is a Owner, Contractor and supervisor, but in general dams in Indonesia use a budget from the government. Dam construction work owners are currently faced with various problems such as land acquisition, budget changes, efficiency in organization, changes in layout design, demonstrations by the community, social relations, incidents that occur, and so on. This situation creates problems that can hinder work and increase the difficulty in estimating costs and time accurately.

To mitigate potential risks, good and appropriate risk management is needed to avoid risks that will possibly occur. If there is a risk that occurs, an organization that risks are quickly handled because it already knows what actions must be taken. The dam construction process in East Java began in 2019 and is planned to be completed in 2022 but has an additional *multi-year contract* until 2024. There are several problems in the construction so the construction of the dam becomes one of the high-risk projects. This will cause various risks that will affect the construction of the dam

Owners of dam construction work in East Java have risks that must be identified so that work owners can know the high-risk factors that can affect dam construction

The research conducted includes the identification, analysis, and rating of risks that will be potential risks for job owners during the construction period. The risks to be identified can be used in the construction of dams within the owner's side of the work. This research has the advantage that it can be used as a reference source for construction companies, especially in the field of dam construction work so that it can be used to minimize the risks posed

2. Methodology

The primary data collection method in the study was carried out with the results of questionnaires with several officials and supervisors who have authority on dam construction in East Java who were selected as respondents related to risk assessment. The flow chart in the following of research repreparation as shown in Figure 1

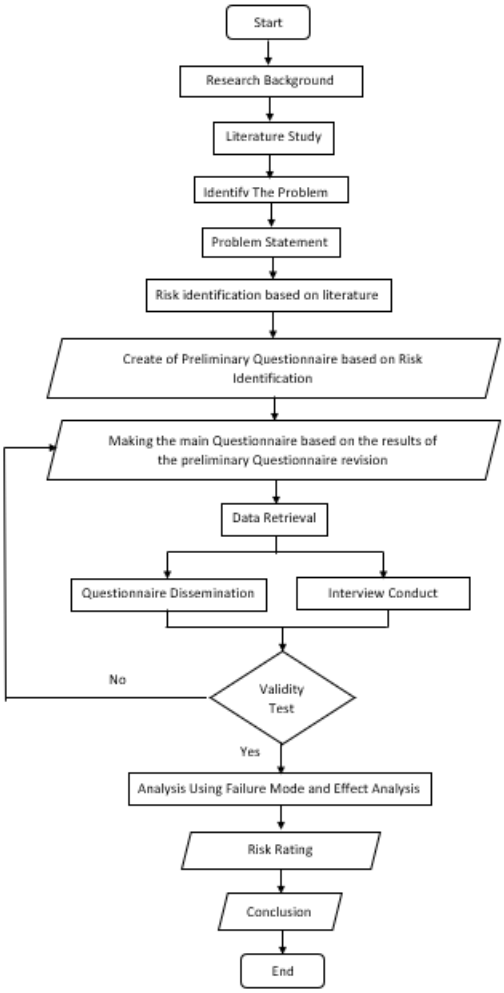

Figure 1 - Flow Chart

Respondents in dam construction research in East Java are the owners of work involved in the implementation of dam construction projects. The identity of respondents was asked about their name, position, level of education, and work experience.

Risk management is defined as the process of risk factors. Risk management is an ongoing process on a project to manage the entire project turnaround. The work unit on a project needs a standard for handling potential events that can cause losses to the project. According to (Juran, 2018) states There are three factors or methods of failure that exist in FMEA, namely Severity, Occurrence and Detection.

Risk data analysis using the Failure Mode and Effect Analysis (FMEA) method uses three criteria, namely severity, occurrence, and detection. Severity is the severity of the effect of a failure risk that will be perceived by the user, occurrence is the level of frequency of occurrence of each failure or cause of failure, and detection is the possibility that failure will be detected before affecting a risk.

