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Evaluating the Determinant Factors of Construction Project Quality via Multivariate Modeling in Lamongan

Zulkifli Lubis[1], Hendramawat Aski Safarizki[2], Hardian Ningsih[3]

[1]Civil Engineering Department, Universitas Narotama, Surabaya, INDONESIA
[2]Civil Engineering Department, Universitas Veteran Bangun Nusantara, Sukoharjo, INDONESIA
[3]Department of Agribusiness Diploma, Faculty of Vocational School, Universitas Sebelas Maret, Surakarta, INDONESIA

E-mail: zulkifli@narotama.ac.id

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ABSTRACT

Infrastructure development serves as a vital catalyst for driving regional economic growth. In Lamongan Regency, ongoing road construction programs aim to elevate infrastructure quality. However, implementation is often hampered by significant obstacles. Common issues such as discrepancies between planning and execution, project delays, suboptimal material usage, and the risky practice of underbidding frequently compromise the durability and standards of construction projects. To address these challenges, Unit Price Analysis (AHSP) emerges as a critical instrument for balancing cost efficiency with high-quality outcomes. This study specifically analyzes how AHSP, contractor pricing, project supervision, contractor experience, material availability, and time management influence the quality of construction projects within the regency. Utilizing a quantitative approach, the research surveyed 171 respondents through Likert-scale questionnaires, semi-structured interviews, and comprehensive documentation. The data were analyzed using multivariate regression, incorporating rigorous validity, reliability, and classical assumption tests. The findings reveal that all studied variables exert a significant simultaneous effect on project quality, supported by a high coefficient of determination of 0.930. These results underscore the necessity of integrated project management. Ultimately, this research provides a strategic model for local authorities to enhance construction standards by harmonizing cost efficiency with disciplined time management.

Keywords: AHSP, quality, time management, construction, regression.

INTRODUCTION

Infrastructure development is a pivotal factor in stimulating regional economic growth and enhancing social welfare [1]. Adequate infrastructure facilitates the mobility of goods and services while significantly improving inter-regional connectivity [2]. As a developing region, Lamongan Regency consistently strives to elevate the quality of its infrastructure, particularly road construction, through various strategic local government programs. By October 2025, the completion rate of road improvements in Lamongan reached 59.97%, equivalent to 400.138 km [3]. Nevertheless, practical implementation still encounters numerous challenges that compromise the ultimate quality of construction projects.

Lamongan Regency, situated in East Java Province, is currently prioritizing the acceleration of infrastructure development—specifically within the road and bridge sector—through its flagship program, Jamula Mantap (Smooth and Stable Roads of Lamongan). According to data from the Public Works and Highways Agency (Dinas Pekerjaan Umum Bina Marga) of Lamongan Regency, as of October 2025, the structural integrity of the regency's road network achieved 59.97%, covering approximately 400 km of the 667 km under regional jurisdiction [4]. The local government targets the completion of 38 road sections by the end of 2025, with a designated budget of IDR 35.5 billion. This budget is allocated for the rehabilitation of 20 road sections (14.47 km) and the construction of new roads spanning 16.68 km.

Frequently, the quality of construction projects deviates from the initial planning parameters. This discrepancy is evidenced by inconsistencies between predefined technical specifications and the

actual physical outcomes on-site [5]. Furthermore, project delays constitute a prevalent issue in construction, often precipitating a broader decline in overall project quality [6]. Additional persistent challenges include the utilization of substandard materials and the suboptimal management of project resources [7]. These prevailing conditions indicate that construction project quality is influenced by a complex interplay of interdependent factors.

A fundamental element in the execution of construction projects is the Unit Price Analysis (Analisis Harga Satuan Pekerjaan or AHSP). The AHSP serves as the foundational framework for project cost planning, encompassing labor, material, and equipment components [8]. The formulation of an unrealistic AHSP can result in an imbalance between cost and output quality, as cost estimation directly dictates the efficiency of resource utilization [9]. Moreover, the predatory pricing practices of contractors submitting excessively low bids to secure tenders risk degrading project quality due to severe budget constraints during the execution phase. Consequently, accurate and AHSP-grounded cost planning is critical for maintaining the equilibrium between cost, time, and quality in construction endeavors.

Beyond financial considerations, project supervision plays a vital role in preserving construction quality. Effective oversight ensures that project execution aligns with predefined plans, technical specifications, and established quality standards [10]. However, a majority of regional contractors, including those in Lamongan, have yet to fully adopt internationally standardized quality management systems. Consequently, project execution remains heavily reliant on individual discipline and manual on-site supervision. This situation underscores the critical nature of supervisory effectiveness in guaranteeing overall project quality.

