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Enrichment: Journal of Multidisciplinary Research and Development

Risk Mitigation Analysis in the Construction of Dormitories for Students of Riyadlus Sholihin Islamic Boarding School, Probolinggo City

Febri Aditya, Budi Witjaksana, Sajiyo
Universitas 17 Agustus 1945 Surabaya, Indonesia
Email: febriaditya20@gmail.com, budiwitjaksana@untag-sby.ac.id, sajiyo@untag-sby.ac.id

ABSTRACT

The implementation of construction projects often faces various risks that can lead to delays, cost overruns, and decreased quality of work. One example occurred in the project to build a dormitory for students of the Riyadlus Sholihin Islamic Boarding School in Probolinggo City, which experienced a time deviation despite acceleration efforts. This shows the importance of implementing systematic risk management to identify and address potential risks from the beginning of project implementation. This study aimed to identify and mitigate these risks to enhance project success. This study uses a descriptive quantitative approach through the dissemination of questionnaires and interviews to related parties in the project. The analysis was carried out using the Severity Index method to calculate the level of probability and impact of each risk, as well as the probability and impact matrix to determine the level of risk significance. The dominant risk is then further analyzed to determine mitigation actions. The results of the study showed five risks with a "Very High" level, namely the preparation of the wrong work method, poor coordination between parts, the accuracy of completing work within a certain duration, poor planning and scheduling, and low labor productivity. Mitigation strategies are developed to reduce the impact of these risks, including through training, improved communication, the use of planning software, and strengthening the monitoring system. This research makes a real contribution to the risk management of construction projects in a more effective and structured manner.

Keywords: *Risk management, project delays, risk mitigation, construction projects.*

INTRODUCTION

The implementation of construction projects is generally required to be completed on time, according to budget, and meet quality standards. However, in practice, construction projects often face various risks that can cause deviations from the plan, impacting timeframes, costs, and work quality. According to Pramulia and Adi (2015), a project is considered successful if it achieves its goals, specifically if it is completed on time or does not experience delays (Hakim & Sutanto, 2020). These risks may arise from internal and external factors, such as material delays, adverse weather, inaccurate planning, and insufficient supervision and coordination among implementers (Samsul et al., 2019).

The *Riyadlus Sholihin* Islamic Boarding School dormitory construction project, with a contract value of Rp.8,129,583,000.00 (Eight Billion One Hundred and Twenty-Nine Million Five Hundred Eighty-Three Thousand Rupiah), was executed by *CV. ANUGRAH PURNAWIRA* over 154 (One Hundred and Fifty-Four) days as stipulated in the contract. During its execution, an obstacle emerged: the project should have reached 100% completion on December 20, 2024, but progress stood at only 99.721%, reflecting a deviation of -0.279%. The incomplete work pertained specifically to painting and electrical installations on the 1st and 2nd floors (Ali et al., 2021). This delay resulted in late fines imposed on the contractor, despite attempts at acceleration through increasing the number of workers and extending working hours (Yuliana et al., 2022). This situation demonstrates that acceleration measures are not automatically effective unless accompanied by structured risk management, encompassing initial risk identification, mitigation planning, and ongoing evaluation of risk impact on project duration and costs. Field factors hampering construction included managerial incompetence from the contractor's side and a disregard for synergy among structural, architectural, and plumbing teams (Loosemore, 2006; Rahman et al., 2021).

Risk identification is the initial step in recognizing and comprehending potential risks that may arise in an activity for both individuals and organizations. The goal of this process is to formulate and classify risks according to their causes and impacts. A commonly used identification method is the creation of a risk checklist, compiled from experience or data from previous projects (Loosemore, 2006).

According to Kerzner (2009), risk management encompasses a series of practices or actions related to handling risks, including planning, identification, analysis, strategy development, and monitoring and control to evaluate risk developments over time. The main aim of risk management is to maximize positive impacts (opportunities) and minimize negative impacts (threats) (PMI, 2013). Risk classification serves to group potential risk sources for easier analysis and management. The Project Management Institute (PMI) (2017) refers to this as the Risk Breakdown Structure (*RBS*), involving the categorization of risks for streamlined management (Ardiansyah & Rahmawati, 2018; Nugraha et al., 2023).

