Jurnal Teknik Indonesia

Volume 4 Nomor 4 Oktober 2025

https://jti.publicascientificsolution.com/index.php/rp

Efficiency Analysis Of Material Management On The Construction Contract Value Of School Buildings In Surabaya

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Abstract

The construction industry faces intense competition, necessitating breakthroughs in budget efficiency through proper management. To achieve company optimization, three main aspects are emphasized: time management, cost management, and material management. In this regard, the study Efficiency Analysis of Material Management on the Construction Contract Value of School Buildings in Surabaya focuses on analyzing material management and its influence on work performance in the construction of school buildings in Surabaya. School building projects were chosen because they are considered unique in design and structure, generally uniform from the first floor upwards. Such standardization presents opportunities to save materials, thereby reducing project expenditures. Efficient material management plays a crucial role in minimizing waste, optimizing the use of resources, and maintaining project quality within the available budget constraints. The regression equation obtained in the study is Y1 = 1.360 + 0.187 + 0.425 – 0.124 + 0.402 – 0.190 – 0.097, where 1.360 is the constant value. Variables with positive (+) coefficients signify that their implementation positively affects project performance, while those with negative (–) coefficients suggest the opposite effect when not implemented effectively. The analysis shows that effective material management contributes efficiency levels ranging from 3% to 5% of the total contract value. This contribution is relatively significant, considering that each project carries different contract amounts. Although the percentage may seem small, the impact on larger-scale projects is substantial, underscoring the importance of strategic material management in enhancing construction project efficiency.

Keyword: *Efficiency; Analysis; Material Management*

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Introduction

Nowadays, development and competition in the construction industry, especially among contractors, are progressing rapidly (Harris, McCaffer, Baldwin, & Edum-Fotwe, 2020). Therefore, it is highly relevant that internal company management plays an important role in enabling contractors to compete with others, aiming to achieve good,

E-ISSN: 2963-2293 | P-ISSN: 2964-8092
DOI: 10.58860/jti.v4i4.771

strong, and timely project results (Demirdöğen & IŞIK, 2016; Du et al., 2016). Broadly speaking, construction is divided into three categories, namely building construction, engineering construction, and industrial construction (Myers, 2022). Schools are physical structures specifically designed to support the educational process, both formal and non-formal (White & Lorenzi, 2016). These buildings not only function as places of learning but also as facilities that create a conducive environment for student development (Barrett, Treves, Shmis, & Ambasz, 2019; Nair, 2019).

The use of materials can influence the quality and performance of construction project implementation in school buildings such as SMP Giki-1 Surabaya, SMPIT At-Taqwa Surabaya, and SMPIT Usman Surabaya. The use of leftover materials from previous projects by the implementing contractor can be quite helpful in reducing the cost of purchasing new materials (Ajayi & Oyedele, 2018; Ajayi et al., 2017). These materials may include personal protective equipment, wood, and beams for concrete deck scaffolding formwork, among others (Li, Lin, Bao, & Xie, 2022). Proper record-keeping during project implementation is essential (Neupane & Jaisi, 2025). In this regard, the logistics section must be meticulous in recording data, ensuring that the information can serve as a final reference for evaluating the effectiveness of material expenditure from the initial foundation work to the project handover (Pitkänen, 2024; Salzano, Cascone, Zitiello, & Nicolella, 2024).

In addition to monitoring material management, attention is also given to the effectiveness of reusing materials from other projects for future use (Iacovidou, Purnell, & Lim, 2018). To arrive at a sound conclusion, this study employs both qualitative and quantitative research methods (Ahmad et al., 2019; Queirós, Faria, & Almeida, 2017). The research plan involves several schools in Surabaya as samples for questionnaire distribution or interviews, including school construction projects at SMP Giki-1, SMPIT At-Taqwa, and SMPIT Usman Surabaya.

One relevant previous study is by (Sila & Gakobo, 2021), which assessed the impact of material management practices on construction project performance. This study concluded that material inventory management and waste control had a significant positive impact on overall project performance. However, it did not specifically address the context of school construction projects in Surabaya; therefore, its findings cannot be directly applied to the local situation.

Another study by (Kulkarni, Sharma, Hote, & Civil, 2017) analyzed factors affecting material management at construction sites. The results indicated that having the right materials at the right place and time is crucial for effective project execution. Nonetheless, this study did not specifically focus on cost efficiency within school construction projects, which is the focus of this research.

