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Multiple Regression Analysis of Project Costs and Quality on Human Resource Costs

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ABSTRACT

The success of construction projects heavily relies on effective management of time, cost, and quality. In Dili City, Timor Leste, construction projects often face challenges due to cost overruns, project delays, and resource inefficiencies. This research aims to analyze the influence of financing factors—such as contract value, project duration, and the number of floors—on human resource costs in construction projects. The research method combines primary data collection through interviews and questionnaires with contractors, along with secondary data from project documents. Data analysis is conducted using multiple linear regression to examine the relationship between project financing variables and labor costs. The results show that the contract value, project duration, and number of floors significantly impact expert labor costs, skilled labor costs, and general labor costs, explaining nearly 98% of the variance. This highlights the critical role of financial management in optimizing labor costs and improving project outcomes. The findings contribute valuable insights for project managers and policymakers in enhancing project performance and cost management. Future research should explore additional factors such as material costs and project complexity to further refine construction cost management practices.

Keywords: Construction Management, Human Resources, Multiple Linear Regression, Project Costs.

INTRODUCTION

Time and cost greatly affect the success and failure of a project (Hermawan et al., 2023). Project success is usually seen from a short completion time with minimal costs without reducing the quality of work (Merrow, 2024). Systematic project management is needed to ensure that the project implementation time is in accordance with the contract or even faster so that it can provide benefits in terms of cost and time. From the optimal time and cost, the project implementer can get the maximum profit (Belferik et al., 2023). To be able to get this, it must be done in time and cost optimization is to make a project work network look for critical activities and calculate the duration of the project and know the amount of resources.

However, project delays are a frequent problem in construction. That's why, performance evaluation is necessary for companies to determinde efficiency, the effectiveness of sustainable

use of operating costs, and to provide information for management decision-making (Putri et al., 2024). The literature shows that delays are often caused by contractors, such as poor quality of work, lack of experience in labor planning, and failures in the field and financial management. In addition, factors from the project owner are also often the cause of delays, such as land acquisition constraints, design changes, payment delays, and unavailability of materials in the market (Elawi et al., 2016). Although the causes of delays can vary, the impact is almost always significant, such as cost overruns, schedule revisions, as well as the threat of fines for the contractor.

All project resources such as labor, equipment, permanent (fixed) and temporary materials, supplies and facilities, funds, technology, and methods and time to complete the project on time within budget and in accordance with the quality and performance standards specified by the planner (Rumengan et al., 2019). The larger an activity is, the more complex its mechanisms are, which means more problems are encountered. If not handled properly, these various problems will result in impacts in the form of delays in project completion, deviations in the quality of results, cost overruns, waste of resources, unhealthy competition between implementers, and failure to achieve the desired facility objectives (Mophethe, 2024).

Good project management is the solution to overcome these challenges (Kerzner, 2025). The process of controlling a project includes all activities included in the project life cycle, so that in completing a project, you must look at the implementation by paying attention to the project control system so that the control can consider resources including time, cost and performance of the project work so that it can be controlled (Pramadha et al., 2024). The project management process includes planning, implementing, and controlling projects to achieve objectives within time, cost, and quality constraints. The three basic elements of project management-time, cost, and quality-must be managed optimally because they influence each other. In this case, time relates to the scheduling of project activities, cost relates to the management of funds and resources, while quality ensures that the project deliverables conform to the specified specifications.

Several studies have examined the integration of time, cost, and quality management. For instance, a research by (Sholeh, 2023) explored the impact of effective project scheduling techniques on time and cost efficiency in large-scale infrastructure projects, showing how project delays were minimized through advanced scheduling software and proactive resource management. Another research by (Rumane, 2017) analyzed the role of quality control practices in ensuring project completion within the stipulated time and budget, emphasizing the need for continuous monitoring and risk management strategies. Additionally, research by (Butt et al., 2016) focused on the challenges faced by contractors in balancing these three elements and proposed a framework for better resource allocation and stakeholder communication to improve project performance.

Integrated management of time, cost, and quality requires systematic application of

methods. Facilities and infrastructure development projects in Dili City that are implemented by the government in collaboration with the private sector often face additional cost challenges due to customization needs. Therefore, efficient resource management is needed to achieve the project completion target on time, within budget, and meet the set quality standards.

Based on the above background, the purpose of this research is to analyze the application of time, cost, and quality management in the Agenci Dejenvolvementu Nacional (ADN) building construction project in Dili City, Timor Leste, and to identify the factors that influence the effectiveness of managing these three elements. The benefits of this research are expected to contribute to project managers in designing more efficient management systems, as well as providing guidance for the government and the private sector in improving collaboration, reducing the risk of delays and cost overruns, and ensuring project outcomes meet established quality standards.