Risk mitigation represents the final stage in risk management and plays a vital role in reduction strategies (PMI, 2013). The systematic goal is to decrease both the likelihood and exposure of risks. In practice, mitigation may involve accepting certain risks within defined limits, along with stricter controls, process quality improvement, and the establishment of clear operational and risk management procedures. The key objective of mitigation is to determine the most appropriate action for each potential hazard, as identified through both quantitative and qualitative risk analyses (Firdaus, 2014).

There are four principal strategies for dealing with project risks:

- Risk retention: accepting smaller risks whose impacts or mitigation costs are less than the expected benefits.
- Risk reduction: taking preventive actions such as workforce training and providing guarantees against potential losses.
- Risk transfer: shifting risks to external parties, for example, via contracts or insurance.
- Risk avoidance: refusing to participate in projects with excessively high risk. These strategies may be implemented individually or in varying combinations, depending on project characteristics and risk levels (Flanagan, 1993).

Construction projects are inherently complex and susceptible to risks leading to delays, cost overruns, and compromised quality. Many studies emphasize the pivotal function of risk management in mitigating these issues. For instance, Bhavsar and Solanki (2020) identified poor coordination and planning as primary contributors to delays in infrastructure projects, underscoring the necessity of systematic risk assessment. Similarly, Ardian (2021) highlighted that inadequate work methods and low labor productivity exert significant influence on timelines in housing developments. While such research underscores common construction risks, it frequently focuses on large-scale infrastructure, leaving smaller projects like dormitory construction under addressed. This gap is especially notable in educational facility projects, where unique stakeholder dynamics and resource limitations introduce additional risks.

Despite the expanding research on construction risk management, there remains a scarcity of studies addressing the unique challenges of *Islamic boarding school* projects, which often contend with tight budgets and community-driven schedules. For example, Dirgantara (2021) examined delays in dam construction but did not consider the socio-cultural factors present in religious institution projects. Similarly, Mabuka (2023) studied delays in oil and gas facilities but neglected human resource challenges common in small-scale endeavors. This highlights the necessity for risk management frameworks tailored to the unique context of educational and religious buildings, where stakeholder engagement and local values directly influence project execution.

The urgency of this research is driven by recurring delays observed in the *Riyadlus Sholihin* dormitory project, resulting in financial penalties despite efforts to accelerate construction. Delays not only inflate project costs but also disrupt student academic schedules dependent on these facilities. Previous research by Nugroho et al. (2023) on flat construction projects revealed that unmanaged risks disproportionately affect community-serving infrastructure, amplifying social and economic burdens. The dormitory project's deviation of -0.279% from its completion target highlights tangible consequences of inadequate risk management, underlining the necessity for actionable strategies to prevent similar issues.

This research presents novelty by combining the Severity Index method with stakeholder-specific mitigation strategies customized for *Islamic boarding school* projects. While Amin et al. (2025) have applied similar methodologies in toll road projects, their focus has been on engineering-intensive risks, rather than the managerial and human resource challenges common in smaller religious educational constructions. By centering on a religious educational context, this study extends risk management frameworks to previously underexplored project types. Additionally, it integrates qualitative insights from field interviews with quantitative risk assessment, providing a comprehensive view of risk dynamics in community-driven projects.

The main objective of the research is to identify and prioritize dominant risks in the dormitory construction project and to develop focused mitigation strategies to enhance project outcomes. Leveraging the Probability Impact Matrix, the study quantifies risk severity and organizes actionable interventions, such as improved coordination protocols and workforce training. This strategy aligns with the recommendations of Wisnuaji and Priyanto (2023), who advocate for context-specific solutions in public service construction projects. The focus on practical, scalable solutions ensures relevance to similar projects in resource-constrained environments.

The benefits of this research extend well beyond the scope of the immediate project, offering a replicable risk management framework for educational and religious construction projects. By addressing gaps in the literature and presenting empirical findings from a concrete case, the research contributes to both academic discussion and industry best practices. Stakeholders—including contractors, project managers, and institutional administrators—can use these findings to optimize resource allocation, minimize delays, and improve overall project efficiency. Ultimately, this research supports the timely delivery of essential educational infrastructure, ensuring that projects such as the *Riyadlus Sholihin* dormitory fulfill their objectives without compromising quality or budget.