This study aims to analyze the impact of material management on cost efficiency in school construction projects in Surabaya. Using both quantitative and qualitative methods, it is expected to provide new insights into effective material management practices in the local context. The potential benefits include practical recommendations for contractors to better manage materials, reduce waste and costs, and contribute to construction management literature in Indonesia.

Method

In data processing using SPSS27 software, which is a computer program to make it easier to analyze input data into output data that can be used for analysis.

Validity & Reliability

Validity is an indicator that shows the extent to which an instrument can be seen as valid. In quantitative research, in order to obtain valid, reliable, and objective data, it is necessary to use instruments that have been proven to be valid and reliable. Research must also be conducted on samples that are representative of the population, and the process of data collection and analysis must be carried out properly and systematically.
Reliability test

$$r\,11 = \left(\frac{k}{k-1}\right)\left(1-\frac{\sum\sigma}{\sigma 2/1}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Description
r11 = Instrument reliability value
K = Number of question items
∑∂= Total item variance value
∂ = Total variance value

Multiple Linear Regression Analysis

Multiple linear regression analysis is a statistical method used to reveal the relationship and influence between the dependent variable (Y) and two or more independent variables (X). The purpose of this analysis is to measure the level of strength of the relationship between these variables, so that it is possible to predict the value of Y based on changes that occur in the variable X. The basic model of multiple linear regression analysis can be explained as follows (Ridwan, 2011)

$$Y = \beta_0+\beta_1X_1+\beta_2X_2+\ldots+\beta_nX_n+\varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Description:
Y : Dependent variable Y1
X1 : Independent variable X1
β0 : constant
β1 : regression constant X1
βn : regression constant Xn
X2 : Independent variable X2

Jurnal Teknik Indonesia
E-ISSN: 2963-2293 | P-ISSN: 2964-8092
DOI: 10.58860/jti.v4i4.771

β2 : regression constant X2

ε : residual

Simultant Significance Test (F test)

To understand the influence of independent variable X on dependent variable Y simultaneously, simultaneous significance testing can be carried out. The following is the formula that

$$F0 = \frac{R2/(k-1)}{(1-R2)(n-k)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

F0 : Simultaneous Test value

R2 : Determination Coefficient value

n : Number of data value

k : Number of independent variables value

Partial significance test ('t' test)

This test is to prove that an independent variable has an effect on the dependent variable.

$$\frac{\beta"i-\beta i}{Se(\beta"i)} \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

description

β"I = Partial regression coefficient i. from sample regression

βi = Partial coefficient value i. on the null hypothesis

Se(β"i) = Standard error

Variable Classification

To make it easier to group, a classification of variables X and Y is made, where variable X is the independent variable and variable Y is the dependent variable, namely Y is performance improvement while X is material management.

Tabel 1. Sub variable Quisioner

No	Variable	Sub Variabel		References
		Item	**Questionnaire Question Items**	
1	X1 (Planning material procurement according to specifications)	X1.1	Carrying out material specification planning	Haekal Hassan (2016)
		X1.2	Carrying out procurement schedule preparation	Nugraha et al.,(1985)
		X1.3	Method of using materials in work is required	Kurniawan,B.Y (2011)
		X1.4	Materials used according to	brainstrorming

No	Variable	Sub Variabel		References
		Item	Questionnaire Question Items	
2	X2 (Purchase of materials according to planning)	X2.1	Purchase orders are issued out of sync with the work schedule	Interview and brainstrorming
		X2.2	Material payments are often late.	Haekal Hassan (2016)
		X2.3	Material procurement schedules are still not detailed.	Kurniawan,B.Y (2011)
		X2.4	Procurement procedures at the company management level are too complicated	Interview and brainstrorming
3	X3 (using specifications and installation schedule)	X3.1	The social situation around the project hinders the material delivery process.	Ingterview and brainstrorming
		X3.2	Quality damage occurs during the distribution process.	Ingterview and brainstrorming
		X3.3	Material requirement estimates are not detailed enough.	Nugraha et al.,(1985)
		X3.4	Material delivery times are not in line with the installation schedule.	Ingterview and brainstrorming
4	X4 (Storage and security of materials)	X4.1	Damp warehouse conditions reduce material quality	Interview and brainstrorming
		X4.2	Social factors around the logistics warehouse affect operations	Kurniawan,B.Y (2011)
		X4.3	Arrangement of goods in the warehouse is too far from the project area	Ingterview and brainstrorming
		X4.4.	Location of the place is too far from the project area	Interview and brainstrorming
5	X5 (Use of materials according to material characteristics)	X5.1	Installation does not consider material characteristics	Kurniawan,B.Y (2011)
		X5.2	Control of material use is less effective	Interview and brainstrorming
		X5.3	Material stock is often insufficient	Haekal Hassan (2016)

