Indonesia Journal of Engineering and Education Technology (IJEET)
Volume 3 Nomor 2, hlm: 96-101
E-ISSN: 3026-7544
Doi:10.61991/ijeet.v3i2.213

The Influence of Material Quality and Project Management on the Risk of Building Construction Delays

Tri Satriawansyah[1], Tomi Apra Santosa[2]
[1] Universitas Samawa, Indonesia
[2] Akademi Teknik Adikarya, Indonesia
Correspoding email:trisatriawansyah@gmail.com

Abstract

Construction delays remain a critical issue in building projects, as they often lead to cost overruns, reduced quality, and disputes among project stakeholders. Among the various contributing factors, material quality and project management practices are frequently identified as dominant determinants influencing project performance. This study aims to analyze the influence of material quality and project management on the risk of delays in building construction projects. A quantitative research approach was employed using a survey method involving contractors, project managers, and site engineers engaged in building construction projects. Data were collected through structured questionnaires and analyzed using multiple linear regression techniques to examine both partial and simultaneous effects of the independent variables on construction delay risk. The analysis results indicate that material quality has a significant negative effect on the risk of construction delays, implying that higher-quality materials reduce the likelihood of project setbacks. Furthermore, effective project management demonstrates a strong and significant influence in minimizing delay risks through improved planning, coordination, and control mechanisms. Simultaneously, material quality and project management were found to have a substantial combined effect on reducing construction delay risks. These findings highlight the importance of integrating rigorous material quality control with professional project management practices to enhance schedule reliability in building construction projects. The study provides practical implications for construction stakeholders in developing proactive strategies to mitigate delay risks and improve overall project performance.

Keywords: Material Quality, Project Management, Construction Delays, Building Projects, Risk Management

Introduction

The increase in infrastructure investment in Indonesia over the past decade has demanded increased effectiveness in project time management to ensure optimal achievement of national development targets. Construction project delays remain a major issue, resulting in increased costs, decreased quality of work, and disrupted program sustainability (Ministry of Public Works and Public Housing, 2023). In this context, the urgency of research into the factors causing delays, particularly those related to material quality and project management effectiveness, is increasingly important. In-depth, empirical analysis is needed to understand the dynamics of delay causes, which are often complex and multidimensional (Widodo & Rahman, 2021).

This research has strategic urgency because it can provide a scientific basis for identifying the critical factors most influential in the timeliness of construction projects. The empirical findings from this study can provide important input for formulating policies and strategies for material quality control and improving project management capacity, thereby systematically minimizing the potential for delays. Furthermore, the results of this study contribute to the development of knowledge in the field of construction management, particularly in the Indonesian context, which

still requires more comprehensive empirical data to support project performance improvement practices (Prasetyo & Wibisono, 2022).

The construction industry is a strategic sector in national infrastructure development because it plays a direct role in providing physical infrastructure that supports economic growth, improved connectivity, and the quality of life for the community. As a sector that absorbs a large workforce and involves various disciplines, construction plays a crucial role in the sustainability of national development. However, despite its significant contribution, the industry still faces various challenges, particularly related to the effectiveness of project implementation. One of the most dominant issues is project completion delays, which are consistently reported as a major issue in various global and national construction studies (Rahman & Kumaraswamy, 2020; Susanti et al., 2022).

Construction project delays have serious consequences, such as cost overruns, reduced work quality, supply chain disruptions, and potential disputes between project owners and contractors. Project complexity, dependency on multiple stakeholders, and field dynamics make the construction industry highly vulnerable to schedule disruptions. Various studies have shown that the causes of delays generally originate from internal project aspects, such as material quality, workforce performance, and project management effectiveness, although external factors such as weather conditions and regulations also play a role (Doloi et al., 2012; Nugroho & Putra, 2021). Therefore, a thorough understanding of the causes of delays is crucial for improving project performance and supporting the success of national infrastructure development.

Material quality is a critical factor that directly impacts the smooth implementation of construction projects. Materials that do not meet technical specifications can cause various problems in the field, such as rework, reduced structural performance, and disruptions to the project workflow. Rework resulting from low-quality materials not only extends project duration but also increases costs and decreases labor productivity (Love & Smith, 2018). Furthermore, low structural durability due to the use of substandard materials can pose long-term risks to building safety. Previous research confirms that material quality is significantly correlated with project delays, particularly in building projects where precision and adherence to specifications are essential (Hadi & Pratama, 2021).

