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RISK ANALYSIS OF CONSTRUCTION WASTE FACTOR IN THE CONSTRUCTION PROJECT OF APARTMENT WESTOWN VIEW SURABAYA

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ABSTRACT

Construction waste refers to the depletion of resources resulting from activities that incur direct or indirect costs without add value to the final product or construction progress. This research aims to identify and analyze construction waste factors that influence the construction project of Apartment Westown View Surabaya. A quantitative approach through a questionnaire survey was applied, with respondents consisting of workers involved in the project. Data analysis was conducted using linear regression to determine the most influential factors, and the COSO ERM framework was used for risk management. The results revealed that the most influential factors on construction waste are: (1) Owner: X7.1; (2) Consultant: X2.3; (3) Contractor: X4.4; (4) All parties: X2.3. The overall project performance assessment shows: (1) approved cost increments, (2) approved time increments, (3) good quality of project performance, (4) sufficient level of satisfaction with project performance. The estimated risk mitigation costs are: (1) Owner: 2.76%, (2) Consultant: 2.07%, (3) Contractor: 1.96%, (4) All parties: 3.67% compared to contract value. This research offers important insights for construction project stakeholders to identify and mitigate factors that cause waste, with the aim of improving overall project efficiency and performance.

Keywords : Construction Waste; Risk Management; Linear Regression; COSO ERM

1. INTRODUCTION

Good construction management is essential in any construction project. Through effective management and anticipation of potential risks, construction projects can proceed more efficiently and optimally. Risk management is a crucial aspect of construction management. Essentially, construction management functions to control quality, cost, and time. This control requires analytical skills, critical thinking, and flexible decision-making tailored to on-site conditions. There are two types of risk management techniques: preventive techniques used before a project begins to manage anticipated risks during project execution, and remedial techniques used during execution to address risks that have occurred (Iqbal et al. 2015, 65). Effective construction management is expected to reduce potential risks and maximize the success of construction projects.

Without proper risk management, a project can experience negative impacts and uncontrolled construction waste. Commonly experienced and observable impacts include cost overruns, project delays, and non-compliance with the quality stipulated in the contract. According to (Sulaiman in Natalia et al. 2021, 161), project delays occur almost annually, causing significant financial and time losses for both service users and providers. Besides the direct negative impacts, there are secondary effects such as changes in work culture, social gaps, reduced synergy among workers, and other potential issues arising from unmanaged construction waste.

The Westown View Apartment project in Surabaya experienced slight delays from the planned schedule. Observations indicated that one of the contributing factors to this delay was inadequate risk management regarding construction waste. To find the best solutions and evaluations, an analysis of construction waste factors in the project was conducted, focusing on internal factors (project organizers) and external factors (surrounding environment, politics, weather, unforeseen events, etc.), along with problem-solving from the perspectives of contractor, consultants, and owners.

2. METHOD

DATA COLLECTING

Data collection is a very important initial stage in this research. The data collected is separated into two sorts, to be specific primary data and secondary data.

A. Primary Data Collection Questionnaire

Primary data is obtained through distributing questionnaires to respondents related to the Westown View Surabaya Apartment construction project. Respondents to the questionnaire were determined from the population relevant to this project, and the sample taken was 24 respondents.

B. Secondary Data Collection

In this research, secondary data is needed as a research reference. The secondary data required in this study are project planning data and project implementation data.

1) Project Planning Data

- Project Budget Plan Data (RAB)
- Implementation Schedule / Time Schedule Data
- Technical Specifications

2) Project Implementation Data

- Week 1 to Week 46 Report Data

DATA ANALYSIS

The analysis method in this research is divided into 4 different points of view, namely: the owner, the consultant, the contractor, and all parties. For each party or point of view, 2 analysis methods were carried out, linear regression analysis and risk management using COSO ERM 2004. Details of the test or analysis carried out on each party or point of view are as follows:

A. Parties or points of view under research:

1) Owner Parties
2) Consultant Parties
3) Contractor Parties
4) All Parties

B. Methods to be tested:

1) Linear Regression

The use of linear regression method to determine the most influencing factors on the performance of Apartment Westown View Surabaya Construction Project. The following stages are tested in linear regression:

a. Validity Test

The validity test is used to determine how accurately an item measures what it wants to measure. An item is said to be valid if it is associated with a total score. The validity test in this study used the Pearson's Product Moment correlation, formula are as follows:

$$Rx = \frac{n\sum X_i X_{total} - (\sum X_i)(\sum X_{total})}{\sqrt{\{n\sum {X_i}^2 - (\sum X_i)^2\}\{n\sum {X_{total}}^2 - (\sum X_{total})^2\}}} \quad (2.3)$$

Description:

Rx = Correlation Coefficient
n = Number of trial respondents
X = Score of each item
X_{total} = Score of all trial respondents on Variabel X

b. Reliability Test

The reliability test is used to determine the regularity or consistency of the measurement tool usually using a questionnaire. If the calculated reliability coefficient value ≥ 0.6, it can be concluded that the instrument concerned is declared reiabel. The formula are as follows:

$$r = \left\{\frac{k}{k-1}\right\}\left\{1 - \frac{\sum s_i}{St}\right\} \quad (2.4)$$

Description:

r = Cronbach's Alpha Value
ΣSi = The sum of the variances of the scores of each item
St = Total Variance
k = Number of Items

c. Pearson Correlation Test

Pearson correlation test is useful for determining the extent to which two sets of data are linearly correlated. In this research, the Pearson correlation test will be applied to measure the relationship between each item in the questionnaire (X) and the total score (Y), thus providing a strong foundation for the interpretation of the research results and using formula:

$$R\,xy = \frac{n\sum X_i Y - (\sum X_i)(\sum Y)}{\sqrt{\{n\sum {X_i}^2 - (\sum X_i)^2\}\{n\sum Y^2 - (\sum Y)^2\}}} \quad (2.5)$$

Description:

Rx = Correlation Coefficient
n = Number of trial respondents
X = Score of each item
Y = Score of all trial respondents

d. T-Test or Partial Regression Coefficient Test

The T test aims to determine whether partially the independent variable contributes significantly or not to changes in the dependent variable. The formula are as follows:

$$T_{count} = \frac{R_{y\,1.\,2}\sqrt{n-2}}{\sqrt{1-{R_{y\,1.\,2}}^2}} \quad (2.6)$$

Description:

Ry 1. 2 = Correlation value between Y and Xn, X 1, 2, 3, 4, is considered constant.
n = Number of Samples
k = Number of Free Variables

e. F-Test or Regression Coefficient Test

The F test is utilized to decide whether the independent variables simultaneously have a critical impact on the dependent variable. The formula are as follows:

$$F_{count} = \frac{R^2(n-k-1)}{k\,(1-R^2)} \quad (2.7)$$

Description:

R^2 = Coefficient of Determination

n = Number of Samples

k = Number of Free Variables

f. Coefficient of Determination

The coefficient of determination, denoted as R square (R^2), represents how well the independent variable explains the variation in the dependent variable. An R^2 value near 1 suggests that the independent variable accounts for most of the variability in the dependent variable, whereas a value close to 0 implies it explains very little. The formula for the coefficient of determination in linear regression is as follows:

$$R^2 = \frac{(b_1 \sum x_1 y)+(b_2 \sum x_2 y)+\ldots.(b_n \sum x_n y)}{\sum y^2} \quad (2.8)$$

Description:

$$b_1 = \frac{(\sum {x_2}^2 * \sum x_1 y)-(\sum x_2 y * \sum x_1 x_2)}{(\sum {x_1}^2 * \sum {x_2}^2)-(\sum x_1 * \sum x_2)^2} \quad (2.9)$$

$$b_2 = \frac{(\sum {x_1}^2 * \sum x_2 y)-(\sum x_1 y * \sum x_1 x_2)}{(\sum {x_1}^2 * \sum {x_2}^2)-(\sum x_1 * \sum x_2)^2} \quad (2.10)$$

2) COSO ERM 2004

The application of the COSO 2004 ERM method to determine the variables that are considered the foremost dominant according to respondents at the side risk management analysis on the Apartment Westown View Surabaya Construction Project, with the following stages:

a. Internal Environment

Internal Environment is defined by the cultural environment, ethics, and values created by the organization's management and employees that can influence how risks are identified, measured, and managed. It contains factors such as management philosophy, organizational structure, assignment of authority, and culture that influence the organization's approach to risk management.

b. Objective Setting

Objective Setting is defined as the process of setting and communicating organizational goals and determining how to achieve them. Contains setting organizational goals, identifying strategic initiatives, and linking goals and strategies with risk management.

c. Event Identification

Event Identification is defined as the recognition of potential occasions or circumstances that can influence the achievement of organizational objectives. Contains identification of various events that can affect the desired outcome, including opportunities and threats. The measurement uses a Likert scale which is commonly used in questionnaires and is the most widely used scale in survey research. Respondents decide their level of agreement with a articulation by choosing one of the accessible options. 5 scale options are provided in the probability level and consequence level assessment columns with a format as follows:

Assessment on the probability level:

1. SS, *Sangat Setuju*. Given score 5
2. S, *Setuju*. Given score 4
3. CS, *Cukup Setuju*. Given score 3
4. TS, *Tidak Setuju*. Given score 2
5. STS, *Sangat Tidak Setuju*. Given score 1

Assessment on the level of consequences:

1. Fatal or Catastrophic, Given score 5
2. Major damage or Critical, Given score 4
3. Major injury or Serious, Given score 3
4. Minor Injury or Marginal, Given score 2
5. Very Little Impact or Negligible, Given score 1

d. Risk Assessment

Risk assessment refers to the process of analyzing the potential impact and probability of risk events on the attainment of objectives. A likelihood scale is applied to measure the probability level based on the responses gathered from the questionnaire. The *Likehood* scale table can be seen in table 2.5 below:

Table 2.5 Likehood Scale

Description	Notation	Level
Frequent	Almost Certain to Occur / repeatedly	5
Probable	Very Likely to Happen / Many times	4
Occasional	Probably Happens / some times	3
Remote	Occasionally Occurs	2
Improbable	Almost Unlikely to Happen	1

Source: Godfrey (1996)

The consequence scale is used to determine the value of the fatality rate obtained from the questionnaire. The consequence scale table can be seen in table 2.6 below:

Table 2.6 Consequence Scale

Description	Notation	Level
Catastrophic	Death, System Loss, Criminal Guilt, Bankruptcy	5

Description	Notation	Level
Critical	Injury or illness, Major damage, Substantial damage, Exceeding contingency	4
Serious	Loss of time due to injury or illness, Leads to interruption of planned time, Requires insurance claim.	3
Marginal	Injury or illness that requires first aid only, minor damage that requires regular treatment, is accommodated as a contingency or excess insurance.	2
Negligible	So minor, it is considered without consequence	1

Source: Godfrey (1996)

The result of the combination of the Likehood scale value with the consequence scale will show the level of risk assessment as a reference in determining the priority scale of a risk later. The risk assessment level is obtained based on the matrix table below:

RISK ASSESSMENT MATRIX						
CONSEQUENCE / PROBABILITY		NEGLIGIBLE	MARGINAL	SERIOUS	CRITICAL	CATASTROPHIC
		1	2	3	4	5
IMPORABLE	1	VL	VL	L	M	M
REMOTE	2	VL	VL	L	M	H
OCCASIONAL	3	VL	L	M	H	H
PROBABLE	4	L	M	M	H	H
FREQUENT	5	M	M	H	H	H

Figure 2.5 Risk Assessment Matrix
Source: Godfrey (1996)

Description:
VL = Verry Low Risk
L = Low Risk
M = Moderate Risk
H = High Risk

e. Risk Response

Risk Response is defined as the development of actions to respond to risk, including risk avoidance, acceptance, mitigation, or transfer. Contains risk response planning, stakeholder engagement, and actions taken to manage risks. Below is the risk assessment response matrix table.

