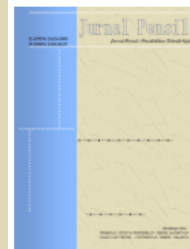


Available online at: <http://journal.unj.ac.id>

Jurnal
Pensil

Pendidikan Teknik Sipil

Journal homepage: <http://journal.unj.ac.id/unj/index.php/jpensil/index>



RISK MANAGEMENT ANALYSIS USING THE 5×5 RISK MATRIX METHOD (MIL-STD-882B): A CASE STUDY OF THE SLINGA KIRI IRRIGATION DEVELOPMENT PROJECT, PURBALINGGA REGENCY

Shasba Indah Permata Putri^{1}, Novi Andhi Setyo Purwono², Diyah Ayu Widayanti³*

^{1,3} Civil Engineering Study Program, Faculty of Engineering, Universitas Wijaya Kusuma, Jl. Raya Beji Karangsalam No. 25, Dusun III, Karangsalam Kidul, Kedungbanteng District, Banyumas Regency, Central Java, 533152, Indonesia

² Civil Engineering Study Program, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Jl. Glagahsari No. 63, D.I. Yogyakarta, 55164, Indonesia
Jalan Grafika No.2, Mlati, Sleman, Special Region of Yogyakarta, 55284, Indonesia

*shaindptr01@gmail.com, novi.andhisp@gmail.com, diyahayu@unwiku.ac.id

Abstract

Project risk management involves a systematic approach to planning, identifying, analysing and responding to potential risks throughout project implementation. This study aims to identify, evaluate and develop appropriate risk reduction strategies for the Slinga Kiri Irrigation Area project in Purbalingga Regency. In 2022, primary data were gathered during the construction phase by means of a quantitative method using structured questionnaires administered to the individuals taking part in the project. Data were analysed using the 5×5 Risk Matrix method (MIL-STD-882B) and the Importance Index, supported by IBM SPSS Statistics version 25 and Microsoft Excel. The results identified six main risk categories: materials, equipment, human resources, contractor qualifications and experience, financial factors, and field management. A total of 28 risk indicators (93.33%) fall into the medium risk category with Importance Index values of 9 and 12, while 2 indicators (6.67%) fall into the high risk category with an Importance Index value of 16, namely X6.10 (unexpected conditions and events such as extreme weather), an external/environmental risk beyond the project's direct control, and X6.7 (work accidents resulting from non-compliance with occupational health and safety/K3 procedures), a procedural/compliance risk within the contractor's internal control. Therefore, different mitigation strategies are required: preventive-corrective measures through a K3LK plan for procedural risks and adaptive-contingency measures through BMKG weather monitoring and work-method adjustments for environmental risks.

P-ISSN: [2301-8437](#)
E-ISSN: [2623-1085](#)

ARTICLE HISTORY

Accepted:
28 Maret 2026
Revision:
20 September 2026
Published:
30 September 2026

ARTICLE DOI:
[10.21009/jpensil.v15i3.66861](https://doi.org/10.21009/jpensil.v15i3.66861)



Jurnal Pensil :
Pendidikan Teknik
Sipil is licensed under a
[Creative Commons](#)
[Attribution-ShareAlike](#)
[4.0 International License](#)
(CC BY-SA 4.0).

Keywords: Management; Risk Matrix; Construction Project, Project Risk Management; Risk Identification

Introduction

To ensure national food security, water resources infrastructure is an indispensable support. This is even more critical for countries like Indonesia, which takes agriculture as its core industry; these countries' national economy and people's livelihoods are largely tied to agriculture (Kementerian Pekerjaan Umum, 2025). Whether food supply can remain stable is directly linked to the overall stability of the entire country, and having sufficient and well-utilized water resources-related facilities naturally becomes one of the most core sources of confidence. For the stable supply of water to farmland, the laying of irrigation systems plays a key role. With a reliable irrigation system, farmers no longer need to rely on the sky for rain, and the land where crops are grown can access sufficient water at any time (Fadilah, 2025). With an irrigation system, the same piece of arable land can support more planting cycles per year; there is no need to wait for more than half a month for natural water storage after one crop is harvested before sowing the next. Increasing total grain output and preventing yield reductions or crop failures due to insufficient water and soil moisture are achievable outcomes. Additionally, the livelihoods of farming households may improve, as surplus grain and additional crops can be converted into tangible income, thereby reducing economic strain. In pursuit of these objectives, Purbalingga Regency in Indonesia has initiated the construction project for the Slinga Kiri Irrigation Area (DI Slinga Kiri) (BBWS Serayu Opak, 2025). This is an initiative launched by the local government, aimed at optimizing sustainable water resources management. It not only seeks to use the available water resources more efficiently, but also to ensure they can be used long-term, without overexploiting future water resources for immediate harvests, so that this land can continue to produce grain, and farming households can sustain their improved livelihoods (Pambudi, 2025).