Another pivotal factor is contractor experience. Highly experienced contractors typically possess superior managerial and technical competencies required for effective project management [11]. This proficiency directly influences the quality of the final output, resource allocation efficiency, and the capacity to mitigate operational challenges that arise during implementation. Additionally, the availability of adequate materials that adhere to specifications is a fundamental determinant of project quality. Materials constitute the primary physical components that directly dictate the structural integrity of the final construction [12]. The utilization of substandard materials, coupled with deficient quality control, can lead to degraded workmanship and premature deterioration of the infrastructure [13]. Therefore, both contractor experience and robust material management are paramount in ensuring the delivery of high-quality construction projects.

Furthermore, time management is an essential aspect of construction project execution. Ineffective time management often leads to project delays, which invariably result in cost overruns and compromised work quality [5]. Delays are frequently associated with deficient schedule planning and control, ultimately diminishing overall project performance. Hence, rigorous time management protocols are necessary to ensure that each project phase is completed in accordance with the established schedule.

Based on the aforementioned challenges, it is evident that the quality of construction projects, particularly within Lamongan Regency, is contingent upon a multitude of interconnected factors, including cost dynamics, supervision, human resources, material management, and time constraints. Additionally, Lamongan Regency's expansive geographical topography and the varying levels of readiness among local contractors further complicate the execution of government project quality control activities.

This study aims to analyze the impact of Unit Price Analysis (AHSP), contractor bid pricing, project supervision, contractor experience, material availability, and time management on the quality of construction projects in Lamongan Regency. Furthermore, the research seeks to identify the most dominant variable influencing construction project quality.

The findings of this research are anticipated to yield both theoretical and practical contributions. Theoretically, this study enriches the existing literature regarding the determinants of construction project quality. Practically, the results are expected to serve as a strategic reference for local governments, contractors, and relevant stakeholders in enhancing the quality of future construction project implementations.

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Project management is the process of planning, organizing, implementing, monitoring, and controlling resources to achieve specific objectives within a defined time, budget, and quality standard. It is widely applied in construction, infrastructure development, business, and other sectors [18]. Effective project management involves coordinating human resources, materials, equipment, finances, and information to ensure activities are completed efficiently. The main stages include project initiation, planning, execution, monitoring and control, and project closure. Project managers are responsible for defining project scope, allocating resources, managing risks, coordinating stakeholders, and evaluating performance. Important aspects include time management, cost control, quality assurance, occupational safety, and communication. Successful project management minimizes delays, prevents cost overruns, and improves productivity [19], [20].

RESEARCH METHODS

Methods

This research was conducted on government construction projects in Lamongan Regency, specifically focusing on infrastructure projects such as roads, bridges, and drainage systems executed between 2022 and 2025. This location was selected due to the high intensity of infrastructure development driven by the Jamula Mantap (Smooth and Stable Roads of Lamongan) program, coupled with observed variances in project quality, which constitute a primary concern of this study. The research was carried out from January 2 to February 28, 2026, encompassing the stages of data collection, data processing, and results analysis.

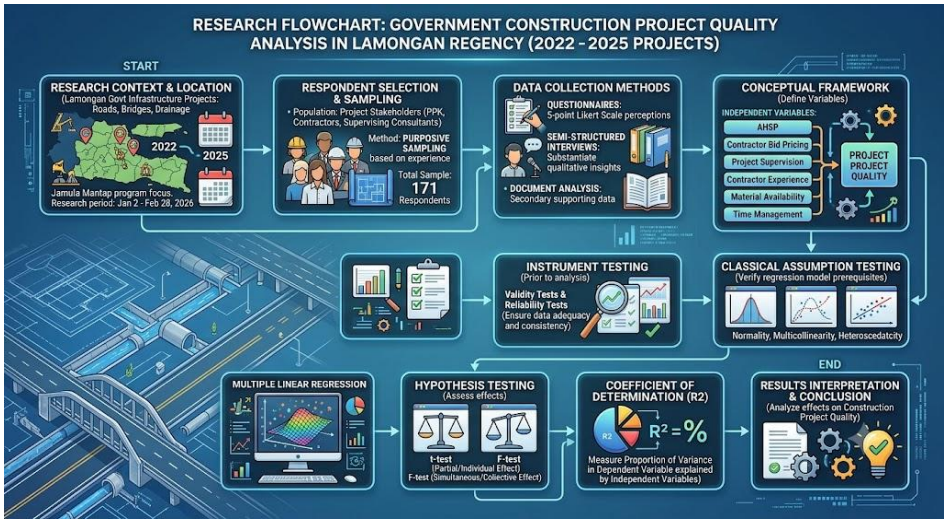


Figure 1. Research Flowchart (generate by Gemini-AI)

Figure 1 illustrates the structured methodological flow of a research project focused on construction quality analysis. The flowchart guides the viewer through each critical step: identifying the conceptual framework with its independent and dependent variables, collecting data from 171 participants, performing validity and reliability tests, verifying classical assumptions, and ultimately executing multiple linear regression to determine the individual and collective impact of variables.