Of these three criteria, the final result to determine high risk is the Risk Priority Number (RPN) value. The RPN value is obtained from Equation 1.

$$RPN = Severity \times Occurrence \times Detection \quad (1)$$

The risk value is wailed on the results of distributing questionnaires to the intended respondents. After calculating the RPN, the highest potential risk from dam construction was obtained from the owner of the work in East Java.

3. Results and Discussion

Risk identification is made using secondary data, namely data obtained from agencies in charge of dam construction work in East Java. risk preparation based on Circular Letter of the Ministry of Public Works and Public Housing Number 04/SE/M/2021 concerning guidelines for the implementation of risk management. There are 7 (seven) risks, namely financial, reputation, fraud, legal, work accident, service, and performance risks. After obtaining the data, the potential risks are compiled, and make a preliminary questionnaire to ask whether the risk has high potential or not, so that the following risks are obtained as shown in Table 1.

Table 1 Risk Identification

No	Types of risks	Failure Mode
1	Reputational Risk	Negative news on public
2		Abandoned work
3	Performance Risk	Overpay on a Progress
4		Delay in Work progress
5		Rejection of the proposed budget increase plan
6		The investigation design study document is not in accordance with the conditions in the field
7		Problematic environmental impact analysis documents
8		Delayed Auction process
9		Document Licensing Not in Accordance with the Proposal
10		Structural Failure
11	Legal Risk	Communities Resist Land Acquisition
12		Differences in mechanisms with other ministries
13		Delay in Submission & Disbursement of Guarantees to the Bank by the provider
14	Service Risk	Natural Disasters (Landslides, Earthquakes)
15		Design Review
16		The dam cannot operate immediately
17	Budget Risk	Proposed Budget Increase Request
18		Refocusing the Budget
19	Risk of fraud	Execution of Work not in accordance with technical specifications
20		Unsuitable Experts
21	Risk of Work Accidents	Work accidents resulting in loss of life

After obtaining risk identification, a validation test will be carried out by using the IBS SPSS Statistic 25 application by comparing their r_{count} and r_{table} at a 95% confidence level. An item will be valid if it correlates significantly with a score at a 95% confidence level. The validity test is carried out with these 3 Log Person, Corelation, and Sig Tailed. Validity test is done by looking at the Pearson Correlation significance value. The results of the validity test as shown in Table 2.

Table 2 - Output Pearson Correlation

Correlations		Total	Result
A1	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
A2	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
B1	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
B2	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
B3	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
B4	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
B5	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
B6	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
B7	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
B8	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
C1	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
C2	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
C3	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
D1	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
D2	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
D3	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
E1	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
E2	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
F1	Pearson Correlation	1	Valid

	Sig. (2-tailed)	0	
F2	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
G1	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	
TOTAL	Pearson Correlation	1	Valid
	Sig. (2-tailed)	0	

The implementation of the reliability test is carried out after the validity test. The reliability test is expressed at values between 0-1. Reliability testing is done by comparing the value of Cronbach's alpha with the level / significant level used with criteria as follows: If the value of *Cronbach's alpha* > a significant level, then the instrument is declared reliable. If the value of Cronbach's alpha < a significant level, then the instrument is declared unreliable. The level of reliability based on Cronbach's Alpha as shown in in Table 3.

Table 3 - Reliability Levels

Cronbach's Alpha	Reliability Level
0.00 s/d 0.20	Unreliable
0.20 s/d 0.40	Less Reliable
0.40 s/d 0.60	Quite Reliable
0.60 s/d 0.80	Reliable
0.80 s/d 1.00	Highly Reliable

Source: [4]

The next step is to test the reliability by comparing the value of Cronbach's Alpha. The Cronbach's Alpha value from statistics output obtained was 0.973 as shown in Table 4. by referring to Table 3 the interpretation is highly reliable.

Table 4 - Output Reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
0.973	21

The analysis of the FMEA method issues an output, namely the Risk Prority Number (RPN) which will be able to determine the priority risk for dam construction. RPN is obtained from three criteria, namely Severity (S), Occurrence (O), and Detection (D). The following is the average result of the questionnaire distributed to the intended respondents as shown in Table 5.