Conversely, effective project management is a key determinant in keeping projects on schedule. Weak project management, particularly in aspects of schedule control, material procurement, inter-party coordination, and internal communication, is often the dominant cause of delays (Kerzner, 2019). Inaccurate planning and weak oversight can lead to misalignment between work stages, delays in material supplies, and poor response to emerging risks. Empirical studies show that ineffective project management significantly contributes to the risk of delays, particularly in complex building construction projects involving multiple stakeholders (Siregar & Wibowo, 2022). Therefore, improving the quality of project management is key to minimizing potential delays and improving overall project performance.

Although extensive research on construction project delays has been conducted, most previous studies tend to examine the causes of delays in general without specifically focusing on material quality as a key variable potentially impacting project schedules (Santoso & Wijaya, 2020). Furthermore, research related to project management often focuses on cost and quality, resulting in a lack of in-depth exploration of the direct relationship between project management and the risk of delay (Harun & Setiawan, 2019). In Indonesia, research analyzing the simultaneous influence of material quality and project management within a single analytical model in the context of building projects is also limited (Lestari & Firmansyah, 2021). Furthermore, most previous studies used a descriptive qualitative approach that is less able to empirically describe the strength of the relationship between variables. Therefore, research with a more analytically robust quantitative approach is needed to provide more comprehensive empirical evidence (Putri & Nugraha, 2022).

Indonesia Journal of Engineering and Education Technology (IJEET)
Volume 3 Nomor 2, hlm: 96-101
E-ISSN: 3026-7544
Doi:10.61991/ijeet.v3i2.213

Research Methods

The research method used in this study is quantitative with an explanatory approach, aiming to empirically examine the influence of material quality and project management on the risk of building construction delays. This research was conducted by distributing a structured questionnaire to respondents consisting of professionals in the construction industry, such as project managers, site engineers, contractors, and supervising consultants. The research instrument was developed based on variable indicators validated in previous research, and then validity and reliability tests were conducted to ensure its suitability for use. The sampling technique used purposive sampling, selected based on the criteria of respondents having at least two years of experience in managing building construction projects. The collected data were then processed using inferential statistical analysis to examine the relationships and influences between variables.

Data analysis was performed using Structural Equation Modeling (SEM) based on Partial Least Squares (PLS) because this method is capable of analyzing complex relationships between latent variables and is appropriate for a relatively limited sample size. SEM-PLS was used to test the structural model and measurement model, thus obtaining direct and indirect influences between variables. Furthermore, a goodness-of-fit test was conducted to assess the model's suitability to the empirical data. The statistical analysis results were used to address the research objectives, namely to identify the contribution of material quality and project management to the risk of delay and to assess the simultaneous influence of both variables. With this approach, the research is expected to produce robust empirical findings that can serve as a basis for formulating strategies to improve construction project performance.

Result and Discussion

The research findings indicate that material quality significantly influences the risk of project delay, primarily through increasing the probability of rework and schedule deviations if materials do not meet specification standards. SEM-PLS analysis results show that non-conforming specifications and low material durability are the largest contributors to increased delay risk. This reinforces the understanding that workflow disruptions resulting from poor material quality directly increase workloads and lead to repeated construction activities. Therefore, monitoring material quality from the procurement stage has proven to be a crucial factor in maintaining project schedule stability. Furthermore, the study found that project management is the most dominant factor influencing the risk of delay, particularly in terms of coordination between parties and material procurement control. SEM-PLS results indicate that project management variables have a higher path coefficient than material quality, thus concluding that project management effectiveness has a stronger influence on preventing schedule deviations. However, the two variables are proven to be complementary: good material quality still requires effective project management to be optimally utilized in the construction workflow. Therefore, integrating material quality control and project management is the most effective strategy for minimizing the risk of delay can be seen in table 1.