This study employed a quantitative approach utilizing a survey method to analyze the impact of various independent variables on the quality of construction projects. This approach was selected for its capacity to objectively elucidate the relationships between variables through rigorous statistical analysis. The research focused on road construction projects in Lamongan Regency, engaging key project stakeholders as respondents. The population for this study comprised individuals directly involved in the execution of construction projects, specifically the Commitment-Making Officers (PPK), contractors, and supervising consultants. The sample was determined using a purposive sampling technique, whereby respondents were selected based on specific criteria, primarily their requisite knowledge and direct experience in managing construction projects. A total of 171 respondents participated in this study.

Data collection was conducted through the distribution of questionnaires, semi-structured interviews, and document analysis. The questionnaire was structured using a 5-point Likert scale (ranging from 1 to 5) to quantitatively measure respondents' perceptions regarding the research variables. Interviews were conducted to substantiate the quantitative data and to acquire in-depth qualitative insights into actual on-site conditions. Additionally, documentation served as secondary supporting data pertaining to project implementation.

The conceptual framework of this study comprises independent and dependent variables. The independent variables include Unit Price Analysis (AHSP), contractor bid pricing, project supervision, contractor experience, material availability, and time management. Meanwhile, the dependent variable is the quality of the construction project.

Data analysis was performed using multiple linear regression to ascertain the impact of the independent variables on the dependent variable. Prior to the regression analysis, instrument testing—comprising validity and reliability tests—was conducted to ensure the adequacy and consistency of the collected data. Furthermore, classical assumption tests, including normality, multicollinearity, and heteroscedasticity evaluations, were performed to verify that the regression model satisfied the prerequisite statistical assumptions.

Hypothesis testing was conducted using the t-test to determine the partial (individual) effect of each independent variable on project quality, while the F-test was utilized to assess the simultaneous (collective) effect of all independent variables. Finally, the coefficient of determination (R^2) was calculated to measure the proportion of variance in the dependent variable that can be explained by the independent variables.

RESULT AND DISCUSSION

The demographic characteristics of the respondents involved in this study are presented in Table 1. The data illustrates the distribution of participants based on their specific roles within the construction projects. A total of 171 respondents participated in the survey, comprising Project Owners (PPK), Contractors, and Supervising Consultants. As shown in the table, the majority of the respondents are contractors, accounting for nearly half of the total sample (46.8%), followed by supervising consultants (35.7%) and project owners (17.5%).

Table 1. Respondent Profile

Category	Frequency	Percentage (%)
Project Owner (PPK)	30	17.5
Contractor	80	46.8
Supervising consultant	61	35.7
Total	171	100

Source: Primary data

Table 2 presents the descriptive statistics for all the variables examined in this study, which include AHSP, Contractor Price, Supervision, Experience, Material, Time Management, and Project Quality. The table outlines the mean, standard deviation, minimum, and maximum values derived from the respondents' assessments. These statistical measures provide an overview of the data distribution and the general tendency of the respondents' perceptions regarding the factors influencing construction project quality.

Table 2. Descriptive Statistics

Variable	Mean	Std. Deviation	Minimum	Maximum
AHSP	4.12	0.65	2.5	5
Contractor Price	3.98	0.72	2.3	5
Supervision	3.85	0.70	2.1	5
Experience	4.20	0.60	2.8	5
Material	4.05	0.66	2.6	5
Time Management	4.30	0.58	3.0	5
Project Quality	4.15	0.62	2.7	5

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Note: Likert scale (mean) is 1.00 – 1.80 (very low); 1.81 – 2.60 (low); 2.61 – 3.40 (moderate/fair); 3.41 – 4.20 (high/good); 4.21 – 5.00 (very high/very good). Likert scale (standard deviation) is < 0.5 (highly homogeneous); 0.5 – 1.0 (moderately homogeneous); and > 1.0 (heterogeneous).