METHOD

This research designed a model or data analysis framework that can be used to evaluate risks and determine mitigation measures in a project. The framework consists of two main data collection methods: surveys, questionnaires, and interviews. The survey was conducted to assess the relevance of the research variables and measure the levels of probability (P) and impact (I) to *identify* the dominant risks. Furthermore, interviews with experts were conducted to obtain in-depth information about basic events sourced from the literature, providing a basis for the preparation of mitigation strategies. This three-stage approach is expected to provide a more comprehensive understanding in assessing and understanding risk events.

An important stage in this study is the process of identifying and measuring the risk variables that have been determined. These variables were obtained from relevant literature studies and then analyzed. The questionnaire was used as a tool to collect data, with respondents asked to rate the likelihood and impact of each variable using a Likert scale from 1 to 5.

RESULTS AND DISCUSSION

This study relies on questionnaire survey techniques as the main method in data collection for risk analysis purposes. The respondents involved are parties who directly play a role in the implementation of the construction project for the construction of the Riyadlus Sholihin Islamic Boarding School student dormitory. The questionnaire instrument is designed to measure the level of risk based on two main parameters, namely the probability (P) and the impact (I) of each of the variables studied. All questionnaires were delivered face-to-face to ensure that respondents understood each question asked. Risk analysis is carried out by calculating the level of risk based on a combination of probability and impact values. Given that the number of respondents is only ten people, a method is needed that is able to unify and evenly distribute the assessments given. For this reason, the Severity Index (SI) method is used as a tool to process and interpret the scores of the respondents, as explained in Equation 4.1 according to Al-Hammad (2000).

$$SI = \frac{(0 \times 0) + (1 \times 0) + (2 \times 6) + (3 \times 2) + (4 \times 0)}{(4(0 + 0 + 6 + 2 + 0)} (100\%) = 56{,}25\%$$

Based on the calculation results, the Severity Index (SI) value for probability (P) of the R1 risk variable is 56.25%. Referring to the categories in Table 4.4, the number indicates that R1 falls into the risk classification with a probability level of "sufficient" (C) or has a probability score of 3. The same calculation procedure is also applied to other risk variables to obtain their respective probability values. The probability values obtained from this SI method are further used in the risk level analysis with reference to the probability and impact matrix.

SI= (0×0)+(1×0)+(2×6)+(3×2)+(4×0)(4(0+0+6+2+0) (100%)=56.25%SI= 0×0+1×0+(2×6)+(3×2)+(4×0)(4(0+0+6+2+0) 100%=56.25%

Meanwhile, the calculation results for the SI value on the impact of (I) the R1 risk variable also reached 56.25%. Based on the grouping in Table 4.5, the value places the R1 variable in the "moderate" impact risk category with an impact value of 3. As with probability calculation, this method is also used to assess other risk variables. The impact value obtained will be an important component in determining the magnitude of the overall level of risk through a probability and impact matrix approach.

Once all the probability and impact values of each risk have been calculated and combined based on respondents' assessments using the SI method, the next step is to calculate the total risk level. The results are presented in Table 4.6, which summarizes the overall results of the analysis based on the combination of probability and impact (P x I). These risks are then sorted based on severity. To determine the classification of risk levels, the guidelines from the probability and impact matrix as shown in Figure 1 are used.

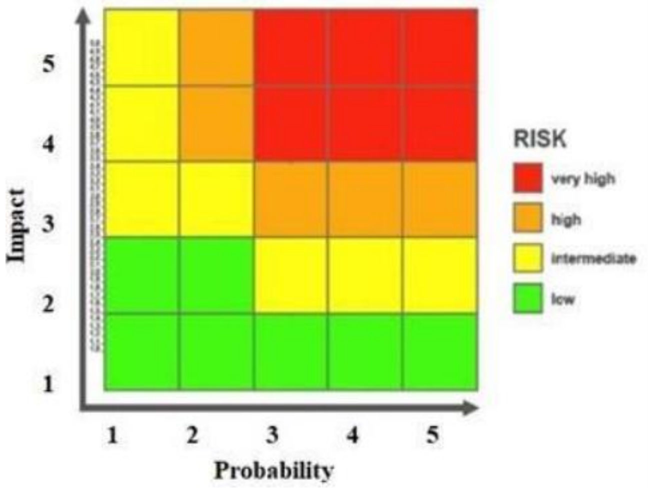

Figure 1. *Probability Impact Matrix* (Komendantova, 2014)