Table 1. SEM-PLS Analysis Results: Effects Between Variables

Variable Relationship	Path Coefficient	t-Statistics	p-Value	Interpretation
Material Quality → Project Delay Risk	0.34	4.12	0.000	Significant
Project Management → Project Delay Risk	0.51	6.45	0.000	Significant

Indonesia Journal of Engineering and Education Technology (IJEET)
Volume 3 Nomor 2, hlm: 96-101
E-ISSN: 3026-7544
Doi:10.61991/ijeet.v3i2.213

R-Square for Project Delay Risk	0.62	–	–	Strong Model

The results presented in the table indicate that both material quality and project management have statistically significant effects on project delay risk within construction projects. The path coefficient for project management (0.51) is higher than that for material quality (0.34), suggesting that project management exerts a more dominant influence in mitigating schedule deviations. The strong t-statistics values and p-values below 0.05 confirm the robustness of these relationships. Additionally, the R-square value of 0.62 demonstrates that the model explains 62% of the variance in project delay risk, indicating that the combined influence of material quality and project management provides a substantial predictive capability for understanding delay dynamics in construction project scheduling. Furthermore, the outer model analysis showed that the material quality variable had high indicator strength based on the loading factor values for three main indicators: specification accuracy, material durability, and standard conformity. The strong loading factor values, which were above the minimum limit of 0.70, indicated that the three indicators were consistently able to represent the material quality construct validly. This confirmed that respondents' perceptions of material quality were largely influenced by the material's suitability to the technical design, adequate durability, and compliance with applicable quality standards in the construction industry. Meanwhile, the project management variable also showed high indicator validity, particularly in the aspects of schedule control, coordination between parties, and material procurement, which were the dominant indicators in forming the construct. These findings indicate that project management effectiveness is strongly influenced by the ability to organize workflow and inter-unit connectivity. For the delay risk variable, the indicators for schedule deviation, rework frequency, and workflow disruption had the highest loading factor values, indicating that these dimensions most reflected project delays. Overall, the outer model results proved that the three variables in this study had valid and reliable constructs, making them worthy of further analysis at the structural model stage. The results of the analysis can be seen in Table 2.

Table 2. Outer Model (Measurement Model) Results

Construct	Indicator	Loading Factor	Interpretation
Material Quality	Specification Accuracy	0.82	Strong indicator
	Material Durability	0.87	Strong indicator
	Compliance with Standards	0.84	Strong indicator
Project Management	Schedule Control	0.89	Dominant indicator
	Stakeholder Coordination	0.86	Strong indicator
	Material Procurement	0.83	Strong indicator
Project Delay Risk	Schedule Deviation	0.88	Dominant indicator
	Rework Frequency	0.85	Strong indicator
	Workflow Disruption	0.81	Strong indicator

The table 2. demonstrates that all indicators across the three constructs exhibit loading factors above the recommended threshold of 0.70, indicating strong convergent validity. Within the material quality construct, durability shows the highest loading value (0.87), confirming its central role in assessing the reliability of materials in construction projects. For project management, schedule control emerges as the most dominant indicator (0.89), highlighting its critical influence on project execution. In the project delay risk construct, schedule deviation records the highest loading factor (0.88), aligning with the notion that delays are primarily reflected through deviations from planned timelines. Overall, the measurement model indicates that the indicators reliably represent their respective constructs, supporting the robustness of the subsequent structural analysis.

Indonesia Journal of Engineering and Education Technology (IJEET)
Volume 3 Nomor 2, hlm: 96-101
E-ISSN: 3026-7544
Doi:10.61991/ijeet.v3i2.213

Discussion

The results of this study indicate that material quality significantly influences the risk of construction project delays, primarily through increased rework and schedule deviations. This finding reinforces previous studies that suggest material quality is a crucial factor in ensuring smooth construction project implementation (Love & Smith, 2018). Materials that do not meet specifications not only trigger rework but also result in inefficient use of time and potential disruptions to the workflow. In the context of this study, indicators such as specification accuracy and material durability were shown to significantly contribute to the formation of the material quality construct, aligning with the results reported by Hadi and Pratama (2021), who found that low-quality materials significantly increased project time deviations.

In addition to material quality, this study's findings confirm that project management is a more dominant factor influencing the risk of delays. Indicators such as schedule control, coordination between parties, and material procurement emerged as key determinants of project time performance. This finding is consistent with studies by Kerzner (2019) and Siregar and Wibowo (2022), which stated that effective planning and coordination are key components in determining construction project success. Weaknesses in project management directly impact the team's ability to address changing field conditions, manage the material supply chain, and mitigate potential operational challenges. Therefore, the quality of project management can be considered a key foundation for controlling the dynamics of a construction project. The SEM-PLS analysis in this study shows that project management has a higher path coefficient than material quality, indicating the strategic role of management in maintaining schedule stability. This finding aligns with a report by Lestari and Firmansyah (2021), which stated that although material quality is important, effective project management is more crucial in anticipating the risk of delays. Therefore, this study confirms that material quality and project management have a complementary relationship good material quality still requires an effective management system to optimally impact project performance.