When implementing construction projects in practice, it is rare for projects to advance all the way smoothly; all kinds of risks are always encountered, and these unforeseen situations will all disrupt the originally planned construction rhythm. Specifically, common situations include delayed construction schedules that make it impossible to deliver the work as originally scheduled; budget overruns where the amount spent far exceeds the initially calculated figure; design flaws where the drawn-up drawings fail to meet the actual on-site requirements; or, when construction proceeds underground, the discovered geological conditions are completely inconsistent with the results of previous surveys. In addition to these problems that may arise within the project itself, many external factors also create disruptions, such as sudden extreme weather or unexpected social and environmental incidents around the project site—none of these can be fully controlled in advance (Mahyuddin et al., 2023).

According to Labombang (2011), the project's success will be greatly diminished due to the various risks involved. When referring to production efficiency, construction time is defined as the quantity of work that should be completed on schedule. It's impossible to complete and it'll affect how the project ends up in terms of overall performance. Why? It was impossible to achieve the intended outcome. The academic also presented pertinent viewpoints, stating that project risks cannot be fully managed. There is no way to completely avoid possible disasters. Nevertheless, A formal and structured management approach can mitigate the negative outcomes that come with it. Hence, One can prevent minor issues from escalating into major ones through risk management.e. Delaying the entire project can lead to derailment in risk management. Unforeseeable occurrences are now an integral part of modern project management. The entire scope of management work involves multiple processes and procedures. As mentioned in the original text, the first link is to identify all concealed risks one at a time, which is the. Risk identification process (Rodriguez, 2016).

Research Methods

This study employs a descriptive research approach that incorporates both qualitative and quantitative methods (Creswell, 2017). This research is focused on examining various risk factors

that are embedded in the construction project in Slinga Kiri Irrigation Area, Purbalingga Regency, Central Java. The research team employed three distinct methods to gather adequate data for their study. Several different techniques were used. At first, the group planned routes and observation points to conduct organized observation and record data on-site at the project location. Afterward, the team distributed questionnaires to all stakeholders who had a direct interest in the project's core objectives to gather firsthand information. The group collated all project-specific files in a systematic manner, followed by cross-reference and classification according to the same logic, and extracted relevant material. Qualitative methods are employed to gain knowledge of the actual situation, ongoing circumstances, and societal and technical factors that impact the project's acceleration process. To investigate the structure of the project acceleration phenomenon, quantitative methods are employed to develop and evaluate mathematical models, theories, or hypotheses (Chih-Pei & Chang 2017). This methodology involves the examination of quantitative information to establish classifications for acceleration metrics, projected timelines, and the efficacy of resource allocation (Rolobessy et al., 2025).

The integration of these two methodologies is intended to yield more thorough research outcomes. Quantitative data is represented numerically, derived from the measurement of project work components and subjected to analysis to determine the most effective project timeline estimation. Concurrently, qualitative data is acquired through site observations, interviews, and documentary review (Creswell, 2021). From the collected information, the research team first screened out all risk-related variables. The aforementioned variables underwent a scoring and evaluation process utilizing a five-point Likert scale. The ratings were subsequently analyzed across two distinct dimensions: The probability that a given risk would actually occur, and the severity of the impact if the risk did materialize (Likert, 1932; Boone & Boone, 2012). After all risks were scored, the research team analyzed the scores using a 5×5 Risk Matrix based on MIL-STD-882B. The analysis served two purposes: first, to determine the level of each individual risk, and second, to prioritize all risks to distinguish their order of urgency (U.S. Department of Defense, 1984; Aven, 2015). As for this study's approach of integrating qualitative and quantitative methods, it follows the mixed research framework proposed by a certain scholar, and the relevant content in the original text ends here, with no additional follow-up information. The theoretical underpinnings of this investigation are depicted in Figure 1.

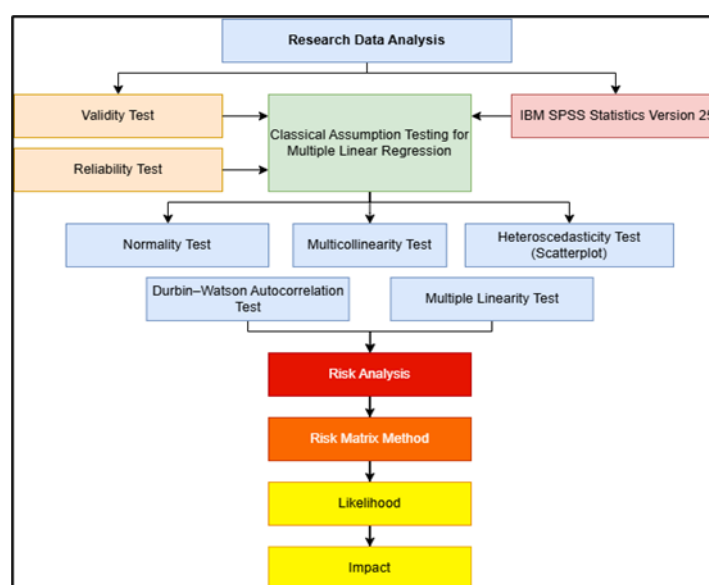


Figure 1. Conceptual Framework

This study was conducted at the construction site of the Slinga Kiri Irrigation Area project, which is specifically located in Purbalingga Regency, Central Java Province, falls within the

jurisdiction of the Serayu Bogowonto River Basin, and draws its main water source from the Klawing River.