RISK RESPONSE MATRIX						
CONSEQUENCE / PROBABILITY		NEGLIGIBLE	MARGINAL	SERIOUS	CRITICAL	CATASTROPHIC
		1	2	3	4	5
IMPORABLE	1	NEGLIGIBLE	NEGLIGIBLE	ACCEPTABLE	ACCEPTABLE	UNDESIRABLE
REMOTE	2	NEGLIGIBLE	ACCEPTABLE	ACCEPTABLE	UNDESIRABLE	UNDESIRABLE
OCCASIONAL	3	ACCEPTABLE	ACCEPTABLE	UNDESIRABLE	UNDESIRABLE	UNDESIRABLE
PROBABLE	4	ACCEPTABLE	UNDESIRABLE	UNDESIRABLE	UNDESIRABLE	UNACCEPTABLE
FREQUENT	5	UNDESIRABLE	UNDESIRABLE	UNACCEPTABLE	UNACCEPTABLE	UNACCEPTABLE

Figure 2.6 Risk Assessment Response Matrix
Source: Godfrey (1996)

If the risks arising from an activity have been recognized, at that point assist activity is taken to reduce the risks that arise, called risk mitigation. Godfrey (1996) provides direction for each of the risk acceptance categories, namely:

I. Unacceptable
This risk is classified as a risk that cannot be tolerated, so it needs to be eliminated or transferred, for example by cooperating with other institutions so that the risk is not completely borne alone.

II. Undesirable
This risk could be a risk that must be avoided, but if it is maintained, it requires proper supervision and monitoring by Top Management.

III. Acceptable
This risk is an acceptable risk in case it can be overseen appropriately on a standard premise.

IV. Negligible
This risk could be a risk with very small impact, so it does not require further consideration and handling.

f. Control Activities

Control Activities are defined by Policies and procedures that help ensure that actions taken are in accordance with the risk management plan. These activities involve the design and execution of internal controls to minimize risks and ensure the achievement of objectives.

g. Information & Communication

Information and Communication is defined by the flow of information that supports risk management and effective communication. Contains information reporting systems, internal and external communication, and understanding of information needed for risk management.

h. Monitoring

Monitoring is defined as the process of continuous evaluation of the viability of the risk management framework. Contains continuous supervision of changes in the environment and organization, as well as continuous improvement of risk management.

RESEARCH FLOWCHART

,The stages that will be used are as follows:

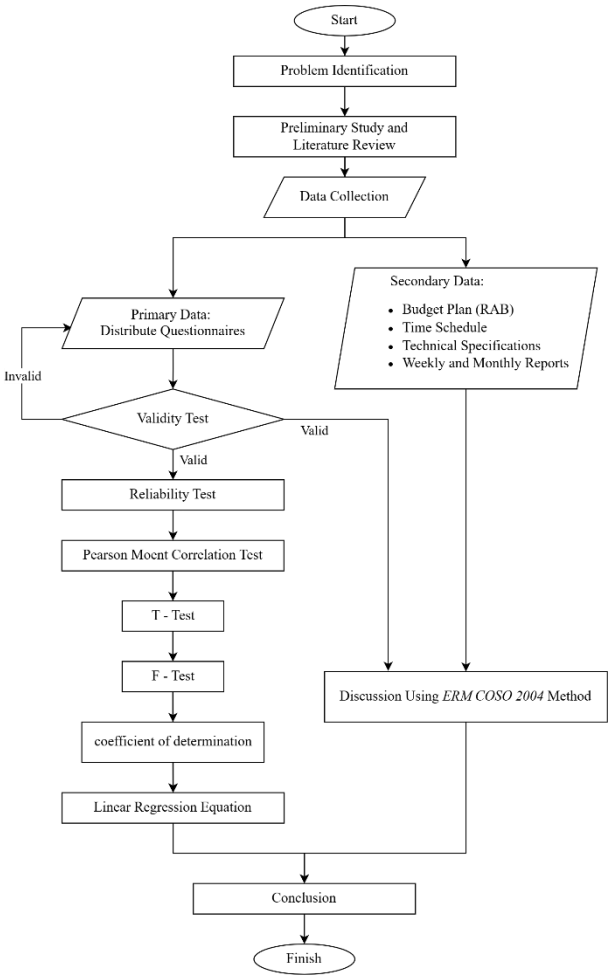


Figure 3.2 Research Flowchart
Source: Author

3. RESULT AND DISCUSSION

A. Owner's Discussion (PT. PPRO)

From processing the data above using SPSS, the results were obtained:

1) The validity test results show that 34 of the 53 statement items have a value of $R_{count} > R_{table}$ or sig < 0.05. So it can be concluded that 7 variables and 34 indicators passed the validity test
2) Reliability test results from the owner get value ***Cronbach's Alpha*** of 0.974, greater than the standard used. So from All 7 variables and 34 indicators passed.
3) In the Pearson correlation test for 7 variables and 34 indicators, only 3 variables and 4 indicators passed the Pearson correlation test
4) A linear regression equation analysis was carried out on the 3 variables and 4 indicators. The following results were obtained:
   a. Multicollinearity occurs which is assumed to occur due to several factors
   b. Only the indicator (X7.1) can proceed to the linear regression equation analysis stage.
   c. From the Owner, the value of the linear regression equation is obtained: Y = - 1.545 + 3.364 (X7.1)

From the analysis of the linear regression equation above, it can be seen that only indicator (X7.1) is the independent variable of Project Performance (Y). So it can be concluded that the main factor that is very influential is design changes by the owner/consultant/planner.