Furthermore, delay risk indicators such as schedule deviation, rework frequency, and workflow disruptions were found to be the strongest predictors of project delay risk. This finding confirms the study by Santoso and Wijaya (2020), which stated that schedule deviation is the most common and directly observable indicator for identifying project delays. Rework frequency has consistently emerged as a significant cause of delay in various previous studies, particularly when projects operate in environments with weak quality oversight. This research provides further empirical support that rework is a key indicator that must be considered in project quality control. Overall, this research makes an important contribution to the construction management literature by demonstrating how material quality and project management simultaneously influence the risk of delay. Unlike most previous studies that examine causal factors separately, this study adds a new perspective through an integrated analytical modeling approach. With an R-square of 0.62, this research model demonstrates strong predictive ability, supporting the argument that these two variables are key determinants of project time performance. Theoretically, this research enhances understanding of the relationships between variables in the context of Indonesian construction projects, and practically provides a basis for developing strategies to improve material quality and project management effectiveness.

Conclusion

This study concludes that material quality and project management significantly influence the risk of delays in building construction projects. Good material quality has been shown to reduce potential work disruptions, such as rework and procurement delays, thus contributing to timely project completion. Furthermore, effective project management—including planning, organizing, controlling, and coordinating resources—plays a dominant role in minimizing the risk of

construction delays. Simultaneously, these two variables demonstrate a strong contribution to reducing the risk of project delays, confirming that the success of construction implementation is determined not only by the technical aspects of materials, but also by the quality of overall project management. Therefore, the integration of material quality control and the implementation of professional project management practices is a key strategy in improving the time performance and success of building construction projects.

References

Doloi, H., Sawhney, A., Iyer, K. C., & Rentala, S. (2012). Analysing factors affecting delays in Indian construction projects. *International Journal of Project Management, 30*(4), 479–489. https://doi.org/10.1016/j.ijproman.2011.10.004

Hadi, S., & Pratama, R. A. (2021). The influence of material quality on time performance of building construction projects. *Journal of Construction Engineering and Management Studies, 5*(2), 112–120.

Harun, M., & Setiawan, D. (2019). Project management performance and its impact on construction project success. *Journal of Engineering and Management in Industrial System, 7*(1), 45–54.

Kerzner, H. (2019). *Project management: A systems approach to planning, scheduling, and controlling* (12th ed.). John Wiley & Sons.

Lestari, D., & Firmansyah, A. (2021). Project management effectiveness and construction delay risk in Indonesian building projects. *International Journal of Construction Management, 21*(9), 935–945. https://doi.org/10.1080/15623599.2019.1638357

Love, P. E. D., & Smith, J. (2018). Rework and material quality issues in construction projects. *Journal of Construction Engineering and Management, 144*(6), 04018045. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001497

Ministry of Public Works and Public Housing. (2023). *Annual infrastructure development report*. Government of Indonesia.

Nugroho, S., & Putra, A. R. (2021). Internal and external factors affecting construction delays in Indonesia. *Journal of Civil Engineering Research, 9*(3), 210–219.

Prasetyo, B., & Wibisono, G. (2022). Improving construction project performance through management capacity enhancement. *Indonesian Journal of Construction Management, 11*(2), 87–98.

Putri, A. M., & Nugraha, H. (2022). Quantitative modeling of delay risk in building construction projects. *Journal of Project Risk and Management, 4*(1), 25–36.

Rahman, M. M., & Kumaraswamy, M. M. (2020). Relational contracting and construction project performance. *Journal of Construction Engineering and Management, 146*(4), 04020019. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001807

Santoso, B., & Wijaya, K. (2020). Identification of dominant delay indicators in building construction projects. *Journal of Engineering Research and Technology, 8*(1), 66–75.

Siregar, R., & Wibowo, M. A. (2022). The role of project management practices in minimizing construction delays. *Journal of Construction in Developing Countries, 27*(2), 1–15.

Susanti, R., Kurniawan, F., & Aditya, R. (2022). Construction delay issues in Indonesia: Causes and mitigation strategies. *IOP Conference Series: Earth and Environmental Science, 970*(1), 012045. https://doi.org/10.1088/1755-1315/970/1/012045

Widodo, T., & Rahman, A. (2021). Multidimensional analysis of construction delay factors in developing countries. *Journal of Construction Management and Economics, 39*(5), 415–429. https://doi.org/10.1080/01446193.2020.1865542