During the research, data collection was implemented through three methods. The first was to conduct on-site surveys at the project site to inspect the actual conditions of the site in person; the second was to distribute questionnaires to selected interviewees to collect their feedback; the third was to organize various types of documented written materials to sort out usable information. The materials used throughout the collection process were divided into two categories: one category consisted of first-hand original observation records collected at the project site, and the other was archived secondary materials related to the project, all of which were sourced from the project's own relevant records (Taherdoost, 2021).

Participants in this study were identified as participants, primarily staff and workers involved in the project. The following are the characteristics of the research population, sample, respondent types, and sampling protocols:

- The irrigation project in PT Brantas Abipraya (Persero) involves the participation of its staff and workers.
- The Slovin formula ($n = N/(1+Ne^2)$) was used to calculate the sample size, with an error margin of 15%, resulting in around 30 participants.
- The respondents comprised of 18 employees, including engineers, surveyors, technical/operations staff, site supervisors and QC, as well as 12 field personnel.
- Inclusion criteria includes active staff and workers with direct field experience who were directly involved in ongoing project activities.
- Sampling technique: Purposive sampling was employed, while the sample size was determined using the Slovin formula.
- Response rate: 100% (30 out of 30 questionnaires were returned fully completed), as the questionnaires were administered with direct assistance from the researcher.
- Respondents' experience: The respondents were categorized into two groups based on their work experience: less than 5 years and 5–10 years.
- Unit of analysis: The risk level of each indicator (item), assessed based on the aggregate perceptions of the 30 respondents.

Table 1. Likert Scale Values

Independent Variables (X)	Dependent Variable (Y)
X1: Materials	Frequency of Quality Performance
X2: Equipment	Very High: score 5
X3: Human Resources	High: score 4
X4: Contractor Qualifications and Experience	Moderate: score 3
X5: Financial Factors	Low: score 2
X6: Field Management	None: score 1
Very Often: score 5	Dependent Variable (Y)
Often: score 4	Frequency of Quality Performance

This research employs a Likert scale framework to assess risk classifications, determined by two primary factors: the probability of an event and the magnitude of its consequences. The integration of these two aspects is then used to determine the overall level of risk in a systematic manner (Roselidyawaty, 2024).

Data Analysis

Table 2. Validity Test Results Using the r-Table

Internal Variable	Item	r Table	Calculated r (Impact)	Conclusion	Calculated r (Probability)	Conclusion
Materials (XI)	XI.1	0,361	0,508	Valid	0,21	Invalid
	X1.2	0,361	0,534	Valid	0,388	Valid
	X1.3	0,361	0,439	Valid	0,711	Valid
	X1.4	0,361	0,58	Valid	0,61	Valid
Equipment (X2)	X2.1	0,361	0,638	Valid	0,286	Invalid
	X2.2	0,361	0,62	Valid	0,114	Invalid
Human Resources (X3)	X3.1	0,361	0,461	Valid	0,41	Valid
	X3.2	0,361	0,752	Valid	0,348	Invalid
	X3.3	0,361	0,728	Valid	0,629	Valid
	X3.4	0,361	0,716	Valid	0,736	Valid
Contractor Qualifications and Experience (X4)	X4.1	0,361	0,799	Valid	0,786	Valid
	X4.2	0,361	0,426	Valid	0,318	Invalid
	X4.3	0,361	0,269	Invalid	0,382	Valid
	X4.4	0,361	0,823	Valid	0,678	Valid
	X4.5	0,361	0,752	Valid	0,727	Valid
	X4.6	0,361	0,713	Valid	0,662	Valid
Financial Factors (X5)	X5.1	0,361	0,736	Valid	0,747	Valid
	X5.2	0,361	0,649	Valid	0,73	Valid
	X5.3	0,361	0,644	Valid	0,713	Valid
	X5.4	0,361	0,699	Valid	0,781	Valid
Field Management (X6)	X6.1	0,361	0,595	Valid	0,422	Valid
	X6.2	0,361	0,543	Valid	0,85	Valid
	X6.3	0,361	0,395	Valid	0,282	Invalid
	X6.4	0,361	0,61	Valid	0,655	Valid
	X6.5	0,361	0,241	Invalid	0,506	Valid
	X6.6	0,361	0,458	Valid	0,8	Valid
	X6.7	0,361	0,674	Valid	0,097	Invalid
	X6.8	0,361	0,467	Valid	0,556	Valid
	X6.9	0,361	0,611	Valid	0,865	Valid
	X6.10	0,361	0,646	Valid	0,061	Invalid

Results of the validity test for most items/ questionnaires are statistically valid. This is substantiated by the adjusted item-total correlation coefficient, which surpasses the established r-table threshold (r-table = 0.361). Any items below this threshold were discarded from analysis.