Table 5 - Average Results of the Questionnaire

Types of risks	Failure Mode		$\bar{x}$ (S)	$\bar{x}$ (O)	$\bar{x}$ (D)
Reputational Risk	A.1	Negative news on public	3,000	3,000	2,000
	A.2	Abandoned work	3,000	3,000	2,000
Performance Risk	B.1	Overpay on a Progress	3,000	3,000	2,000
	B.2	Delay in Work progress	4,000	4,000	3,000
	B.3	Rejection of the proposed budget increase plan	3,000	3,000	3,000

	B.4	The design investigation study document is not in accordance with the conditions in the field	4,000	4,000	3,000
	B.5	Problematic environmental impact analysis documents	3,000	3,000	2,000
	B.6	Delayed Auction process	3,000	3,000	2,000
	B.7	Document Licensing Not in Accordance with the Proposal	3,000	3,000	3,000
	B.8	Structural Failure	3,000	3,000	2,000
Legal Risk	C.1	Communities Resist Land Acquisition	4,000	3,000	2,000
	C.2	Differences in mechanisms with other ministries	3,000	3,000	3,000
	C.3	Delay in Submission & Disbursement of Guarantees to the Bank by the provider	3,000	2,000	2,000
Service Risk	D.1	Natural Disasters (Landslides, Earthquakes)	3,000	3,000	3,000
	D.2	Design Review	3,000	3,000	2,000
	D.3	The dam cannot operate immediately	3,000	3,000	2,000
Budget Risk	E.1	Proposed Budget Increase Request	3,000	3,000	3,000
	E.2	Refocusing the Budget	4,000	3,000	3,000
Risk of fraud	F.1	Execution of Work not in accordance with technical specifications	3,000	3,000	2,000
	F.2	Unsuitable Experts	3,000	3,000	2,000
Risk of Work Accidents	G.1	Work accidents resulting in loss of life	3,000	3,000	2,000

The calculation of Risk Priority Number (RPN) uses three variables, namely severity, occurrence, and detection. From the data obtained, an analysis of the calculation of the average value obtained on an indicator with the results as shown in Table 6.

Table 6 - RPN Value Results

Types of risks	Failure Mode		$\bar{x}$ (S)	$\bar{x}$ (O)	$\bar{x}$ (D)	RPN
Reputational Risk	A.1	Negative news on public	3,000	3,000	2,000	18
	A.2	Abandoned work	3,000	3,000	2,000	18
Performance Risk	B.1	Overpay on a Progress	3,000	3,000	2,000	18
	B.2	Delay in Work progress	4,000	4,000	3,000	48
	B.3	Rejection of the proposed budget increase plan	3,000	3,000	3,000	27
	B.4	The design investigation study document is not in accordance with the conditions in the field	4,000	4,000	3,000	48

	B.5	Problematic environmental impact analysis documents	3,000	3,000	2,000	18
	B.6	Delayed Auction process	3,000	3,000	2,000	18
	B.7	Document Licensing Not in Accordance with the Proposal	3,000	3,000	3,000	27
	B.8	Structural Failure	3,000	3,000	2,000	18
Legal Risk	C.1	Communities Resist Land Acquisition	4,000	3,000	2,000	24
	C.2	Differences in mechanisms with other ministries	3,000	3,000	3,000	27
	C.3	Delay in Submission & Disbursement of Guarantees to the Bank by the provider	3,000	2,000	2,000	12
Service Risk	D.1	Natural Disasters (Landslides, Earthquakes)	3,000	3,000	3,000	27
	D.2	Design Review	3,000	3,000	2,000	18
	D.3	The dam cannot operate immediately	3,000	3,000	2,000	18
Budget Risk	E.1	Proposed Budget Increase Request	3,000	3,000	3,000	27
	E.2	Refocusing the Budget	4,000	3,000	3,000	36
Risk of fraud	F.1	Execution of Work not in accordance with technical specifications	3,000	3,000	2,000	18
	F.2	Unsuitable Experts	3,000	3,000	2,000	18
Risk of Work Accidents	G.1	Work accidents resulting in loss of life	3,000	3,000	2,000	18

Figure 2 shows the average value of RPN. The highest average value is a budget risk; this means that it is important for financial or budget management to set budget priorities.