Followed by risk management analysis using COSO ERM, the results were known and obtained:

1) Low Risk – ACCEPTABLE there is 1 indicator
2) Moderate Risk – UNDESRIABLE there are 13 indicators
3) High Risk – UNDESRIABLE there are 15 indicators
4) High Risk – UNACCEPTABLE there are 5 indicators
5) The highest score was obtained for the probability and consequence values:

Table 4.21 9 Highest scores at the Probability level (possibility of occurrence) for the Owner

Probability Level	**X4.9**	**X6.1**	**X6.2**	**X6.4**	**X6.3**
	18	18	18	18	17
	X7.1	**X5.4**	**X7.9**	**X4.3**	
	17	16	16	16	

Source: Calculation

Table 4.22 9 Highest score on Consequences level for the Owner

Consequence Level	**X3.7**	**X3.9**	**X4.9**	**X2.4**	**X3.8**
	19	18	18	17	17
	X6.1	**X6.2**	**X6.4**	**X7.1**	
	17	17	17	17	

Source: Calculation

6) The following performance assessments were obtained for the Westown View Surabaya apartment construction project:

Table 4.23 Project performance value obtained from the Owner

Performance Project	**Y1**	**Y2**	**Y3**	**Y4**
	12	7	15	17

Source: Calculation

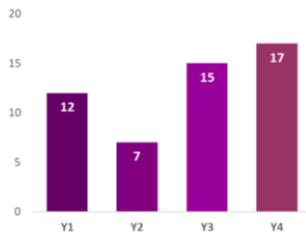


Figure 4.1 Column graph for Owner's project performance values
Source: Calculation

7) The following are the total values at the probability and consequence levels:

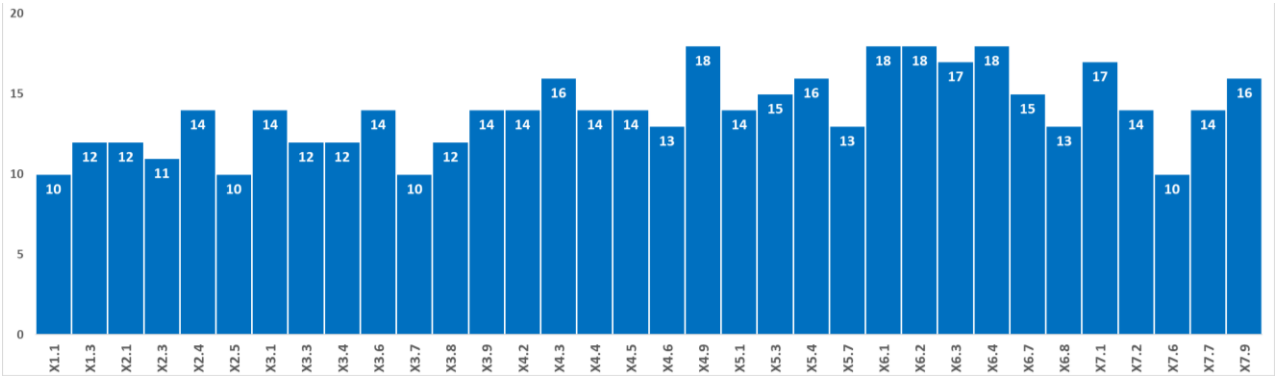


Figure 4.2 Column graph for the Owner's probability level value
Source: Calculation

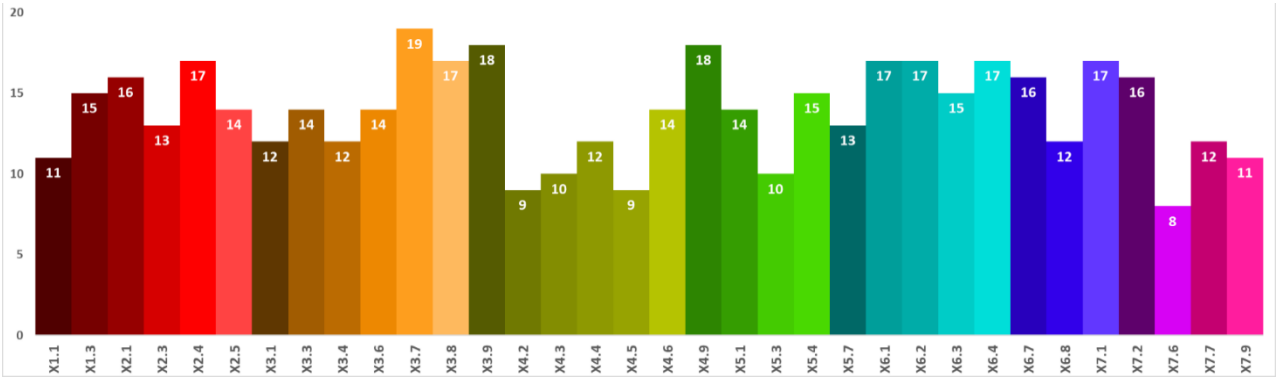


Figure 4.3 Column graph for Owner's consequence level values
Source: Calculation

B. Consultant's Discussion (CV. MKU)

From processing the data above using SPSS, the results were obtained:

1) The validity test results show that 38 of the 53 statement items have a value of $R_{count} > R_{table}$ or sig < 0.05. So it can be concluded that 7 variables and 38 indicators passed the validity test
2) The results of the reliability test from the consultant get value ***Cronbach's Alpha*** of 0.987, greater than the standard used. So from All 7 variables and 38 indicators passed.
3) In the Pearson correlation test for 7 variables and 38 indicators, only 2 variables and 3 indicators passed the Pearson correlation test
4) A linear regression equation analysis was carried out on the 2 variables and 3 indicators. The following results were obtained:
   a. The results of the T test indicators ($X_{2.3}$), ($X_{2.5}$), ($X_{4.1}$) were all stated to have an effect on (Y), because T count > T table. With each value:
      i. ($X_{2.3}$) = 17,744
      ii. ($X_{2.5}$) = - 4.958
      iii. ($X_{4.1}$) = - 3.614
   b. The F test results of the independent variable (X) are stated to have a simultaneous effect on (Y), because F calculate > F table. With the calculated F value = 120.221
   c. From the consultant, the values for the linear regression equation were obtained:
      $Y = 4.491 + 4.575 (X_{2.3}) – 1.169 (X_{4.1}) – 0.700 (X_{2.5})$
   d. The value of the coefficient of determination (r^2) obtained = 0.986, meaning the independent variable ($X_{2.3}$),($X_{2.5}$), ($X_{4.1}$) simultaneously has an influence of 98.6% on the dependent variable (Y). The remaining 1.4% is influenced by other variables not tested in the research

From the analysis of the linear regression equation above, it can be seen that only the indicators ($X_{2.3}$) has the largest coefficient with a value of 4.575. So it can be concluded that the main factors that are very influential are Improper determination of work duration.