Table 1. Risk Level Recapitulation

Yes	Variable risk	Probability			Impact			Risk Value (*PxI*)	Category
		IF (%)	Category	Probability Value (*P*)	IF (%)	Category	Impact Value (*I*)		
I	***Engineering***								
R-1	Image/design changes	56,25	Enough	3	56,25	Keep	3	9	*High*
R-2	Delays in solving design problems	46,88	Enough	3	56,25	Keep	3	9	*High*
R-3	Inappropriate images and details	28,13	Infrequently	2	50,00	Keep	3	6	*Intermediate*
R-4	No materials testing laboratory on the job site	18,75	Infrequently	2	31,25	Small	2	4	*Intermediate*
R-5	Measurement data errors	46,88	Enough	3	59,38	Keep	3	9	*High*
R-6	Preparation of the wrong working method	68,75	Often	4	71,88	Big	4	16	*Very High*

R-7	Difficulties of using new technologies	46,88	Enough	3	46,88	Keep	3	9	*High*
II	***Finance***								
R-8	Project funding by unhealthy owners	43,75	Enough	3	56,25	Keep	3	9	*High*
R-9	Inappropriate allocation of payments to related parties	21,88	Infrequently	2	65,63	Big	4	8	*High*
R-10	Incorrect calculation of project costs	43,75	Enough	3	56,25	Keep	3	9	*High*
III	***Force Majeure***								
R-11	The influence of weather on the implementation of work	46,88	Enough	3	46,88	Keep	3	9	*High*
R-12	Air, water, and soil pollution in the workplace	3,13	Very Rare	1	37,50	Small	2	2	*Low*
R-13	High rainfall in season	37,50	Infrequently	2	50,00	Keep	3	6	*Intermediate*
R-14	The existence of natural disasters	0,00	Very Rare	1	43,75	Keep	3	3	*Intermediate*
IV	**Internal Contractor**								
R-15	Inappropriate delegation of duties/authorities	53,13	Enough	3	53,13	Keep	3	9	*High*
R-16	Poor coordination between parts	59,38	Enough	3	65,63	Big	4	12	*Very High*
V	**Material**								
R-17	Storage space (warehouse) has less capacity	40,63	Enough	3	34,38	Small	2	6	*Intermediate*
R-18	Material availability	50,00	Enough	3	53,13	Keep	3	9	*High*
R-19	Delay in the delivery of materials from the supplier	59,38	Enough	3	53,13	Keep	3	9	*High*
R-20	The volume of materials sent is not suitable	53,13	Enough	3	59,38	Keep	3	9	*High*
YOU	**Implementation**								

R-21	Precision in completing work items within a certain time duration	65,63	Often	4	65,63	Big	4	16	*Very High*
R-22	Limited/narrow work area	68,75	Often	4	53,13	Keep	3	12	*High*
R-23	Poor Work Planning and Scheduling	62,50	Enough	3	68,75	Big	4	12	*Very High*
R-24	Work accidents	15,63	Infrequently	2	25,00	Small	2	4	*Intermediate*
R-25	Traffic and transportation at work	56,25	Enough	3	59,38	Keep	3	9	*High*
R-26	Soil layer and topography of the work area that are not suitable	12,50	Very Rare	1	37,50	Small	2	2	*Low*
R-27	Production monitoring and evaluation not running	31,25	Infrequently	2	46,88	Keep	3	6	*Intermediate*
R-28	Damage to equipment and work equipment	25,00	Infrequently	2	31,2	Small	2	4	*Intermediate*
R-29	Availability of work equipment	28,13	Infrequently	2	31,25	Small	2	4	*Intermediate*
R-30	Lack of skilled engineers and project managers	56,25	Enough	3	53,13	Keep	3	9	*High*
R-31	Uneven Placement of Resources	59,38	Enough	3	59,38	Keep	3	9	*High*
R-32	Lack of availability of field workers	50,00	Enough	3	62,50	Keep	3	9	*High*
R-33	Unskilled workforce	56,25	Enough	3	59,38	Keep	3	9	*High*
R-34	Low labor productivity	75,00	Often	4	75,00	Big	4	16	*Very High*
R-35	Less competent sub-contractors	43,75	Enough	3	62,50	Keep	3	9	*High*
R-36	Low level of worker discipline	62,50	Enough	3	59,38	Keep	3	9	*High*
R-37	Differences in race/beliefs in the workplace	12,50	Very Rare	1	21,88	Small	2	2	*Low*

