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# ANALYSIS OF FACTORS CAUSING MATERIAL WASTE AND COST LOSS IN HIGH-RISE BUILDING CONSTRUCTION PROJECTS IN JAKARTA

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**ABSTRACT:**
The waste materials generated from construction activities have an impact on the increasing costs incurred by contractors. As construction costs increase for each project, it poses a potential loss for the project, especially considering the significant amount of wasted materials. The aim of this research is to analyze the model of the influence of causes of leftover materials on construction cost losses in high-rise buildings in Jakarta. This study was conducted based on data collected from 12 distinct projects, with a total of 21 respondents. The sampling technique employed in this study utilized questionnaires. The design planning, material procurement, material handling, work implementation, and residual materials variables were found to have an impact on construction cost losses. Among these variables, material procurement and design planning were identified as the most influential factors contributing to construction cost losses. Construction cost losses were derived from indicators with the highest averages, specifically in the variable of leftover material procurement for indicator X2-1, with an average score of 5.19, and in the design planning variable for indicator X1-1, with an average score of 5.05. These indicators are related to "material orders" and "design changes," respectively.

**Keywords:** Waste Materials, Construction Cost Losses, High-Rise Buildings

## INTRODUCTION

Jakarta, as the capital city of Indonesia, has the highest population density in the country (Chiu, 2022). Therefore, the basic needs of its residents include owning residential areas, office spaces, and entertainment centers. Due to the limited land availability, the direction of development has shifted from horizontal to vertical. This is done by constructing low-rise or high-rise buildings (Fekade, 2000).

In previous research, waste material can be defined as unwanted or non-valuable material that cannot be reused (Oliveux et al., 2015). It is common for every construction project to have leftover materials since materials are essential in construction activities (de Oliveira et al., 2012). Consequently, the presence of

leftover materials in construction projects will inevitably increase construction costs. The leftover materials generated from construction activities have an impact on increasing the expenses incurred by the contractor (Ann et al., 2013). With the escalating construction costs for each project, there is a potential risk of financial loss, especially due to the wastage of materials (Omede, 2021).

Materials are one of the important components in determining the cost of a project. The percentage of cost attributed to leftover materials in a project ranges from 40 to 60% of the total overall expenditure incurred by the contractor (Patel & Vyas, 2011). This indirectly plays a crucial role in supporting the success of the project, particularly in terms of cost components (Intan et al., 2005). Meanwhile, the percentage of leftover materials generated from all building construction projects ranges from 3 to 13.5% (Ilyas et al., 2019). In the construction process, the use of materials by field workers can result in a significant amount of leftover materials. According to (Dempsey et al., 2012) waste material accounts for approximately 15-30% of the total waste in a city.

There are many factors that can contribute to material waste, including design factors, procurement factors, handling factors, execution factors, and residual factors (Nagapan et al., 2011). In light of these issues, the researcher is interested in analyzing the leftover materials in the implementation of high-rise building construction projects in Jakarta. If the factors causing leftover materials can be minimized and avoided, the project's success in terms of cost can be achieved by the contractor.

## RESEARCH METHODS

The research was conducted on 12 projects located in Jakarta. After distributing the questionnaires, information was obtained regarding the sample size, which consisted of 21 individuals from the entire set of projects. The criteria for selecting respondents included individuals involved in material usage in high-rise building projects, such as project managers, site managers, supervising consultants, field supervisors, logistics personnel, and warehouse personnel.

There are five variables in this research, namely design planning, material procurement, handling of leftover material, execution of work, and residual leftover material in relation to cost loss. The design in this research consists of primary and secondary data. Primary data is a source of information that directly provides information to the information authority, while secondary data is a source of information that indirectly provides information to the data collector. The data sources in the research to be conducted consist of two sources:

1. The primary data to be collected for this research will consist of observations, questionnaire distribution, and interviews with the individuals involved in the research object, which is the construction of high-rise buildings in Jakarta.
2. Secondary data for the survey method research was obtained from literature sources, including websites, books, journals, and previous studies.

The research analysis method used in this study is multiple linear regression. The tests conducted include validation test, reliability test, classical assumption test, multiple linear regression test, t-test, and F-test. If the research instruments are deemed valid and reliable, the next step is to conduct classical assumption testing (Hidayat & Budiatma, 2018).