RESEARCH METHOD

The research will be conducted in Dili City, Timor Leste, specifically on Bedik-Hun Street in the Fatuhada area, spanning a period of 20 days from November 17, 2024, to December 7, 2024. This timeline is based on the approval of the research by the Faculty of Engineering at the University of 17 August 1945 (UNTAG) Surabaya.

Data collection will involve both primary and secondary sources. Primary data will be gathered through questionnaires and interviews with contractors involved in construction projects in Dili City. This will include information on human resource costs, contract values, project durations, and building specifications. Secondary data will be derived from project reports, contract documents, and technical specifications of 20 selected construction projects in the city.

The research will use a combination of literature review and field research approaches. The literature review will focus on the Theory of Constraints (TOC) and its relevance to construction project management. Field research will include two phases of data collection: the first phase will involve identifying constraints in construction projects, and the second will assess strategies for resolving these constraints through surveys and sampling contract data to analyze the impact of project financing on human resource costs.

Data analysis will be performed using multiple linear regression to explore the relationships between independent variables such as contract value, project duration, and the number of floors, with dependent variables including expert labor cost, skilled labor cost, and general labor cost. The regression model is represented as:

$$\mathbf{Y = \alpha + B1X1 + B2X2 + B3X3 + e}$$

The research will also apply statistical tests, including correlation analysis (R) to measure the strength of relationships, the coefficient of determination (R^2) to assess how well the

independent variables explain labor cost variations, and hypothesis testing using F-tests and T-tests to evaluate the combined and individual effects of the independent variables.

This research uses multiple linear regression to model the relationship between time, cost, and quality factors on human resources in development projects in Dili City. Multiple regression was selected because it allows for the modeling of relationships between several independent variables and dependent variables, providing a more nuanced understanding of the factors affecting construction project outcomes.

RESULT AND DISCUSSION

The following are the results of research on the effect of building construction project financing consisting of contract value, project duration, number of floors on human resource costs consisting of 3 components, namely experts, skilled workers, and workers / mentors / laden on Building Construction projects in the Agenci Dejenvolvementu Nacional (ADN) Government Office environment in Dili City, Timor Leste.

Effect of Construction Project Financing on Expert Costs

The results for each building construction project financing variable consisting of contract value, project duration, number of floors that allegedly affect the expert cost variable, have the following results.

a. The results of the hypothesis testing of the effect of building construction project financing consisting of contract value, project duration, number of floors which are thought to simultaneously affect the cost of experts on Building Construction projects in the office environment of the Agenci Dejenvolvementu Nacional (ADN) Government Office Dili City Timor Leste), can be seen in the ANOVA test results in Table 1 below.

Table 1. Anova Test

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	3,359E9	3	243,577	243,577	0,000[a]
Residuals	7,356E7	16	4597313,726		
Total	3,433E9	19			
a. Predictors: (Constant), Number of Floors, Contract Value, Duration					
b. Dependent Variable: Expert					

Based on the results of the simultaneous test, the calculated test value is 243.577 with a significance value of 0.000. It is concluded that the significance value of the project has a value of below 0.05 so that it can be said that the variable number of floors, the contract value variable, and the project duration variable together (simultaneously) affect the cost of experts on the Construction Project for the Construction of the Office of Agenci Dejenvolvementu Nacional (Adn) Dili City Timor Leste.

Based on the simultaneous test results, the research hypothesis H(a) is accepted, and rejects the hypothesis H(0). So it can be said that the multiple linear regression model obtained in equation (1) is significant:

Y = -9459.052 + 6.641E-6 X1 + 176.681 X2 + 5685.645 X3 (1)

The regression model equation has a resulting constant (a) of -9459.052 indicating that the value of expert labor costs (Y) will decrease by $9459.052 if the cost of contract value (X1), duration (X2) and number of project floors (X3) are constant.

The project contract coefficient (β1) of 0.000006641 indicates that if the project contract value variable (X1) is increased by one unit, it will result in an increase in expert labor costs by $0.000006641 assuming other variables are constant.

The project duration coefficient value (β2) of 176.681 indicates that if the project duration value variable (X2) is increased by one unit, it will result in an increase in expert labor costs of $ 176.681 assuming other variables are constant.

The coefficient value of the number of project floors (β3) of 5685.645 indicates that if the variable value of the number of project floors (X3) is increased by one unit, it will result in an increase in expert labor costs by $5685.645, assuming other variables are constant.

b. Based on the results of hypothesis testing on the effect of building construction project financing consisting of contract value, project duration, number of floors simultaneously on expert labor costs on the Agenci Dejenvolvementu Nacional (Adn) Office Construction Project in Dili City, Timor Leste, it can also be seen the coefficient of correlation and determination of the multiple linear regression model in table 2 below.