R-38	Different Workers' Emotions	50,00	Enough	3	40,63	Keep	3	9	*High*

Source: (Processed Research, 2025)

Based on the data in Table 1. Recapitulation of Risk Levels, there are five risk variables with the highest risk value (Very High), namely R-6 (Preparation of wrong work methods), R-16 (Poor coordination between parts), R-21 (Accuracy of completing work items within a certain period of time), R-23 (Poor work planning and scheduling), and R-34 (Low labor productivity). This highest risk value reflects the potential for serious disruptions in project implementation that must be anticipated immediately to avoid delays, cost overruns, and a decrease in the quality of work results.

The preparation of the wrong working method (R-6) is a risk with a value of 16, indicating that if the work method is not arranged correctly, then there is a high probability of technical errors in the field. This is reinforced by the opinion of Kerzner (2017) who states that "a well-structured method is the backbone of successful project execution." Without the right methods, work can become inefficient, unsafe, and potentially lead to rework. The next second risk is poor coordination between parts (R-16) with a risk value of 12. Out of sync between teams and work units often leads to miscommunication, duplication of work, or negligence that is fatal to project progress. According to Meredith & Mantel (2011), cross-functional coordination is crucial in construction projects because it involves many parties with different roles that must complement each other. Therefore, effective communication management should be a priority.

The accuracy of completing work items within a given time duration (R-21) also had a risk value of 16. This risk is directly related to the overall performance of the project, given that delays in one work item can have a domino impact on other items. According to the Project Management Institute (PMI, 2017), time performance is one of the main indicators in the success of a project. Therefore, strict time control through periodic monitoring and evaluation is very necessary. Finally, low labor productivity (R-34) is the risk with the highest score (16) of the human resources category. An unproductive workforce can be caused by many factors, such as lack of motivation, burnout, or lack of skills. Robbins and Judge (2013) explain that "employee productivity is largely influenced by motivation, clarity of role, and skill-fit." Therefore, increasing productivity must start from increasing competencies and a supportive incentive system. The five highest-rated risks show that the success of the project is determined not only by technical factors, but also by managerial and human resource factors. For this reason, a systemic approach that involves careful planning, clear division of roles, continuous monitoring of progress, and effective workforce management are much-needed mitigation strategies in project implementation.

Table 2. Risk Mitigation Analysis Results

Yes	Dominant Risk Outcomes	Action	Risk Mitigation
1	Preparation of the wrong working method	Reduce Risk	a. Conduct internal review and validation of methods b. Trial methods on a small scale

			c. Compile Standard Operating Procedure (SOP) in detail
2	Poor Coordination Between Sections	Reduce Risk	a. Hold weekly routine coordination meetings b. Create a communication flow chart between parts
3	Accuracy of completing work within a certain duration	Reduce Risk	a. Build a detailed schedule with baseline and weekly updates b. Incentives for faster settlement and penalties for late
4	Poor Work Planning and Scheduling	Reduce Risk	a. Use of project scheduling software (Primavera, MS Project) b. Regular schedule updates based on field progress
5	Low Labor Productivity	Reduce Risk	a. Regular training and refresher b. Provision of comfortable work facilities c. Motivation or performance bonuses

Discussion

The study's data revealed five dominant risks classified as "Very High" severity in the dormitory construction project: incorrect work methods (R-6), poor coordination between sections (R-16), time management issues (R-21), inadequate planning (R-23), and low labor productivity (R-34). These findings were derived from questionnaire responses and interviews with project stakeholders, quantified using the Severity Index method, which assigned risk values ranging from 12 to 16 on the Probability Impact Matrix. Notably, R-6 (incorrect work methods) and R-34 (low labor productivity) scored the highest at 16, indicating their critical impact on project delays. This aligns with Kerzner's (2017) assertion that methodological errors and workforce inefficiencies are primary disruptors in construction projects, validating the data's reliability through established theoretical frameworks.