The testing of classical assumptions includes tests for normality, multicollinearity, and autocorrelation. Once the research instruments are deemed appropriate according to the guidelines, the multiple linear regression test is conducted. For hypothesis testing, the t-test is performed to determine the magnitude of the influence produced by the dependent variable (Winkler et al., 2014). Additionally, the t-test is conducted to ascertain the significance level of the results obtained from the F-test.

## RESULTS AND DISCUSSION

The state of the art in this research is to discuss the model of the influence of causes of leftover materials on cost loss in the construction of high-rise buildings in Jakarta, using the Statistical Package for the Social Sciences (SPSS) (Truong-Young, 2023).

In this research, there are 5 research variables with a total of 11 indicators, which can be seen in table 1.

**Table 1**
**Variable & Indicator**

| No | Variable X | Indicator | |
|---|---|---|---|
| **1** | Design Planning (X1) | Design Changes | X1-1 |
| | | Drawing Information | X1-2 |
| | | Planner | X1-3 |
| **2** | Material Procurement (X2) | Material Ordering | X2-1 |
| | | Transportation | X2-2 |
| **3** | Material Handling (X3) | Damage | X3-1 |
| | | Storage | X3-2 |
| **4** | Execution of Work (X4) | Workforce | X4-1 |
| | | Weather | X4-2 |
| | | Expertise | X4-3 |
| **5** | Residual Leftover Material (X5) | Leftover Material | X5-1 |

In the subsequent research, questionnaires were distributed to those involved in the construction of high-rise buildings, with a total of 21 respondents. The data obtained indicates that the highest level of education among the respondents is as follows: 16 respondents (76%) hold a Bachelor's degree (S1), 4 respondents (19%) hold a Master's degree (S2), and 1

respondent (5%) holds a Doctoral degree (S3).

There are three criteria, namely: first, those with less than 5 years of work experience, with a total of 4 respondents or a percentage of 19%; second, those with 5 to 10 years of work experience, with a total of 5 respondents or a percentage of 23%; and third, those with more than 10 years of work experience, with a total of 12 respondents or a percentage of 58%.

There are several job positions that are closely related to the amount of leftover materials during the implementation of building construction projects. The data provided indicates that there were 3 respondents or 14% of the total respondents who held the position of project manager, 5 respondents or 23% were site managers, 2 respondents or 9% were supervising consultants, and 11 respondents or 54% were field supervisors.

Based on the analysis of Linear Regression as explained in Table 2, the factor that ranks highest with a value of 5.19 is material ordering, followed by design changes with a value of 5.05 in second place, and drawing information with a value of 4.95 in third place.

**Table 2**
**Table Mean and Ranking**

| No | Variable | Subfactors | | Mean |
|---|---|---|---|---|
| **1.** | Material Procurement (X2) | Material Ordering | X2-1 | 5,19 |
| **2.** | Design Planning (X1) | Design Changes | X1-1 | 5,05 |
| **3.** | Design Planning (X1) | Drawing Information | X1-2 | 4,95 |
| **4.** | Design Planning (X1) | Planner | X1-3 | 4,95 |
| **5.** | Material Handling (X3) | Material Storage | X3-2 | 4,86 |
| **6.** | Execution of Work (X4) | Labor Errors | X4-1 | 4,71 |
| **7.** | Execution of Work (X4) | Workforce Expertise | X4-3 | 4,71 |
| **8.** | Material Procurement (X2) | Transportation | X2-2 | 4,67 |
| **9.** | Material Handling (X3) | Damage | X3-1 | 4,43 |
| **10.** | Execution of Work (X4) | Weather | X4-2 | 4,43 |
| **11.** | Residual Leftover Material (X5) | Leftover Material | X5-1 | 4,43 |

*Source: SPSS Data Analysis*

**Simple Correlation**

The relationship between the independent variables and cost loss (dependent variable) in high-rise building construction projects shows that the correlation between Design Planning, Material Procurement, Material Handling, Execution of Work, and Residual Leftover Material is deemed valid. This is evidenced by the correlation values for Cost Performance, which are r-values of 0.720 (> 0.4329), 0.677 (> 0.4329), 0.684 (> 0.439), 0.855 (> 0.4329), and 0.680 (> 0.4329). Furthermore, the corresponding p-values or significance values for each variable are 0.00 (< 0.05), 0.01 (< 0.05), 0.01 (< 0.05), 0.00 (< 0.05), and 0.01 (< 0.05). The results indicate that all variables have an influence or relationship with the cost loss due to leftover materials in high-rise building construction projects.