Table 2. Assessment of Reliability via Cronbach's Alpha

Variabel Internal Kontraktor	Minimum Value Cronbach's Alpha	Cronbach's Alpha (Impact)	Cronbach's Alpha (Probability)	Conclusion
XI: Materials	0,6	0,921	0,902	Reliable
X2: Equipment	0,6	0,922	0,907	Reliable

X3: Human Resources	0,6	0,923	0,901	Reliable
X4: Contractor Qualification	0,6	0,924	0,898	Reliable
X5: Financial Factors	0,6	0,919	0,895	Reliable
X6: Field Management	0,6	0,936	0,917	Reliable

The reliability test shows that all of the research variables has result of cronbachs alpha > 0.60 This implies that the instrument is consistent with itself and reliably measures data. Next, the normality assumption holds as seen in the Normal Probability Plot where data points line along the diagonal line suggesting a normal distribution.

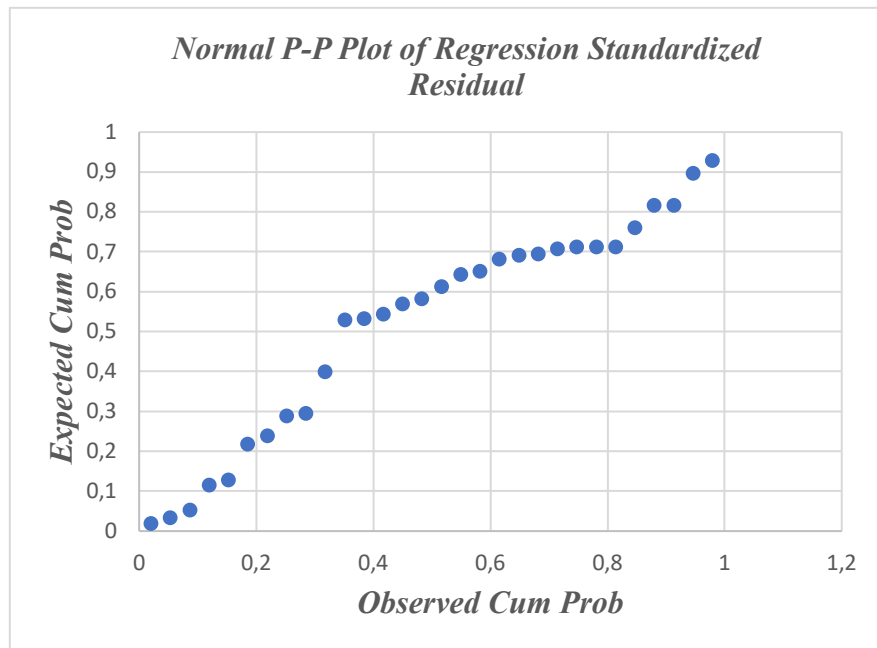


Figure 2. Normal Probability Plot Chart Output

Table 4. Coefficients Output Results

Model	Unstandardized Coefficients		Coefficients ^a Standardized Coefficients	t	Sig.	Collinearity Statistics		
	B	Std. Error	Beta			Tolerance	VIF	
(Constant)	84,118	16,182		5,198	0,000			
1	XI	-2,349	2,225	-0,315	-1,055	0,302	0,255	3,915
	X2	6,588	2,478	0,764	2,659	0,014	0,275	3,638
	X3	-3,623	1,444	-0,842	-2,508	0,020	0,202	4,960
	X4	-1,316	0,960	-0,390	-1,371	0,184	0,280	3,565
	X5	2,696	1,702	0,495	1,584	0,127	0,232	4,304
	X6	0,764	0,668	0,276	1,144	0,264	0,389	2,569

The assessment for multicollinearity reveals that every independent variable exhibits a tolerance exceeding 0.100 and a Variance Inflation Factor (VIF) below 10.00. This outcome suggests the absence of multicollinearity within the regression analysis.

Table 5. Heteroscedasticity Test Results Using Scatterplots

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,691a	0,478	0,342	11,726	1,724

The scatterplot of the residual is one of heteroskedasticity tests which proves that residuals are scattered randomly and there is no pattern created. This indicates homoscedasticity. Besides, the Durbin–Watson of 1.724 uses no autocorrelation of the model.

Research Results and Discussion

Likelihood and Severity Assessment Results

The Table 6 presents a summary of the Likelihood Index (LI) and Severity Index (SI) values along with their respective rankings.

Table 6. Results of the recapitulation of LI and SI values

Code	% Assessment Feasibility	Rank	% Severity Rating	Rank
XI.1	53%	3	66%	4
XI.2	51%	3	67%	4
XI.3	51%	3	53%	3
XI.4	53%	3	75%	4
X2.1	45%	3	71%	4
X2.2	44%	3	58%	3
X3.1	47%	3	81%	4
X3.2	57%	3	71%	4
X3.3	58%	3	67%	4
X3.4	57%	3	63%	4
X4.1	59%	3	73%	4
X4.2	57%	3	75%	4
X4.3	53%	3	53%	3
X4.4	47%	3	63%	4
X4.5	59%	3	71%	4
X4.6	62%	3	67%	4
X5.1	57%	3	75%	4
X5.2	54%	3	65%	4
X5.3	49%	3	69%	4
X5.4	51%	3	73%	4
X6.1	58%	3	66%	4