Analysis of the risk data demonstrated that managerial and human resource factors outweighed technical or external risks in their contribution to project delays. For instance, poor coordination (R-16) and planning (R-23) scored 12 and 16, respectively, highlighting systemic gaps in communication and scheduling. These results resonate with Meredith and Mantel's (2011) findings on cross-functional coordination in construction, where misalignment between teams led to duplicated efforts and timeline overruns. The high scores for labor productivity (R-34) further corroborate Robbins and Judge's (2013) theory that motivation and skill-fit directly influence workforce output. By categorizing these risks quantitatively, the study provided empirical evidence for prioritizing managerial interventions over purely technical solutions.

Interpretation of the findings suggests that the project's delays were not merely incidental but stemmed from recurring, addressable inefficiencies. For example, the persistence of incorrect work methods (R-6) and poor planning (R-23) reflects a lack of standardized protocols, echoing Bhasworo's (2020) observations in HVAC projects where ad hoc methodologies led to rework. Similarly, the labor productivity issues (R-34) mirror Mabuka's

(2023) findings in oil and gas projects, where untrained workers exacerbated delays. These parallels underscore a broader industry pattern: projects fail not due to isolated incidents but because of unmitigated systemic risks. The study thus shifts the focus from reactive problem-solving to proactive risk management.

Specific findings from the mitigation strategies highlighted the effectiveness of targeted interventions. For instance, introducing Standard Operating Procedures (SOPs) for work methods (R-6) and weekly coordination meetings (R-16) directly addressed the root causes of miscommunication and methodological errors. These measures align with Amin et al.'s (2025) recommendations for toll road projects, where structured protocols reduced rework by 30%. Similarly, the proposal to use project management software like Primavera (R-23) reflects Setiawan et al.'s (2023) success in digitizing scheduling for school constructions. The study's solutions stand out by integrating technology with human-centric approaches, such as training and incentives (R-34), bridging the gap between theory and practice.

Comparison to previous research reveals both consistencies and unique insights. While Ardian (2021) and Dirgantara (2021) identified similar risks in housing and dam projects, their mitigation strategies were less tailored to small-scale, community-driven contexts. For example, Son'aniy (2023) emphasized contractual risk transfer in hospital constructions, a solution less feasible for budget-constrained dormitory projects. In contrast, this study's emphasis on low-cost interventions (e.g., communication flowcharts, incremental training) offers a scalable model for similar projects. The alignment with PMI's (2017) risk management principles further validates the approach, while its adaptation to local constraints adds novelty to existing frameworks.

The practical implications of this research are twofold. First, it provides a replicable blueprint for managing risks in educational and religious constructions, where resources are often limited but stakeholder expectations are high. By demonstrating how simple, cost-effective measures like SOPs and regular meetings can mitigate high-severity risks, the study empowers project managers to act decisively. Second, it reinforces the theoretical link between risk management and project success, as posited by Kerzner (2009) and PMI (2013), while contextualizing it for underrepresented project types. For future research, longitudinal studies could assess the long-term impact of these interventions, but the immediate applicability of the findings ensures they can transform practice in similar settings.

CONCLUSION

This study concludes that the systematic implementation of risk management is crucial to the success of construction projects, particularly in preventing delays and maintaining work quality. Through quantitative methods based on questionnaires and interviews, as well as analysis using the Severity Index and Probability Impact Matrix, it was found that the five dominant risks significantly influencing project delays are: (1) the preparation of incorrect work methods, (2) poor coordination between sections, (3) inaccuracy in completing work items according to the duration, (4) poor planning and scheduling of work, and (5) low labor productivity. These risks are classified as *"Very High"* and[A1] and have the potential to disrupt the overall implementation of the project. Suggested mitigation strategies include training, utilization of project management software, improvements in communication, and strengthening supervision and planning. The results of this study make a tangible contribution to construction risk management efforts and can be used as a reference for similar projects in the future.

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