The research findings, based on the model feasibility test (Table 3), indicate that the applied regression model possesses an excellent capability in explaining the variance in construction project quality. This is demonstrated by the coefficient of determination (R^2) value of 0.930, which signifies that 93% of the variance in project quality can be explained by the variables of Unit Price Analysis (AHSP), contractor bid pricing, project supervision, contractor experience, material availability, and time management. The remaining 7% is influenced by other variables outside the scope of this research model.

Table 3. Model Feasibility Test

Indicator	Value
R Square	0.930
Adjusted R Square	0.927
Calculated F (Fcount)	353.4
Significance	<0.001

Note: R Square > 80% indicates that the data is very strong and feasible; sig (p-value) < 0.05 indicates a significant effect.

Based on Table 2, all variables exhibit high mean values (> 3.8), indicating that respondents provided positive assessments of the research variables. The time management variable recorded the highest mean (4.30), whereas project supervision had the lowest (3.85). The project quality variable yielded a mean score of 4.15, suggesting that, in general, the quality of construction projects falls within a good category. The AHSP and material variables also demonstrated high mean values of 4.12 and 4.05, respectively, indicating that cost planning and material utilization have been executed reasonably well. The low standard deviation values (< 1) signify that the data are relatively homogeneous and consistent, thus making them highly suitable for further analysis.

Table 4 displays the results of the data reliability test conducted for each variable in the study. Cronbach's Alpha was utilized to measure the internal consistency of the survey instruments. The results indicate that all variables exhibit acceptable to very good reliability, with Cronbach's Alpha values ranging from 0.78 to 0.90. This confirms that the measurement scales used in the questionnaire are consistent and reliable for subsequent analysis.

Table 4. Data Reliability Test

Variable	Cronbach's Alpha	Remarks
AHSP	0.85	Reliable
Contractor Price	0.82	Reliable
Supervision	0.78	Acceptable
Experience	0.86	Reliable
Material	0.83	Reliable
Time Management	0.90	Very Good
Project Quality	0.88	Reliable

Note: < 0.8 = fairly reliable (acceptable); ≥ 0.8 = reliable; ≥ 0.9 = very good (highly reliable).

According to the reliability test results presented in Table 4, all research variables exhibit a Cronbach's Alpha value above 0.70. This indicates that the instruments utilized in this study possess a good level of internal consistency and can be declared reliable. The AHSP variable has a Cronbach's Alpha value of 0.85, reflecting high reliability. The contractor bid pricing and material variables also show good reliability values, at 0.82 and 0.83, respectively. Meanwhile, the contractor experience variable scored 0.86, demonstrating excellent consistency in measuring the research construct. The time management variable attained the highest Cronbach's Alpha value (Table 4) at 0.90, classifying it in the excellent category. This suggests that the indicators for this variable have

a very high degree of internal consistency. The project quality variable also exhibited good reliability with a score of 0.88. Although the project supervision variable recorded the lowest Cronbach's Alpha value compared to the others, at 0.78, this value remains above the required minimum threshold and is therefore deemed reliable. Based on these results, it is established that all research instruments are appropriate for subsequent analysis as they satisfy the requisite reliability criteria.

Table 5. Classical Assumption Test

Test Type	Results	Description
Normality	Normal	Data Suitable
Multicollinearity	VIF < 10	Not Present
Heteroscedasticity	Sig > 0,05	Not Present

Based on Table 5, the results of the classical assumption tests indicate that the utilized regression model has fulfilled all prerequisite assumptions. The normality test reveals that the data are normally distributed. The multicollinearity test demonstrates the absence of high correlation among the independent variables, with Variance Inflation Factor (VIF) values of less than 10. Furthermore, the heteroscedasticity test shows a significance value above 0.05, confirming that there is no heteroscedasticity issue. Consequently, the regression model is declared robust and valid for analysis.

Based on Table 6, the results of the regression analysis reveal that the majority of the independent variables exert a significant influence on the quality of construction projects. The time management variable has the most dominant effect, with a coefficient value of 0.40 and a significance level of $p < 0.001$. This indicates that effective time management plays a crucial role in enhancing project quality. Additionally, the variables of AHSP, contractor bid pricing, contractor experience, and materials also exhibit a positive and significant impact on project quality. This implies that cost planning, work experience, and material availability are pivotal factors determining the success of construction projects. Conversely, the supervision variable does not demonstrate a significant effect on project quality, yielding a significance value of 0.120. This suggests that the supervisory function has not operated optimally in influencing construction project quality.

Table 6. Regression Analysis Results

Variable	Coefficient (β)	t-value	Sig.	Description
AHSP	0,25	3,45	0,001	Significant
Contractor Price	0,18	2,9	0,005	Significant
Supervision	0,1	1,55	0,12	Not Significant
Experience	0,22	3,1	0,002	Significant
Material	0,2	3	0,003	Significant
Time Management	0,4	5,8	< 0,001	Dominant

Note: If the sig. (p-value) is less than 0.05, the result is considered significant. (Corrected from the original text's typo to align with the table's data).