Code	% Assessment Feasibility	Rank	% Severity Rating	Rank
X62	47%	3	69%	4
X6.3	41%	3	40%	3
X6.4	51%	3	63%	4
X6.5	40%	3	41%	3
X6.6	51%	3	70%	4
X6.7	85%	4	80%	4
X6.8	55%	3	63%	4
X6.9	59%	3	74%	4
X6.10	88%	4	80%	4

As for the results, most identifiers of risks are assigned with a high severity (rank 4) and a moderate score (rank 3). This means that while some risks or issues may not occur all that often, those do have significant potential effects on project implementation. Among all indicators, X6. 7 and X6. All these 10 are recognized as the most common risks since they have high likelihood and severity values with the likelihood score of 85% — 88%, respectively and severity value:80%.

Discussion on the Implications of Dominant Risks

The identification of X6.7 represents a procedural/compliance risk (within the contractor's internal control), whereas X6.10 represents an external/environmental risk (beyond the project's direct control). The results emphasize the extent to which project performance is defined by on-site coordination, supervision and operational control. The numerical scoring system with maximum highest probability and severity of each risk used in the analysis, which indicates that 1-very low risk only appears occasionally, while 5-very high risk has a strong tendency to appear repeatedly if not well managed, and this repeated occurrence could severely limit what one needs to achieve with activities requires time from the project timescale itself (n = 5) increasing construction costs or poor activity quality. So, these risks are the subject of priority in risk management.

Negative risks may also be indicative of deficiencies in supervision or communication mechanisms. Those risks are significant. Process and field resource allocation. When these circumstances are ignored, it leads to a situation where the problem is solved. The failure of projects is caused by delays, rework, and inefficiency. This leads to lower overall success. It's. Where is the optimal location for concentrating risk mitigation efforts, specifically in better risk management? System of managing the field, including better monitoring and reporting. Bringing together all stakeholders to foster cooperation between partners in greater coverage. The required resources for optimal operation. Using proactive and systematic methods to manage risks, The probability of an event occurring can be minimized and the risks associated with it can be mitigated. In. Moreover, these findings serve as the basis for comprehensive risk management in an early stage. The project's success can be attributed in part to the identification of high-impact operational risks, which will facilitate its implementation. Enhanced efficiency and sustainability in project execution.

Results of the Importance Index Calculation

The Importance Index (IMPI), which is made up of the Likelihood Index and Severity Index, was used in the analysis. Moreover, The formula is as follows:

Importance Index (IMPI) = LI × SI

The Importance Index (IMPI) calculation results and risk categories are presented in Table 7. A summary of the Importance Index analysis can be found in this table.

Table 7. Calculation of Importance Index

Variable Internal Contractor	Item Question	Likelihood Index (LI)	Severity Index (SI)	IMPI (LI×SI)	Risk Level Criteria
Materials (KI)	XI.1	3	4	12	MEDIUM
	XI.2	3	4	12	MEDIUM
	XI.3	3	3	9	MEDIUM
	XI.4	3	4	12	MEDIUM
Equipment (X2)	X2.1	3	4	12	MEDIUM
	X2.2	3	3	9	MEDIUM
Human Resources <X3)	X3.1	3	4	12	MEDIUM
	X3.2	3	4	12	MEDIUM
	X3.3	3	4	12	MEDIUM
	X3.4	3	4	12	MEDIUM
Contractor Qualifications and Experience X4	X4.1	3	4	12	MEDIUM
	X4.2	3	4	12	MEDIUM
	X4.3	3	3	9	MEDIUM
	X4.4	3	4	12	MEDIUM
	X4.5	3	4	12	MEDIUM
	X4.6	3	4	12	MEDIUM
Financial Factors (X5)	X5.1	3	4	12	MEDIUM
	X5.2	3	4	12	MEDIUM
	X5.3	3	4	12	MEDIUM
	X5.4	3	4	12	MEDIUM
Field Management (X6)	X6.1	3	4	12	MEDIUM
	X6.2	3	4	12	MEDIUM
	X6.3	3	3	9	MEDIUM
	X6.4	3	4	12	MEDIUM
	X6.5	3	3	9	MEDIUM
	X6.6	3	4	12	MEDIUM
	X6.7	4	4	16	HIGH
	X6.8	3	4	12	MEDIUM
	X6.9	3	4	12	MEDIUM
	X6.10	4	4	16	HIGH

Table 7. presents the results of the Importance Index (IMPI) calculation for 30 risk indicators using the 5×5 Risk Matrix (MIL-STD-882B). The majority of the indicators (IMPI 9–12) fall into the medium-risk category, indicating that these risks remain manageable but require continuous monitoring throughout project implementation.

Two indicators with an IMPI ≥ 16—X6.7, “Workplace accidents occurring due to the failure to implement occupational safety and health (OSH) procedures,” and X6.10, “Unexpected conditions and events, including fires, floods, storms, strong winds, earthquakes, landslides, and severe weather”—have equally high likelihood and impact levels. Therefore, they are classified as

high risks and constitute the main priorities for risk control in the development of the Slinga Kiri Irrigation Area Project, Purbalingga Regency.