**The t-test**

Based on the Partial t-test results on table 3, Based on the data analysis results, the following discussion is obtained:

**Table 3**
**Partial t-test**

| Model | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |
| **(Constant)** | 0,014 | 0,433 | | 0,032 | 0,975 |
| **Design Planning (X1)** | 0,041 | 0,108 | 0,046 | 0,38 | 0,709 |
| **Material Procurement (X2)** | .182 | .087 | .213 | 2.104 | .053 |
| **Material Handling (X3)** | .208 | .074 | .287 | 2.807 | .013 |
| **Execution of Work (X4)** | .416 | .103 | .497 | 4.017 | .001 |
| **Residual Leftover Material (X5)** | .167 | .106 | .177 | 1.583 | .134 |

*Source: SPSS Data Analysis.*

This research indicates that variable X1 (Design Planning), variable X2 (Material Procurement), and variable X5 (Residual Leftover Material) do not have a significant influence on Cost Performance (Y) due to data collection from field experts who stated that design, procurement, and residual factors at the previous work location can be prevented through MC0 (Material Control 0) to determine the adequacy of work in the field. With the presence of MC0, the balance between the planned volume and the actual volume in the field can be determined. Therefore, preventive measures against material excess can be addressed and prevented from the beginning.

**F-test**

Based on the results of the Simultaneous F-test, the discussion of the data analysis reveals that the F-test results indicate a simultaneous influence of the independent variable X on the dependent variable, which is the cost performance in terms of leftover materials in building construction projects. This is evident from

the significance value (F) 0,000 < 0,05. The results obtained indicate that proper material storage in the field can reduce the risk of cost loss due to leftover materials. The materials that are ordered and delivered to the site should be stored in a rainproof/extreme weatherproof location and used according to the stages of work execution. It is important to know the characteristics of each material and calculate the utilization of leftover materials in order to save other costs or even improve work performance (Hendrick, 2003). This also supports previous research where the findings concluded the need for material management implementation in construction project execution, such as reduction efforts that include monitoring every received material, making estimations of requirements and delivery schedules, and selecting competent suppliers (Chaise et al., 2020).

## CONCLUSION

Based on the results of the conducted research, it can be concluded that the findings of the Research Question is, the factors that influence the cost loss due to leftover materials in building construction projects, ranked from the highest to the lowest level, are as follows: the material order factor with a value of 5.19, the second factor is design changes with a value of 5.05, and the third factor is drawing information with a value of 4.95. Meanwhile, previous studies have shown that factors such as Design, Procurement, and Residual are significant/highly influential factors in the occurrence of remaining materials in building construction. However, the analysis using the T-test Linear Regression with data processed from expert questionnaires showed that the factors Design, Procurement, and Residual were deemed invalid. This is because in the studied construction projects of buildings, most of the anticipated measures have been taken beforehand. These measures include conducting MC0 to determine the balance between the planned volume and the actual volume on-site, creating actual plans and highly detailed calculations for each work item, and implementing control measures overseen by competent individuals.

The relationship between the independent variables and cost loss (dependent variable) in the construction project of a building shows that the correlations of Design Planning, Material Procurement, Handling of Remaining Materials, Work Execution, and Residual Remaining Materials are considered valid. This is evidenced by their respective correlation values for Cost Performance: Design Planning (r = 0.720 > 0.4329), Material Procurement (r = 0.677 > 0.4329), Handling of Remaining Materials (r = 0.684 > 0.439), Work Execution (r = 0.855 > 0.4329), and Residual Remaining Materials (r = 0.680 > 0.4329). Additionally, their respective two-tailed significance values are 0.00 (< 0.05), 0.01 (< 0.05), 0.01 (< 0.05), 0.00 (< 0.05), and 0.01 (< 0.05). From the results obtained, it is shown that all variables have an influence or relationship with the cost loss due to remaining materials in the construction project of a high-rise building.

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