Table 2. Correlation Value and Coefficient of Determination

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0,989[a]	0,979	0,975	2.144,135
a. Predictors: (Constant), Number of Floors, Contract Value, Duration				
b. Dependent Variable: Y				

Based on the table above, the R (Correlation Coefficient) value is 0.989. This means that the independent variables X1 (Contract Value), X2 (Duration), and X3 (Number of Floors) with the dependent variable Y1 (Expert) have a close or strong relationship because the value of 0.989 is almost close to 1.

The regression model also has a coefficient of determination of 0.979. This value shows that the variables of contract value, duration and number of floors can explain the expert labor by 97.9%. While the remaining 2.1% is explained by other variables outside this research.

Effect of Construction Project Financing on Skilled Labor Costs

The results for each building construction project financing variable consisting of contract value, project duration, number of floors that are thought to have an effect on the skilled labor cost variable, have the following results.

a. The results of the hypothesis testing of the effect of financing building construction projects consisting of contract value, project duration, number of floors which are thought to simultaneously affect the cost of skilled labor on the Agenci Dejenvolvementu Nacional (Adn) Office Construction Project in Dili City, Timor Leste, can be seen in the ANOVA test results, in table 3 below.

Table 3. Anova Test

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	1,755E9	3	5,849E8	218,347	0,000[a]
Residuals	4,286E7	16	2678871,596		
Total	1,798E9	19			
a. Predictors: (Constant), Number of Floors, Contract Value, Duration					
b. Dependent Variable: Skilled Personnel					

Based on the results of the simultaneous test, the calculated test value is 218.347 with a significance value of 0.000. It is concluded that the significance value of the project has a value below 0.05 so that it can be said that the variable number of floors, the contract value variable, and the project duration variable together (simultaneously) affect the cost of skilled labor on the Construction Project for the Construction of the Agenci Dejenvolvementu Nacional (Adn) Office in Dili City, Timor Leste.

Based on the simultaneous test results, the research hypothesis H(a) is accepted, and rejects the hypothesis H(0). So it can be said that the multiple linear regression model obtained in equation (2) is significant:

Y = -7796.260 + 4.557E-6 X1 + 124.751 X2 + 4525.992 X3 (2)

The regression model equation has a resulting constant (a) of -7796.260 indicating that the value of skilled labor costs (Y) will decrease by $7796.260 if the cost of contract value (X1), duration (X2) and number of project floors (X3) are constant.

The project contract coefficient (β1) of 4.557E-6 indicates that if the project contract value variable (X1) is increased by one unit, it will result in an increase in skilled labor costs by $0.000004557 assuming other variables are constant.

The project duration coefficient value (β2) of 124.751 indicates that if the project duration value variable (X2) is increased by one unit, it will result in an increase in skilled labor costs by $124.751 assuming other variables are constant.

The coefficient value of the number of project floors (β3) of 4525.992 indicates that if the variable value of the number of project floors (X3) is increased by one unit, it will result in an increase in skilled labor costs by $4525.992 assuming other variables are constant.

b. Based on the results of the hypothesis testing of the effect of Building construction project financing consisting of contract value, project duration, number of floors that are suspected simultaneously on the cost of skilled labor on Building Construction projects in the Agenci Dejenvolvementu Nacional (ADN) Government Office environment in Dili City, Timor Leste, it

can also be seen the value of the correlation and determination coefficients of the multiple linear regression model in table 4 below.

Table 4. Correlation Value and Coefficient of Determination

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0,988[a]	0,976	0,972	1.636,726
a. Predictors: (Constant), Number of Floors, Contract Value, Duration				
b. Dependent Variable: Y				

Based on the table above, the R (Correlation Coefficient) value is 0.988. This means that the independent variables X¬1 (Contract Value), X2 (Duration), and X3 (Number of Floors) with the dependent variable Y1 (Expert) have a fairly close or strong relationship because the value of 0.988 is almost close to 1. The regression model also has a coefficient of determination of 0.976. This value shows that the variables of contract value, duration and number of floors can explain 97.6% of skilled labor. While the remaining 2.4% is explained by other variables outside this research.

Effect of Construction Project Financing on Labor Costs of Workers/Mandors/Laden

The results for each building construction project financing variable consisting of contract value, project duration, number of floors that are thought to have an effect on the labor cost variable of Workers/Mandors/Laden, have the following results:

a. The results of hypothesis testing affecting the financing of building construction projects consisting of contract value, project duration, number of floors which are thought to simultaneously affect the labor costs of Workers/Mandors/Laden on Building Construction projects in the Agenci Dejenvolvementu Nacional (ADN) Government Office environment in Dili City, Timor Lested can be seen in the ANOVA test results in table 5 below.