Followed by risk management analysis using COSO ERM, the results were known and obtained:

1) *Moderate Risk – UNDESRIABLE* there are 18 indicators
2) *High Risk – UNDESRIABLE* there are 19 indicators
3) *High Risk – UNACCEPTABLE* there is 1 indicators
4) The highest score was obtained for the probability and consequence values:

Table 4.43 10 Highest value at the Probability level (likelihood of occurrence) for the Consultant

Probability Level	**X3.2**	**X3.6**	**X1.1**	**X3.1**	**X4.1**
	37	37	35	35	35
	X4.4	**X4.8**	**X2.4**	**X4.6**	**X4.7**
	35	35	34	34	34

Source: Calculation

Table 4.44 10 Highest score on Consequences level for the Consultant

Consequence Level	**X1.1**	**X3.1**	**X4.4**	**X3.2**	**X3.6**
	41	39	38	37	37
	X6.8	**X2.4**	**X4.8**	**X6.1**	**X6.2**
	37	36	36	36	36

Source: Calculation

5) The following performance assessments were obtained for the Westown View Surabaya apartment construction project:

Table 4.45 Project performance value obtained from the Consultant

Performance Project	**Y1**	**Y2**	**Y3**	**Y4**
	23	21	31	27

Source: Calculation

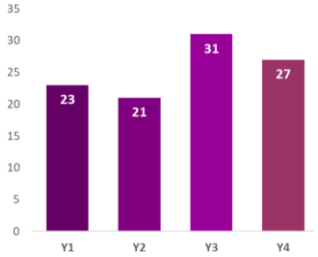


Figure 4.4 Column graph for Consultant project performance values
Source: Calculation

6) The following are the total values at the probability and consequence levels:

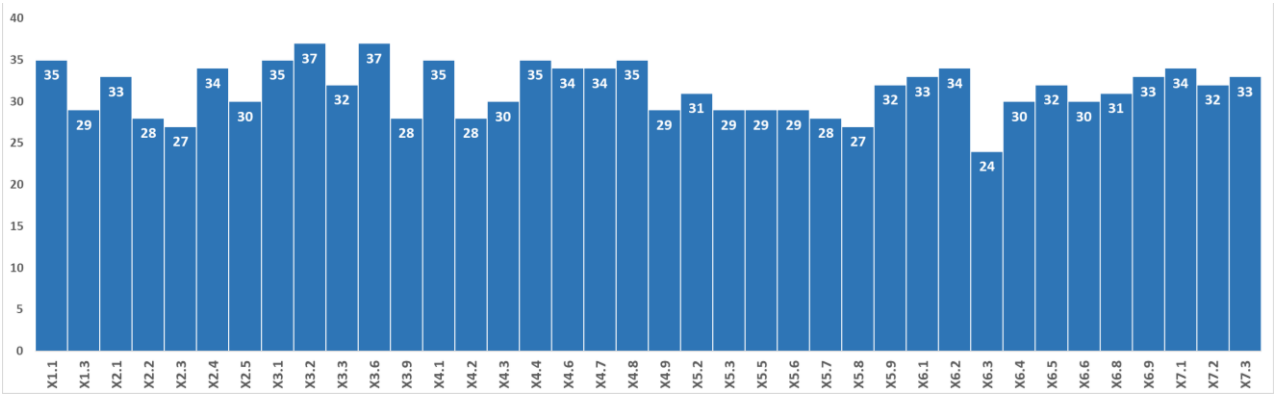


Figure 4.5 Column graph for Consultant Party Probability level values
Source: Calculation

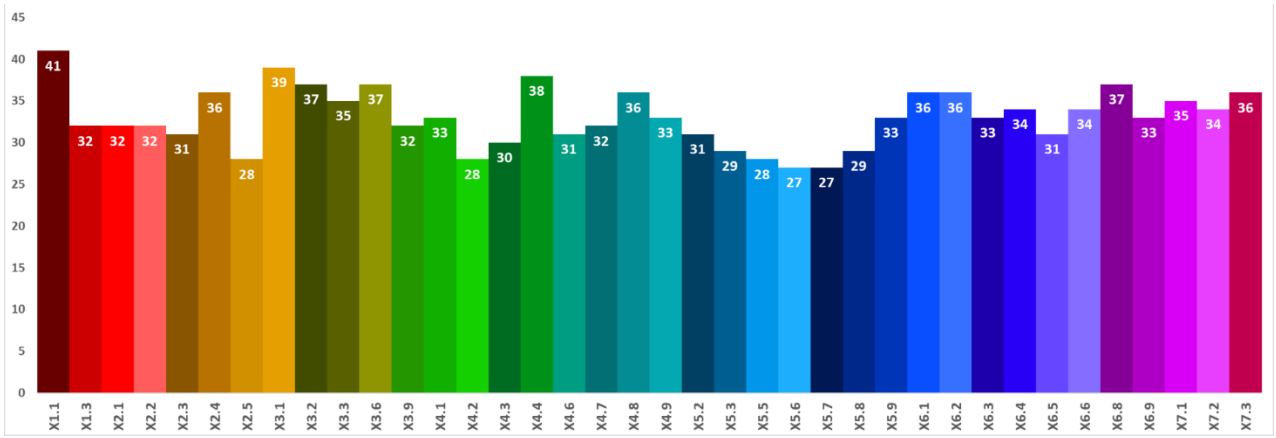


Figure 4.6 Column graph for Consultant Consequence level values
Source: Calculation

C. Contractor's Discussion (PT. PP)

From processing the data above using SPSS, the results were obtained:

1) The validity test results show that 34 of the 53 statement items have a value of $R_{count} > R_{table}$ or sig < 0.05. So it can be concluded that 7 variables and 35 indicators passed the validity test
2) Reliability test results from the owner get value ***Cronbach's Alpha*** of 0.974, greater than the standard used. But on variables X_1 own mark *Cronbach's Alpha* 0.367 so it is variable X_1 does not pass the reliability test. from7 variables and 35 indicators, 6 variables and 34 indicators were declared to have passed.
3) In the *Pearson* correlation test for 6 variables and 34 indicators, only 2 variables and 3 indicators passed the *Pearson* correlation test
4) A linear regression equation analysis was carried out on the 2 variables and 3 factors. The following results were obtained:
   a. The results of the T test indicators ($X_{4.4}$), ($X_{4.5}$), ($X_{5.7}$) were all stated to have an effect on (Y), because $T_{count} > T_{table}$. With each value:
      i. ($X_{4.4}$) = - 3.975
      ii. ($X_{4.5}$) = 3,404
      iii. ($X_{5.7}$) = 2,650
   b. The results of the F test for the independent variable (X) are stated to have a simultaneous effect on (Y), because calculated F > F table. With a calculated F value = 15,594
   c. From the consultant, the values for the linear regression equation were obtained:
      Y = 5,358 – 1,468 ($X_{4.4}$) + 2,281 ($X_{4.5}$) + 1,045 ($X_{5.7}$)
   d. The coefficient of determination (r^2) obtained = 0.870, meaning that the independent variables ($X_{4.4}$), ($X_{4.5}$), ($X_{5.7}$) simultaneously have an influence of 87% on the dependent variable (Y). The remaining 13% is influenced by other variables not tested in the research.

From the analysis of the linear regression equation above, it can be seen that only the indicator ($X_{4.5}$) has the largest coefficient with a value of 2.281. So it can be concluded that the main factors that are very influential are Replacement of new workers.

Followed by risk management analysis using COSO ERM, the results were known and obtained:

1) *Moderate Risk – UNDESRIABLE* there are 6 indicators
2) *High Risk – UNDESRIABLE* there are 29 indicators
3) The highest score was obtained for the probability and consequence values:

Table 4.65 14 Highest value at the Probability level (likelihood of occurrence) for the Contractor

Probability Level	**X3.5**	**X7.1**	**X2.5**	**X5.4**	**X5.6**
	43	43	42	42	42
	X6.2	**X2.1**	**X3.4**	**X3.6**	**X3.8**
	42	41	41	41	41
	X5.7	**X3.3**	**X3.9**	**X4.4**	
	41	40	40	40	

Source: Calculation

Table 4.66 10 Highest score on Consequences level for the Contractor

Consequence Level	**X5.7**	**X2.1**	**X3.6**	**X5.4**	**X5.6**
	45	44	44	44	44
	X7.1	**X2.5**	**X4.4**	**X5.5**	**X6.3**
	44	43	43	43	43

Source: Calculation

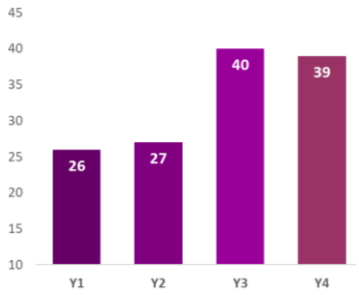
4) The following performance assessments were obtained for the Westown View Surabaya apartment construction project:

Table 4.67 Project performance value obtained from the Contractor

Performance Project	**Y1**	**Y2**	**Y3**	**Y4**
	26	27	40	39

Source: Calculation

Figure 4.7 Column graph for Contractor project performance values



Source: Calculation

5) The following are the total values at the probability and consequence levels:

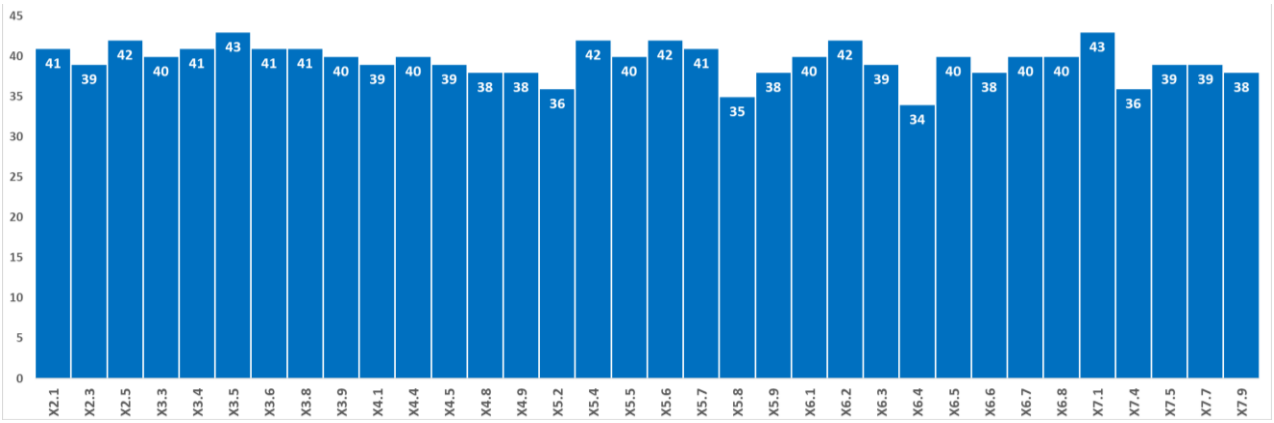


Figure 4.8 Column graph for Contractor Party Probability level values
Source: Calculation