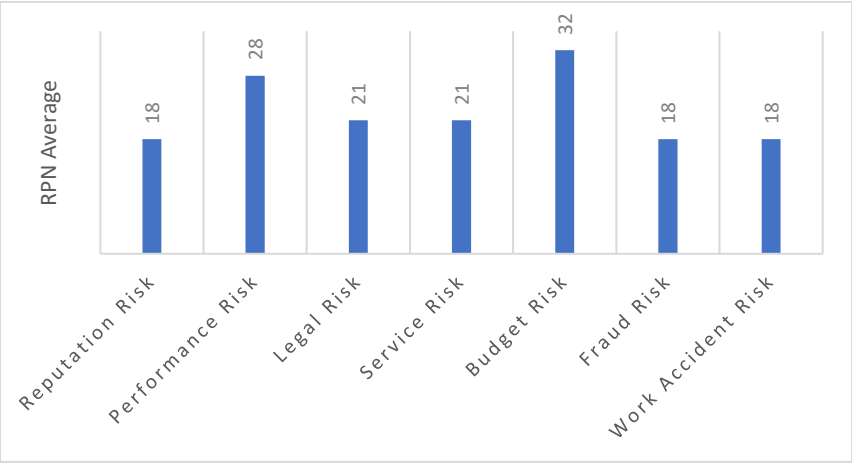

Figure 2 - RPN Average

After getting the RPN value for each risk, it will be sorted from the highest to the lowest RPN value so that risk priority will be obtained for the owner of the dam construction work. The sorting results of RPN value as shown in Table 7.

Table 7 - Risk Ranking Based on RPN Value

Failure Mode		Saverity	Occurance	Detection	RPN
B.2	Delay in Work progress	4,000	4,000	3,000	48
B.4	The design investigation study document is not in accordance with the conditions in the field	4,000	4,000	3,000	48
E.2	Refocusing the Budget	4,000	3,000	3,000	36
B.3	Rejection of the proposed budget increase plan	3,000	3,000	3,000	27
B.7	Document Licensing Not in Accordance with the Proposal	3,000	3,000	3,000	27
C.2	Differences in mechanisms with other ministries	3,000	3,000	3,000	27
C.1	Communities Resist Land Acquisition	4,000	3,000	2,000	24
D.1	Natural Disasters (Landslides, Earthquakes)	3,000	3,000	3,000	27
E.1	Proposed Budget Increase Request	3,000	3,000	3,000	27
A.1	Negative news on public	3,000	3,000	2,000	18
A.2	Abandoned work	3,000	3,000	2,000	18
B.1	Overpay on a Progress	3,000	3,000	2,000	18
B.5	Problematic environmental impact analysis documents	3,000	3,000	2,000	18
B.6	Delayed Auction process	3,000	3,000	2,000	18
B.8	Structural Failure	3,000	3,000	2,000	18
D.2	Design Review	3,000	3,000	2,000	18
D.3	The dam cannot operate immediately	3,000	3,000	2,000	18
F.1	Execution of Work not in accordance with technical specifications	3,000	3,000	2,000	18
F.2	Unsuitable Experts	3,000	3,000	2,000	18
G.1	Work accidents resulting in loss of life	3,000	3,000	2,000	18
C.3	Delay in Submission & Disbursement of Guarantees to the Bank by the provider	3,000	2,000	2,000	12

Figure 3 shows a graph of the risk rating based on the RPN value. . The three highest RPN values are in item B.2, delays in work progress, B.4, nts the design investigation study document is not in accordance with conditions in the field, and E.2, refocusing the budget. These three items must be taken into consideration and the focus of company policy.