E-ISSN: 2963-2293 | P-ISSN: 2964-8092
DOI: 10.58860/jti.v4i4.771

No	Variable	Sub Variabel		References
		Item	Questionnaire Question Items	
		X5.4	Material transfer paths during installation are limited	Interview and brainstrorming
6	X6 (with Control & Logistics)	X6.1	X6.1 Material inventory management is not optimal	Interview and brainstrorming
		X6.2	X6.2 Incoming and outgoing material flows are not recorded properly	Haekal Hassan (2016)
		X6.3	X6.3 Logistics personnel are still lacking	Haekal Hassan (2016)
		X6.4	X6.4 Coordination meetings on logistics and work progress are rarely held	Haekal Hassan (2016)
7	Y(Improving project implementation performance)	Y1	Good material management, work is completed faster	Interview and brainstrorming
		Y2	Use of economical materials will reduce material costs	Interview and brainstrorming
		Y3	Preparation of material list requirements will expedite work	Interview and brainstrorming

(sources: Analysis result,2025)

Results and Discussion

Research location

The research was conducted in several schools in Surabaya, including,

1. GIKI 1 Junior High School Surabaya, located on Jl. Dukuh Kupang Utara ½ Surabaya
2. SDIT At Taqwa Surabaya School, located on Jl. Lidah Kulon Surabaya
3. SMPIT Usman Surabaya School, located on Jl. Lakarsantri, Surabaya


SMP giki 1


SDIT At-taqwa


SMPIT Ustman bin affan

Figure 1. Location of research

Respondent profile

Job classification from respondent data related to position levels from Project Manager to Field Foreman, the following data was obtained in the field with details of 4 project managers, 3 deputy managers, 5 quality control, 8 implementers and 8 foremen, a total of 33 people

Test the validity of respondent date

To find out the relationship between scores, the Pearson correlation technique is used. The assessment criteria are if the correlation coefficient value exceeds the r-table value of 0.344, then the items in the questionnaire are considered valid and suitable for use as data collection instruments.

DF = 33-2

= 31, then rtable is 0.3440

Table 2. Validity date

Variable	Item	Corrected Item-Total Correlation	r Table	Explanation
X1	X1.1	0.379	0.3440	Valid
	X1.2	0.436	0.3440	Valid
	X1.3	0.383	0.3440	Valid
	X1.4	0.345	0.3440	Valid
X2	X2.1	0.392	0.3440	Valid
	X2.2	0.345	0.3440	Valid
	X2.3	0.487	0.3440	Valid
	X2.4	0.587	0.3440	Valid
X3	X3.1	0.709	0.3440	Valid
	X3.2	0.454	0.3440	Valid
	X3.3	0.398	0.3440	Valid
	X3.4	0.465	0.3440	Valid
X4	X4.1	0.354	0.3440	Valid
	X4.2	0.495	0.3440	Valid
	X4.3	0.808	0.3440	Valid
	X4.4	0.444	0.3440	Valid
X5	X5.1	0.445	0.3440	Valid
	X5.2	0.509	0.3440	Valid
	X5.3	0.641	0.3440	Valid
	X5.4	0.648	0.3440	Valid
X6	X6.1	0.512	0.3440	Valid
	X6.2	0.577	0.3440	Valid
	X6.3	0.353	0.3440	Valid
	X6.4	0.410	0.3440	Valid

E-ISSN: 2963-2293 | P-ISSN: 2964-8092
DOI: 10.58860/jti.v4i4.771

Variable	Item	Corrected Item-Total Correlation	r Table	Explanation
Y1	Y1.1	0.520	0.3440	Valid
	Y1.2	0.510	0.3440	Valid
	Y1.3	0.455	0.3440	Valid

Source: Analysis result, 2025

Respondent data reliability test

Tabel 3. cornbach's Alpha

Variable	Cronbach's Alpha	Cut off	Explanation
X1	0.89080	0.600	Reliable
X2	0.88925	0.600	Reliable
X3	0.88787	0.600	Reliable
X4	0.88731	0.600	Reliable
X5	0.88656	0.600	Reliable
X6	0.88869	0.600	Reliable

Source: Analysis result, 2025

Normality Test

In the normality test, if the data obtained is a stable line as in the image below, then it can be stated that the data is normal.