Overall, the risk levels expressed as percentages are as follows:

- High Risk = $(2 \text{ High-Risk Indicators} / 30 \text{ Risk Indicators}) \times 100\% = 6.67\%$
- Medium Risk = $(28 \text{ Medium-Risk Indicators} / 30 \text{ Risk Indicators}) \times 100\% = 93.33\%$

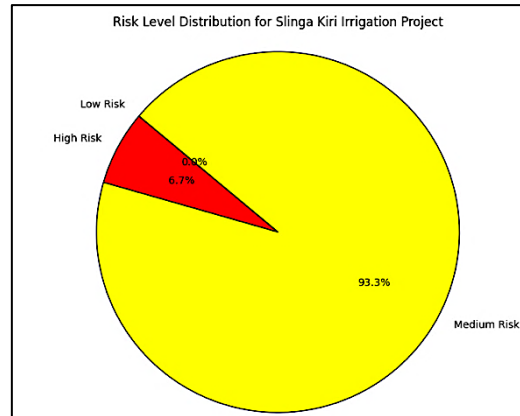


Figure 3. Graph of Risk Level Assessment Results

Figure 3. shows the distribution of risk levels in the construction of Slinga Kiri Irrigation Area project. Results show that most risk indicators (93.33%) Included within the medium risk classification, this designation suggests that such risks remain largely controllable, albeit necessitating persistent oversight and management. Positive indicators for high-risk account for 6.67%, namely, X6. 7 and X6. 10, which needs urgent attention in the rollout of mitigation measures. There are no low-risk indicators which means all the risks we have identified require some degree of management. This visualization can clarify risk priorities and enable more objective and fact-based decision making in project risk management.

Next, to determine whether a risk falls into the low, medium, or high category, the risk matrix method is used as shown in the following risk matrix table.

Table 8. Risk Matrix of IMPI Assessment Results

P R O B A B I L I T Y	Very Often	5					
	Often	4				2	
	Sometimes	3			5	23	
	Rarely	2					
	Never	1					
			1	2	3	4	5
			None	Low	Moderate	High	Very High
IMPACT							

Referring to the table above, the Likelihood Index (LI) multiplied by Severity Index (SI) is an IMPI of 16 with high-risk factors for two indicators. Additionally, medium risk was observed with five indicators for an IMPI value of 9 and for 23 indicators, an IMPI value of 12.

In Table 9 shown below using the Risk Matrix to represent risk categories from the assessment results and their explanations as per Rubble Morgan.

Table 9. Risk Appetite Criteria

Risk Level	Color	Risk Appetite	Risk Treatment Actions
Low	Green	Risk is acceptable	Monitor risk management to ensure it does not create new risks
Medium	Yellow	Risk is conditionally acceptable	Risk treatment is required, with confidence that the risk can still be reduced
High	Red	Risk is not acceptable	Risk treatment is required through replacement, correction, or enhancement of existing risk controls

Resources Figure X: Traffic-light-like visualisation of risk dispersed for Slinga Kiri Irrigation Area construction project. High-risk indicators (Red) for immediate mitigation Medium-risk indicators (Yellow) to be constantly monitored and controlled Low risk indicator (Green) — acceptable values in an acceptable range which are not a threat but need to monitor these beforehand suggestions if escalation seen The 5×5 Risk Matrix analysis (MIL-STD-882B) shows that of the total 30 risk indicators analyzed, only 2 are high risks and about 28 are medium level indicators. High indicators are red – they indicate that the risk is intolerable and so require more rigorous risk treatment by corrective actions, changing them or adding some risk control strategies. The moderate risk indicators fall in the yellow zone, which means they are conditionally acceptable however require continuous mitigation and control processes to lower their impact. Thus, the risk management of this project must give priority to the most critical indicators above as a control objective and at the same time reduce or contain those medium-risk indicators so that they do not escalate into higher risk levels.

Conclusion

The objective of this research was to identify, evaluate, and develop suitable risk reduction measures for the Slinga Kiri Irrigation Area Development Project in Purbalingga Regency. This was accomplished through the application of the 5×5 Risk Matrix (MIL-STD-882B) and the Importance Index (IMPI).

The results showed that project risks were influenced by six main categories: materials, equipment, human resources, contractor qualifications and experience, financial factors, and field management. Most of the identified risk indicators were classified as medium risk. These risks still require control measures but can be managed through continuous monitoring.

Two indicators within the field management category were classified as high risks and identified as the main priorities:

- X6.10 — Unexpected conditions and events (fires, floods, storms, strong winds, earthquakes, landslides, and severe weather), ranked first. This risk is external/environmental in nature and beyond the project's direct control. Its mitigation involves adjusting work methods so that weather conditions do not directly disrupt project implementation and utilizing weather forecasts from BMKG (Indonesian Agency for Meteorology, Climatology, and Geophysics) to adjust the scheduling of weather-dependent activities.
- X6.7 — Workplace accidents resulting from the failure to implement OSH procedures, ranked second. This risk is procedural/compliance-related and within the contractor's internal control. Its mitigation involves preparing an OSH and Environmental Management Plan (K3LK) aligned with the occupational safety and health management system. This

process begins with the identification of OSH aspects, risk assessment, and risk control, followed by the implementation of OSH management programs based on the project's OSH objectives and targets.