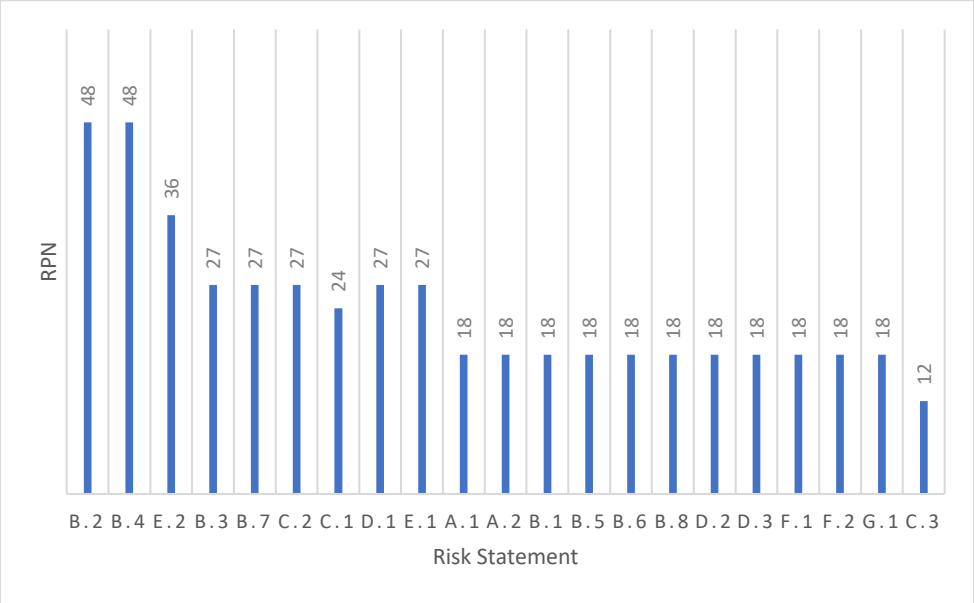

Figure 3 - Graphics Risk Ranking Based on RPN Value

In Table 7, it can be seen that the highest risks affecting dam construction work in East Java are Delays in Work Progress, SID Documents not under field conditions, and Budget Refocusing.

4. Conclusions

According to Circular Letter of the Ministry of Public Works and Public Housing Number 04/SE/M/2021, Risk identification is divided into seven (7) criteria; namely reputation risk, performance risk, legal risk, service risk, installment risk, fraud risk, and work accident risk. Each risk has a risk statement which is a sub-type of the risk. Twenty-one (21) risk statements have been identified and have gone through a preliminary questionnaire for dam construction risks in East Java, Indonesia.

A list of risks that have the potential to become high risk in dam construction is obtained. After analysis using the Failure Mode and Effect Analysis method using three criteria, namely severity, occurrence, and detection. The method produces the three highest RPN values are delays in work progress, the design investigation study document is not in accordance with conditions in the field, and refocusing the budget.

Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.
Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers.

References

[1] D Darma, B. (2021). Research Statistics by using SPSS. Guepedia (in Indonesia).
[2] Hillson, D. (2011). Dealing with Business Uncertainty. http://www.risk-doctor.com/briefings. (Accessed on 16 September 2022)
[3] Hosny, H.E., Ibrahim, A.H., & Fraig, R.F. (2018). Risk management framework for Continuous Flight Auger piles construction in Egypt. *Alexandria Engineering Journal*, Vol. 57 No.4, 2667-2677.
[4] Juran. (2018). *Guide to Failure Mode and Effect Analysis – FMEA*. Retrieved from Juran: https://www.juran.com/blog/guide-to-failure-mode-and-effect-analysis-fmea/ (Accessed on 28 September 2022)
[5] Kementerian PUPR (2021). Circular Letter of the Ministry of Public Works and Public Housing Number 04/SE/M/2021: Application of Risk Management in the Ministry of Public Works and Public Housing . Jakarta (in Indonesia).
[6] Serpella, A. F., Ferrada, X., Howard, R., & Rubio, L. (2014). Risk management in construction projects: a knowledge-based approach. *Social and Behavioral Sciences Journal*, 653-662.
[7] ISO. (2009). *ISO 31000:2009 (2009). Risk management – Principles and Guidelines,* Geneva, Switzerland.