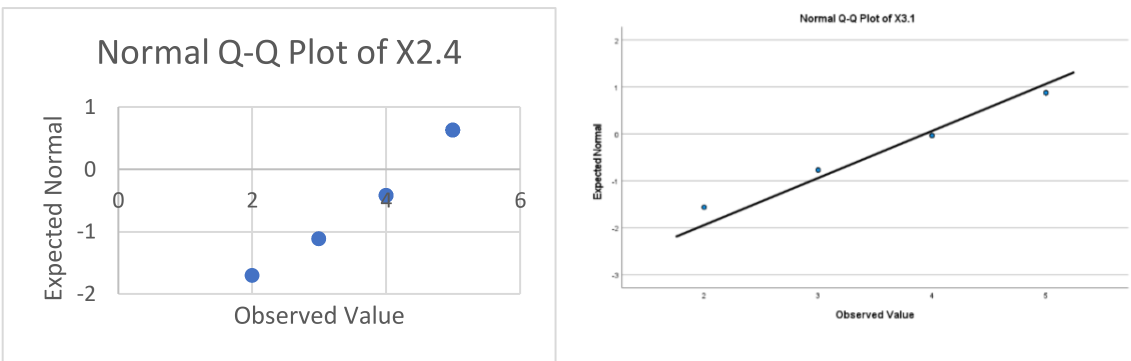

Figure 2. Normality test grafic
Source: Analysis result, 2025

Table 4. Model R

Model	R	R Square	Adjusted R Square	Std Error of the Estimate
1	0.557	0.310	0.150	0.5737

Source: Analysis result, 2025

Based on the table above, the R value obtained is 0.557 or equivalent to 55.7%, which shows that the dependent variable (Y) is influenced by the independent variable by 55.7%. Meanwhile, the remaining 44.3% is influenced by other factors not included in this study.

Simultant test F

This test is used to see all variables that influence the independent variable on the dependent variable simultaneously, if the sig F value obtained is less than 0.05, then it can be concluded that the independent variables together have an influence on the dependent variable. The results of this test will be presented as follows.

Tabel 5. Simultan F

Model	Sum of Squares	Df	Mean Square	F	Sig
Regression	24.828	1	24.828	9.011	0.005%
Residual	85.414	31	2.755		
Total	110.242	32			

Source: Analysis result, 2025

In the table above, the results of the ANOVA test (F test) show that the F value of 9.011 is higher than the F table value of 0.3440.

Parsial test (Test’t’)

The explanation of the independent variables shows that each has a partial influence on the dependent variable. The full explanation is presented below.

Table 6. T test

Model	Unstandardized Coefficients	B	Std. Error	t	Sig
(constant)	1.360	0.880	1.545	0.135	
X1	0.187	0.221	0.846	0.406	
X2	0.426	0.338	1.259	0.219	
X3	-0.124	0.360	-0.343	0.734	
X4	-0.402	0.271	1.483	0.150	
X5	-0.190	0.320	-0.593	0.558	
X6	-0.097	0.290	-0.333	0.742	

Source: Analysis result, 2025

Based on the multiple regression output table from SPSS 27 above, the independent variables that influence implementation performance are variables that have a sig. value below 0.05 with an error rate of 5%.

E-ISSN: 2963-2293 | P-ISSN: 2964-8092
DOI: 10.58860/jti.v4i4.771

Tabel 7. test T

Independent Variable	tcount	ttable	Significance	Decision	Information
X1	0,846	1,696	0,406	Reject H_0	Influental
X2	1,259	1,696	0,219	Reject H_0	influental
X3	0,343	1,696	0,734	Reject H_0	Influental
X4	1,483	1,696	0,150	Reject H_0	Influental
X5	0,593	1,696	0,558	Reject H_0	Influental
X6	0,333	1,696	0,742	Reject H_0	Influental