Table 5. Anova Test

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	1,693E8	3	5,643E7	496,296	0,000[a]
Residuals	1819395,492	16	113712,218		
Total	1,711E8	19			
a. Predictors: (Constant), Number of Floors, Contract Value, Duration					
b. Dependent Variable: Worker/Mandor/Laden					

Based on the results of the simultaneous test, the calculated test value is 496,296 with a significance value of 0.000. It is concluded that the significance value of the project has a value below 0.05 so that it can be said that the variable number of floors, the contract value variable, and the project duration variable together, (simultaneously) affect the labor costs of workers/mandors/laden on the Construction Project for the Construction of the Office of Agenci Dejenvolvementu Nacional (Adn) Dili City Timor Leste.

Based on the simultaneous test results, the research hypothesis H(a) is accepted, and rejects the hypothesis H(0). So it can be said that the multiple linear regression model obtained in equation (3) is significant:

Y = -1053.426 + 4.320E-7 X1 + 55.841 X2 + 427.679 X3 (3)

The regression model equation has a resulting constant (a) of -1053.426 indicating that the value of labor/mandor/laden costs (Y) will decrease by $1053.426 if the cost of contract value (X1), duration (X2) and number of project floors (X3) are constant.

The project contract coefficient (β1) of 4.320E-7 indicates that if the project contract value variable (X1) is increased by one unit, it will result in an increase in expert labor costs by $0.00000004320 assuming other variables are constant.

The project duration coefficient value (β2) of 55.841 indicates that if the project duration value variable (X2) is increased by one unit, it will result in an increase in skilled labor costs by $55.841 assuming other variables are constant.

The coefficient value of the number of project floors (β3) of 472.679 indicates that if the variable value of the number of project floors (X3) is increased by one unit, it will result in an increase in skilled labor costs by $472.679 assuming other variables are constant.

b. Based on the results of hypothesis testing on the effect of building construction project financing which consists of contract value, project duration, number of floors that are suspected simultaneously on the cost of workers/mandors/laden on Building Construction projects in the Agenci Dejenvolvementu Nacional (ADN) Government Office environment in Dili City, Timor Leste, it can also be seen the coefficient of correlation and determination of multiple linear regression models in table 6 below.

Table 6. Correlation Value and Coefficient of Determination

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0,981	0,963	0,956	34,840,955.079
a. Predictors: (Constant), Number of Floors, Contract Value, Duration				
b. Dependent Variable: Y				

Based on the table above, the R (Correlation Coefficient) value is 0.981. This means that the independent variables X¬1 (Contract Value), X2 (Duration), and X3 (Number of Floors) with the dependent variable Y1 (Workers/Mandors/Laden) have a fairly close or strong relationship because the value of 0.981 is almost close to 1.

The regression model also has a coefficient of determination of 0.963. This value shows that the variables of contract value, duration and number of floors can explain the labor of Workers/Mandors/Laden by 95.6%. While the remaining 4.4% is explained by other variables outside this research.

The results of this research demonstrate that the financing factors in building construction projects, including contract value, project duration, and the number of floors, have a significant impact on human resource costs, including expert, skilled labor, and worker/foreman/laden

costs. The findings confirm that a higher contract value, longer project duration, and an increased number of floors are associated with higher costs for expert and skilled labor, as well as for workers. These results align with prior studies that emphasize the close relationship between project financing variables and labor costs in construction projects (Musarat et al., 2021). For instance, in their research, (Van Tam et al., 2021) found that project financing directly influences labor cost management, indicating that projects with larger budgets and extended timelines tend to allocate more resources for labor. Furthermore, the findings from this research are supported by the work of (Lu et al., 2015), who demonstrated that project complexity and scale, such as the number of floors in a building, are crucial factors in determining labor costs. The results also highlight the high explanatory power of the independent variables, with contract value, project duration, and the number of floors explaining nearly 98% of the variance in expert and skilled labor costs, which further supports the significance of these factors in construction cost estimation.

CONCLUSION

The conclusion in this research shows that financing factors in building construction projects, including contract value, project duration, and number of floors, significantly affect human resource costs such as the cost of experts, skilled labor, and the cost of workers/foremen/foremen. The findings of this research highlight that project financing accounts for up to 97.9% of the cost of experts, 97.6% of the cost of skilled labor, and 95.6% of the cost of workers/foremen/ foremen. This emphasizes the important role of financial management in optimizing labor costs. For further research, it is advisable to explore additional factors such as project complexity, material costs, and labor market conditions to provide a more comprehensive understanding of human resource expenditure in the construction sector. Expanding this research to include more projects and more diverse regions can improve the generalization of these findings, which contributes to improving management practices in construction projects globally.

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