These findings indicate that project performance is strongly influenced by field coordination, supervision, and operational control. They also demonstrate that project risks have two distinct sources: one arising from internal system weaknesses that can be directly controlled, and another arising from environmental exposure that can only be anticipated rather than completely eliminated.

The risk management approach for procedural risks is distinct from that of adaptive and contingency measures, while both are treated differently.

In summary, the risk matrix method employed in this study provided a structured approach to risk assessment, helped prioritize risk, and supported decision-making in project risk management.

References

- Anthony Cox, L., Jr (2008), What's Wrong with Risk Matrices?. *Risk Analysis*, 28: 497-512. <https://doi.org/10.1111/j.1539-6924.2008.01030.x>
- Aven, T. (2016). Risk assessment and risk management: Review of recent advances on their foundation. *European Journal of Operational Research*, 253(1), 1–13. <https://doi.org/10.1016/J.EJOR.2015.12.023>
- Banaitiene, N., & Banaitis, A. (2012). Risk Management in Construction Projects. In *Risk Management - Current Issues and Challenges*. InTech. <https://doi.org/10.5772/51460>
- BBWSSerayuOpak. (2025, 07 Oktober). Pembangunan Irigasi Slinga Kiri untuk Perkuat Ketahanan Pangan di Purbalingga, Diakses pada 07 Oktober 2025), dari <https://sda.pu.go.id/balai/bbwsserayuopak/berita/pembangunan-irigasi-slinga-kiri-untuk-perkuat-ketahanan-pangan-di-purbalingga>
- Boone, H. N., & Boone, D. A. (2012). Analyzing Likert Data. *Journal of Extension*, 50(2).
- Chih-Pei, H. U., & Chang, Y.-Y. (2017). John W. Creswell, research design: Qualitative, quantitative, and mixed methods approaches.
- Cnnindonesia.com. (2025, 17 Juni). KemenPU: Infrastruktur SDA Penting untuk Ketahanan Pangan Nasional, Diakses pada 17 Juni 2025, dari <https://www.cnnindonesia.com/ekonomi/20250617092744-97-1240477/kemenpu-infrastruktur-sda-penting-untuk-ketahanan-pangan-nasional>
- Creswell, J. W. (2021). *A concise introduction to mixed methods research*. SAGE publications. <https://doi.org/10.1016/j.brat.2023.104376>
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Demiss, B. A., & Elsaigh, W. A. (2024). Application of novel hybrid deep learning architectures combining convolutional neural networks (CNN) and recurrent neural networks (RNN): construction duration estimates prediction considering preconstruction uncertainties. *Engineering Research Express*, 6(3), 032102. <https://doi.org/10.1088/2631-8695/ad6ca7>
- Derse, O., & Göçmen Polat, E. (2021). Application Of Integrated FTA And 5x5 Matrix for the Comprehensive Risk Evaluation of a Project-Based Enterprise. *Harran Üniversitesi Mühendislik Dergisi*, 6(3), 183-197. <https://doi.org/10.46578/humder.989695>
- Fadilah, U. (2025, 12 Agustus). Mengenal Sistem Irigasi Pertanian: Jenis, Fungsi, dan Penerapannya