Source: Analysis result, 2025

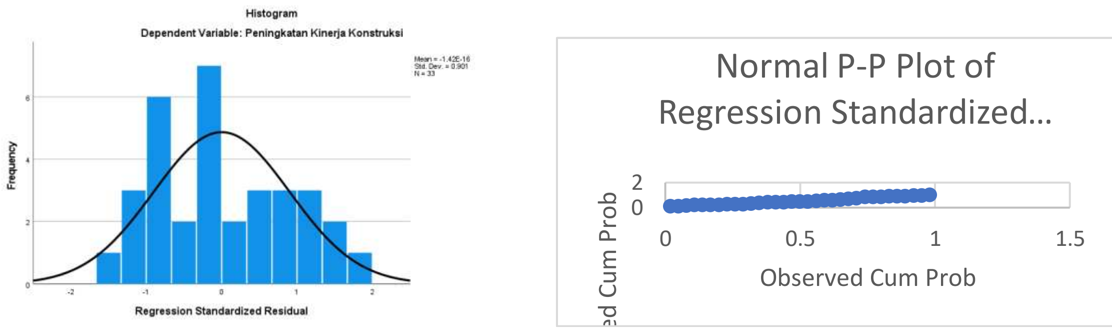

Figure 3. Histogram
Source: Analysis result, 2025

Discussion

Multiple Linear Regression Analysis

Analysis of the model of the influence of material management on the quality of construction performance, and a multiple linear regression model is produced.

Table 8. Unstandardized Coefficients

Model	Unstandardized Coefficients	B	Std. Error	t	Sig
(constant)	1.360	0.880	1.545	0.135	
X1	0.187	0.221	0.846	0.406	
X2	0.426	0.338	1.259	0.219	
X3	-0.124	0.360	-0.343	0.734	
X4	-0.402	0.271	1.483	0.150	
X5	-0.190	0.320	-0.593	0.558	
X6	-0.097	0.290	-0.333	0.742	

Source: Analysis result, 2025

From the data in table 8, at the value of B where 1.360 is a constant value and the values of X1, X2, X4 are positive while X3, X5, X6 are negative, the following multiple linear regression equation is obtained

$$Y1 = 1.360 + 0.187X\_1 + 0.425X\_2-0.124X\_3 + 0.402X\_4-0.190X\_5-0.097X\_6$$

Description

a. Y1: Improving the performance of the implementation of School Building construction
b. X1: Material needs planning is carried out according to the specified specifications
c. X2: The material purchasing process is carried out based on the plan that has been prepared
d. X3: Material distribution is carried out according to the specifications and installation schedule that has been determined
e. X4: The process of storing and securing materials is carried out with a regulated system
f. X5: Utilization of materials is adjusted to the nature and characteristics of the materials used
g. X6: Material control is carried out by the logistics department

From the regression equation obtained, if the t-count value is reviewed, it can be explained that the procurement of materials according to specifications has an effect on increasing the performance of construction implementation because the B value is +0.187>0.05, but it is not significant because Tcount (0.846) <Ttable (1.696).

The relationship between material management and the performance of school building construction is analyzed, focusing on several key variables. The variables include material needs planning (X1), material purchasing process (X2), material distribution (X3), material storage and security (X4), material utilization (X5), and material control (X6). The regression analysis shows that material procurement according to specifications (X1) has a positive impact on construction performance (Y1), with a coefficient value of +0.187. However, this impact is not statistically significant, as indicated by a t-count value of 0.846, which is less than the t-table value of 1.696, suggesting that material procurement alone does not significantly contribute to improving construction performance.

Previous studies support the importance of material management in construction project success. For instance, Akinmoladun and Omoniyi (2021) emphasized that effective material management is critical for the success of construction projects, as it directly affects project timelines, cost efficiency, and quality. Furthermore, Guliyev et al. (2018) found that proper material procurement and distribution practices significantly contribute to the timely completion of construction projects by reducing delays and improving worksite efficiency.

E-ISSN: 2963-2293 | P-ISSN: 2964-8092
DOI: 10.58860/jti.v4i4.771

Although material procurement is essential, the findings of this study suggest that other factors, such as material storage, security, and utilization, may play a more significant role in influencing the overall performance of construction projects. This is consistent with the work of Atkinson and Fitzgerald (2019), who highlighted the importance of integrating various material management processes, including storage, handling, and inventory control, to optimize construction outcomes. Therefore, a holistic approach that addresses all aspects of material management, not just procurement, is critical to achieving high performance in construction projects.

Conclusion

The study demonstrates that effective material management contributes to cost savings of approximately 3% to 5% of the total contract value, a range that, while modest for smaller projects, becomes substantial in larger-scale constructions. Efficient practices such as reusing leftover materials and maintaining accurate logistics records significantly reduce costs and improve project performance. These findings underscore the role of material management in enhancing financial outcomes and operational efficiency, particularly in school construction projects in Surabaya. Future research should explore the integration of digital monitoring systems or supply chain technologies to further optimize material control and sustainability in construction management.

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