The time management variable exerts the most dominant influence on construction project quality. This finding implies that effective time management is the primary key to project success [14]. Project execution delays not only lead to cost overruns but can also degrade work quality due to time constraints and the uncontrolled acceleration of physical work [15]. Therefore, realistic schedule planning and rigorous time control are highly essential in the execution of construction projects.

Furthermore, the Unit Price Analysis (AHSP) variable also exhibits a positive and significant effect on project quality (Table 6). This indicates that the formulation of accurate and realistic unit prices enables the optimal allocation of resources, thereby preserving the quality of work [16]. Conversely, if the established prices are excessively low, contractors tend to implement cost-cutting measures that potentially compromise the quality of the final output.

The contractor experience variable significantly affects project quality as well (Table 6). Contractors with superior experience tend to be capable of managing projects more effectively, both technically

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and managerially [11]. Such experience empowers contractors to anticipate and mitigate various issues that may arise during project implementation.

The availability of materials adhering to specifications is also proven to significantly influence project quality (Table 6). Materials constitute the principal physical component in construction work; hence, their quality and availability critically dictate the outcome [12]. Delays or discrepancies in material provision can impede the execution process and degrade the overall quality of the work [13].

Meanwhile, the contractor bid pricing variable demonstrates a significant impact on project quality. Excessively low bid prices tend to have a negative impact on quality due to severe budgetary constraints during project execution [8]. Therefore, a more stringent evaluation process is required during the tender phase to ensure that the proposed prices remain rational and feasible.

On the other hand, the project supervision variable shows a positive but insignificant effect on project quality. This finding indicates that the supervisory function has not been operating optimally in field practices. This deficiency could be attributed to limited supervisory resources, insufficient supervision intensity, or weak project control systems [17]. This situation highlights the critical necessity for improving the quality of the supervision system so it can play a more effective role in guaranteeing project standards.

Overall, the findings of this study demonstrate that construction project quality is the culmination of the integration of various interconnected factors. The analysis results confirm that the data utilized in this study are valid, reliable, and satisfy all statistical assumptions. The time management variable emerges as the most dominant factor influencing project quality, whereas the supervision variable has yet to provide a significant impact. The research model possesses a very high degree of reliability; thus, the findings of this study can serve as an empirical foundation for policy-making concerning the enhancement of construction project quality. These findings closely align with modern project management concepts that emphasize the importance of striking a balance between cost, time, and quality to achieve project success. Therefore, an integrated project management approach is highly imperative for sustainably improving the quality of construction work outcomes.

CONCLUSION

Based on the research findings and discussion, it can be concluded that all independent variables—namely Unit Price Analysis (AHSP), contractor bid pricing, project supervision, contractor experience, material availability, and time management—simultaneously exert a significant influence (p-value < 0.05) on the quality of construction projects in Lamongan Regency. This indicates that project quality is the manifestation of interacting and interdependent factors within construction project execution. Partially, the time management variable constitutes the most dominant factor influencing the quality of construction projects. This asserts that effective time management plays a pivotal role in maintaining the quality of work. Furthermore, the variables of AHSP, contractor experience, contractor bid pricing, and materials have also been proven to significantly affect project quality. Conversely, the project supervision variable demonstrates a positive yet insignificant effect, indicating that the supervisory function has not been operating optimally. Therefore, the success of a construction project is highly contingent upon the integrated management of cost, time, and resources.

RECOMMENDATIONS

Based on the empirical findings, several recommendations are proposed:

1. Enhancement of Supervision Systems: The local government should improve the project supervision system to increase its effectiveness, for instance, by leveraging digital technology for the real-time monitoring of construction works.
2. Improvement in Time Management: Contractors are advised to elevate their time management capabilities to ensure that project execution adheres to the established schedule without compromising the quality of the work.

3. Rigorous Bid Evaluation: During the procurement process, a more stringent evaluation of bid prices must be implemented to prevent excessively low bidding practices that have the potential to degrade overall project quality.
4. Refinement of Cost Planning: It is necessary to improve the quality of Unit Price Analysis (AHSP) planning to ensure that estimates are more realistic and accurately reflect actual field conditions.
5. Future Research Directions: Future studies are encouraged to incorporate additional variables beyond the scope of this research, such as risk management factors or the implementation of construction technology, to yield more comprehensive insights into project quality determinants.

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