- di Lahan Pertanian, Diakses pada 12 Agustus 2025, dari <https://www.mertani.co.id/id/post/mengenal-sistem-irigasi-pertanian-dan-penerapannya-1>
- Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*.
- Fiorillo, G., & Ghosn, M. (2022). Risk-based life-cycle analysis of highway bridge networks under budget constraints. *Structure and Infrastructure Engineering*, 18(10–11), 1457–1471. <https://doi.org/10.1080/15732479.2022.2059525>
- Gozali, A. F., Setiawan, J., & Nugraha, P. (2020). Survey Status Risiko Pada Tahap Pra-Konstruksi Dan Konstruksi Di Proyek Perumahan. *Jurnal Dimensi Pratama Teknik Sipil*, 9(1), 1-6.
- Guo, S., Li, J., He, J., Luo, W., & Chen, B. (2022). A modified risk matrix method for behavioral risk evaluation in the construction industry. *Journal of Asian Architecture and Building Engineering*, 21(3), 1053–1066. <https://doi.org/10.1080/13467581.2021.1905647>
- Hasan, N. A., Hidayat, A., & Amin, M. (2025). Risk Management Analysis In Spald-T Projects. *Jurnal PenSil*, 14(1), 20–29. <https://doi.org/10.21009/jpensil.v14i1.47879>
- Hasiah, H., Natsir, S., & Arsyad, M. (2016). Desain Model Matriks Penilaian Risiko (Risk Assessment) dalam Perencanaan Audit Umum (Studi pada Satuan Pengawas Internal (SPI), Bagian Keuangan dan Bagian Pengadaan Barang dan Jasa Politeknik Negeri Ujung Pandang). *Jurnal Informasi Akuntansi dan Keuangan (INFAK)*, 42-60.
- Huang, T. S., Shin-Jung Lee, S., Lee, C. C., Chen, C. Y., Chen, F. C., Chen, B. C., Sy, C. L., & Wu, K. S. (2017). Evaluation of a matrix-assisted laser desorption ionization-time of flight mass spectrometry assisted, selective broth method to screen for vancomycin-resistant enterococci in patients at high risk. *PLoS ONE*, 12(6). <https://doi.org/10.1371/journal.pone.0179455>
- Hubbard, D. W., & Seiersen, R. (2023). *How to measure anything in cybersecurity risk* (p. 304). Hoboken, New Jersey: Wiley.
- Ji, T., Liu, J.-W., & Li, Q.-F. (2022). Safety Risk Evaluation of Large and Complex Bridges during Construction Based on the Delphi-Improved FAHP-Factor Analysis Method. *Advances in Civil Engineering*, 2022(1), 5397032. <https://doi.org/10.1155/2022/5397032>
- Kangari, R. (1995). Risk management perceptions and trends of U.S. construction. *Journal of Construction Engineering and Management*.
- Krisper, M. (2021). *Problems with Risk Matrices Using Ordinal Scales*. Graz University of Technology, Graz, Austria
- Labombang, M. (2011). *Manajemen Risiko Dalam Proyek Konstruksi*.
- Likert, R. (1932). A Technique for the Measurement of Attitudes. *Archives of Psychology*.
- Luo, T., Wu, C., & Duan, L. (2018). Fishbone diagram and risk matrix analysis method and its application in safety assessment of natural gas spherical tank. *Journal of Cleaner Production*, 174, 296–304. <https://doi.org/10.1016/j.jclepro.2017.10.334>
- Mahyuddin, et al. *Manajemen Proyek Konstruksi*. Jakarta: Penerbit Yayasan Kita Menulis, 2023
- Marito Harahap, I., Purwandito, M., Samudra Jl, U., Syarief Thayeb, P., Lama, L., & Langsa, K. (2022). Melalui Metode Hiradc dan Metode JSA Pada Proyek Lanjutan Pembangunan Rumah Sakit Regional Langsa. In *Jurnal Teknik Sipil* (Vol. 17, Issue 2).
- Nabila, F., Prihantono, P., & Anisah, A. (2021). Identifikasi Bahaya dan Penilaian Risiko Pada Proses Pekerjaan Pemasangan Atap Sandwich Panel. *Jurnal PenSil*, 10(3), 141–147. <https://doi.org/10.21009/jpensil.v10i3.23242>

- Pambudi, S. (2025). Peran Konservasi Sumber Daya Air dalam Pembangunan Ekonomi Sosial dan Lingkungan Berkelanjutan.
- PMI. (2017). A Guide to the Project Management Body of Knowledge (PMBOK Guide) – 6th Edition
- Rodriguez, J. (2016). Step 2: risk assessment and impact assessment. CAPA in the Pharmaceutical and Biotech Industries, 47–57. <https://doi.org/10.1016/B978-1-907568-58-9.00005-9>
- Rolobessy, A. R. P., Djakfar, L., & Negara, K. P. (2025). Assessment Of Schedule Uncertainty And Risk Mitigation In Accelerated Bridge Construction Using Pert. *Jurnal PenSil*, 14(3), 440–455. <https://doi.org/10.21009/jpensil.v14i3.59011>
- Roselidyawaty, N. (2024). Likert Measurement Scale in Education and Social Sciences: Explored and Explained. *EDUCATUM Journal of Social Sciences*, (10), 77–88. <https://doi.org/10.37134/ejoss.vol10.1.7.2024>
- SDA PU. (2025). Pembangunan Irigrasi Slinga Kiri Untuk Perkuatan Ketahanan Pangan Di Purbalingga. <https://sda.pu.go.id/balai/bbwsserayuopak/beritas/pembangunan-irigasi-slinga-kiri-untuk-perkuat-ketahanan-pangan-di-purbalingga>
- Sols, A. (2018). A Comprehensive Approach to Dynamic Project Risk Management. *Engineering Management Journal*, 30(2), 128–140. <https://doi.org/10.1080/10429247.2018.1450030>
- Taherdoost, H. (2021). Data Collection Methods and Tools for Research; A Step-by-Step Guide to Choose Data Collection Technique for Academic and Business Research Projects. In *International Journal of Academic Research in Management (IJARM)* (Vol. 10, Issue 1). www.elvedit.com
- USA Department of Defense, “Military Standard MIL-STD-882c System Safety Program Requirements,” 1979.
- Yulian, I., & Mursadin, A. (2023). Infrastructure Asset Management Study At PDAM Tanah Laut Regency Risk-Based (Vol. 7). www.techniumscience.com
- Zhu, X.-X., & Xiao, C.-C. (2017). A New Method Using Mean Value Matrix for Risk Types Prediction of Human Papillomaviruses. <http://www.uniprot.org/>