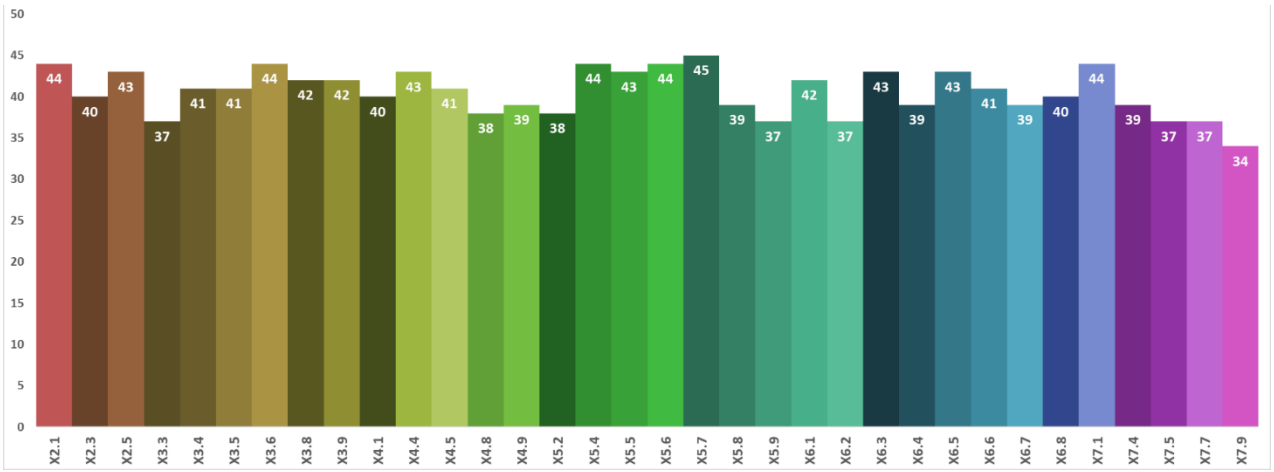


Figure 4.9 Column graph for Contractor Party Consequence level values
Source: Calculation

D. All Partie's Discussion (PT. PPRO; CV. MKU; PT. PP)

From processing the data above using SPSS, the results were obtained:

1) The validity test results show that 48 of the 53 statement items have a value of $R_{count} > R_{table}$ or sig < 0.05. So it can be concluded that 7 variables and 48 indicators passed the validity test.
2) Reliability test results from the owner get value ***Cronbach's Alpha*** of 0.975, greater than the standard used. But on variables X_1 own mark *Cronbach's Alpha* 0.698 so it is variable X_1 does not pass the reliability test. From 7 variables and 48 indicators, 6 variables and 46 indicators were declared to have passed.
3) In the Pearson correlation test for 6 variables and 46 indicators, there were 6 variables and 19 indicators that passed the Pearson correlation test.
4) Linear regression equation analysis was carried out on the 6 variables and 19 indicators. The following results were obtained:

a. The results of the T test showed that 7 indicators did not pass the T test, so that only 12 remaining indicators were declared to have an effect on (Y), because T count > T table (2.77645). With each value:
   i. (X2.3) = 5,607
   ii. (X2.5) = - 4.961
   iii. (X3.9) = - 5,472
   iv. (X4.3) = 4,480
   v. (X5.2) = 4,287
   vi. (X5.3) = - 2.837
   vii. (X5.5) = - 3.451
   viii. (X5.7) = 4,440
   ix. (X5.8) = 4,648
   x. (X6.4) = - 3.882
   xi. (X6.5) = 3,587
   xii. (X6.7) = - 4,430

b. The F test results of the independent variable (X) are stated to have a simultaneous effect on (Y), because calculated F > F table. With the calculated F value = 9.034

c. From the consultant, the values for the linear regression equation were obtained:
$Y = (-1{,}862) + 4{,}462\ (X_{2.3}) - 3{,}785\ (X_{2.5}) - 5{,}921\ (X_{3.9}) + 6{,}342\ (X_{4.3}) + 3{,}992\ (X_{5.2}) - 2{,}660\ (X_{5.3}) - 3{,}066\ (X_{5.5}) + 4{,}417\ (X_{5.7}) + 2{,}405\ (X_{5.8}) - 6{,}012\ (X_{6.4}) + 4{,}489\ (X_{6.5}) - 3{,}241\ (X_{6.7})$

d. The coefficient of determination (r^2) value obtained = 0.977, meaning that the independent variable (X) simultaneously has an influence of 97.7% on the dependent variable (Y). The remaining 2.3% is influenced by other variables not tested in the research.

From the analysis of the linear regression equation above, it can be seen that the indicator ($X_{4.3}$) has the largest coefficient with a value of 6.342. So it can be concluded that the main factors that are very influential are Lack of discipline among workers and employees.

Followed by risk management analysis using COSO ERM, the results were known and obtained:

[1] *Moderate Risk – UNDESRIABLE* there are 14 indicators

[2] *High Risk – UNDESRIABLE* there are 34 indicators

[3] The highest score was obtained for the probability and consequence values:

Table 4.87 All Parties's 9 Highest scores at the Probability level (Likelihood of occurring)

Probability Level	**X6.2**	**X7.1**	**X3.6**	**X4.1**	**X2.4**
	94	94	92	92	91
	X6.1	**X6.5**	**X4.6**	**X5.4**	
	91	91	90	90	

Source: Calculation

Table 4.88 All Parties's 12 Highest score on Consequences level

Consequence Level	**X2.4**	**X7.1**	**X1.1**	**X3.6**	**X3.8**	**X6.1**
	98	96	95	95	95	95
	X2.2	**X3.7**	**X2.1**	**X3.1**	**X3.2**	**X4.4**
	94	94	93	93	93	93

Source: Calculation

[4] The following performance assessments were obtained for the Westown View Surabaya apartment construction project:

Table 4.89 Project performance value obtained by all parties

Performance Project	**Y1**	**Y2**	**Y3**	**Y4**
	61	55	86	83

Source: Calculation

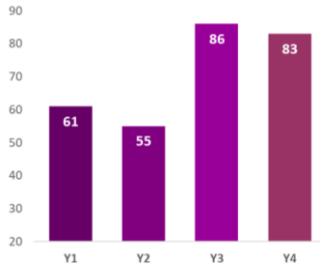


Figure 4.10 Column graph for all parties' project performance scores
Source: Calculation

[5] The following are the total values at the probability and consequence levels:

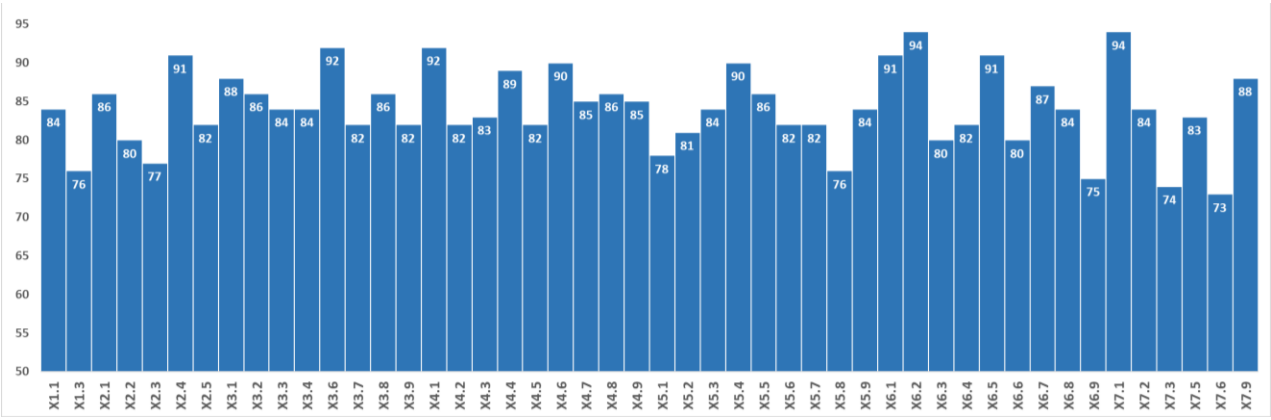


Figure 4.11 All Parties's Column graph Probability level values
Source: Calculation

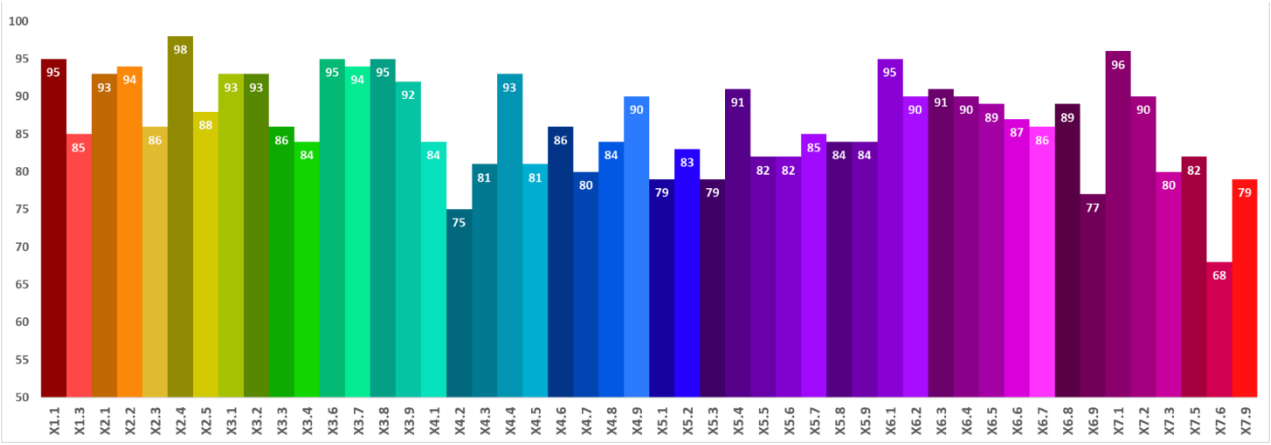


Figure 4.12 All Parties's Column graph Consequence level values
Source: Calculation

4. RESULT AND DISCUSSION

Based on the results of the analysis and discussion, the conclusion of the risk analysis of construction waste factor in the construction project of apartment Westown View Surabaya is:

1. After analyzing, the factors that cause construction waste on each parties are:
   a. Owner parties: 7 variables and 34 indicators.
   b. Consultant parties: 7 variables and 38 indicators.
   c. The contractor parties: 6 variables and 34 indicators.
   d. All Parties: 6 variables and 46 indicators.
2. The factors causing construction waste that have the most and dominant respondent scores are as follows:
   a. Owner parties: Labor & equipment and materials.
   b. Consultant parties: Bureaucracy and Cost.
   c. The contractor parties: Bureaucracy, external factors, and time.
   d. All Parties: Materials, external factors, and bureaucracy.
3. The factors causing construction waste that have the highest coefficient value in the linear regression equation and are most influential are as follows:
   a. Owner parties (PT. PPRO) is $X_{7.1} = 3.364$.
   b. Consultant parties (CV. MKU) is $X_{2.3} = 4.575$.
   c. The contractor parties (PT. PP) is $X_{4.5} = 2.281$.
   d. All Parties (PT. PPRO; CV. MKU; PT. PP) is $X_{4.3} = 6.342$.
4. Risk management analysis of construction waste factors in the Westown View Surabaya apartment project begins with the distribution of questionnaires to 24 construction workers. The validity test is carried out so that the answers taken are valid and measurable, and if the validity test results exceed 50% of the total questions, the valid data is continued to the reliability test. Data that passes these two tests is used in risk management with the COSO ERM 2004 framework. The results obtained include the internal environment, risk identification (causes and impacts), risk assessment, risk response, control activities, information communication, monitoring, and budget plans for control activities. The fund allocation plan can be seen in the risk management monitoring table for each party.
5. Assessment of the performance based on the values obtained from the questionnaire as follows:
   a. Owner parties: Agree enough about additional cost, Agree about addition of time, Has good project performance quality according to respondents and Respondents are satisfied
   b. Consultant parties: Agree about additional cost, Agree about addition of time, Has sufficient project performance quality according to respondents and Respondents feel sufficient
   c. The contractor parties: Agree about additional cost, Agree about addition of time, Has good project performance quality according to respondents and Respondents are satisfied
   d. All Parties: Materials: Agree about additional cost, Agree about addition of time, Has good project performance quality according to respondents and Respondents feel sufficient
6. The estimated costs estimated for risk mitigation efforts to the contract value of the contract project worth IDR 262,033,591,469.00 IDR are:
   a. Owner parties: Rp. 7,242,518,900.00 IDR (2.76%)

b. Consultan1t parties: Rp. 5,425,487,725.00 IDR (2.07%).
c. The contractor parties: Rp. 5,128,555,975.00 IDR (1.96%).
d. All Parties: Rp. 9,622,663,975.00 IDR (3.67%)

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