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EVALUATION OF FACTORS OF DESIGN CHANGE, MATERIAL AVAILABILITY AND LABOR PRODUCTIVITY AGAINST COST PERFORMANCE ON OFFICE BUILDING PROJECTS

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ABSTRACT

Good cost performance will result in profit margins for the company, but on the contrary, poor cost performance will certainly result in cost overruns. And this is often and even always the case with every project, both in construction projects and office building projects. Several factors can influence the decline in cost performance so that there is a cost overrun, such as design changes, material availability, work improvements, poor labor relations, incomplete project documents, increase in material prices, labor, equipment, project finances, and project implementation time. With the various causes of decreased cost performance, this research will limit the analysis of factors such as changes in design, material availability and labor productivity, which are indeed very frequent in construction projects, especially in office building projects. Office building projects are not as large as high-rise construction projects or other civil projects, but in terms of the complexity of detailed types of work, it is often a boomerang for cost overruns. This study used a statistical analysis approach using an SPSS device based on questionnaire data for implementing contractors in Jakarta.

Keywords: cost *performance, cost overrun, office building, SPSS*

INTRODUCTION

A construction project is a series of interrelated activities to achieve project objectives. The inconsistency of realization with expectations in the construction project has the potential to cause losses to the owner, executing contractor or both (Anugerah, 2022). A construction project is a process of design by planners which is then converted into physical building construction. The implementation of construction projects is often found projects experience cost overruns and delays (Carpenter et al., 2004). This process will involve the organization of the project and involves the coordination of all project resources such as labor, construction equipment, materials, funds, technology, and methods and time to complete the project on time in accordance with a predetermined budget, as well as in accordance with the quality and performance standards specified by the planner (Kelley Jr & Walker, 1959). The larger the size of a project, the more problems there are to face (Baloi & Price, 2003).

In construction projects, three important things must be considered: time, cost and quality (Darmanto et al., 2020). In the construction industry as befits service, provisions regarding the cost, quality, and completion time of construction are bound in the contract and determined before the construction begins (Egbelakin et al., 2021). Each construction project has certain objectives that have certain constraint criteria that must be met including according to the budget, the schedule and on quality (RezaHoseini et al., 2021). These three things make the main limitation in the implementation of a construction project or known as triple constraints (Silvius et al., 2017).

METHOD

This research is a quantitative research because it meets scientific rules, namely concrete, empirical, objective, measurable, rational and systematic (Prabowo & Prengki, 2020). Research processes secondary data to determine variables and indicators that affect research variables.

SPSS simulation is to convert qualitative data from interview and validation techniques into numbers using a Likert scale. Secondary data collection is carried out based on literature reviews from e-books, books, national and international journals, and other data supporting research so that the research has results that can add knowledge and be applied in projects and can be used as the next reference.

RESULTS AND DISCUSSION

The primary data collection carried out in this study was carried out through several stages as follows:

1. The first stage is the stage of determining the most influential factors of related journals.
2. The second stage is the *Pilot Survey*: at this stage the questionnaire on the results of determining construction validation is distributed to 5 prospective respondents to find out the level of respondents' understanding of the question items or statements in the questionnaire and the level of difficulty of respondents in answering the questionnaire. At this stage, improvements are made to the editorial of the question items or statements in the questionnaire so that they are easier to understand by potential respondents.
3. The third stage of data collection was carried out by distributing questionnaires to respondents who were sampled. Sampling is carried out in the project. The respondents selected as a sample in this questionnaire survey consisted of **69** individuals involved in similar projects from *Owner*, Director, General Manager, Project Manager, Site Manager, Supervisor, Manager Quantity Surveyor, Quantity Surveyor, *and Estimator* with education above D3.
4. In this fourth stage, expert validation of the results of data analysis obtained from the fourth stage is carried out again. This is intended to convince the results of the analysis that has been carried out.
5. After the data is collected completely, it is then tabulated based on the *Likert* scale in the questionnaire. The simulation process uses the SPSS application for testing from Validity, Reliability, Normality, Kolmogorov-Smirnov, Durbin-Watson, Regression Liner with T test, F test so that the equation of influence of independent variables on dependent variables is found.

Respondent Data

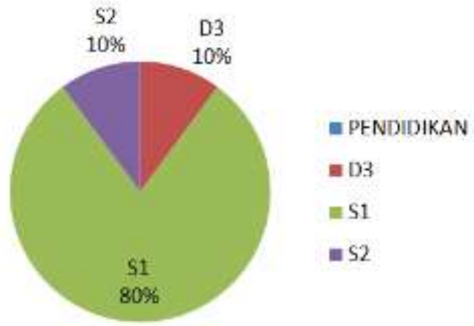


Figure 1. Respondents' Education

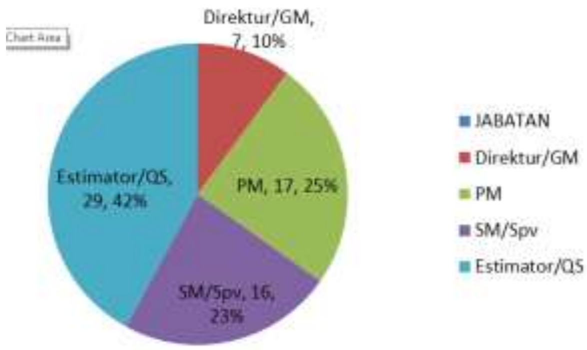


Figure 2. Position of Respondent

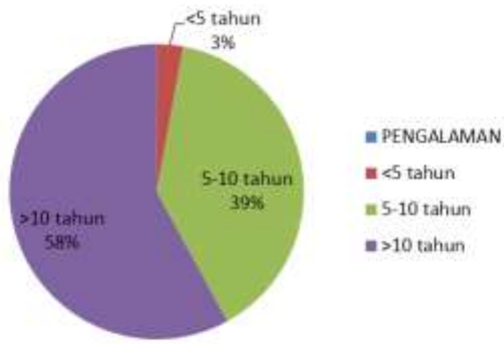


Figure 3. Work Experience Respondent

Factors of Influence of Independent Variables and Dependent

The Independent Variable (X) in this study is

X1 : Design Changes

X2 : Material Availability

X3 : Labor Productivity

Dependent Variable (Y):

Y : Performance Cost

Cost performance referred to independent variables is ***poor cost performance, which causes cost overruns or often referred to as cost overruns.***

The sub-factors that affect the variables are taken from several journals and in the opinion of the researchers themselves, based on experience working in the construction industry.

Table 1. Sub Factor X1 Design Changes

No.	***Sub Factors***		***Reference***
X1	***Design Changes***		
X1	1	Design Errors of working drawings	Yap et al (2021), Darmawi et al (2020), Al-Hakim et al (2017)
X1	2	Approval of the design of the document by the owner	Yap et al (2021), Imran Latif et al (2020)
X1	3	Significant design changes	Yunita &; Oties (2020)
X1	4	Frequent design changes	Balavenkatesh (2017), Memon et al (2011), Yap et al (2021), Yurianto and Trhono (2020), Darmawi et al (2020), Aji (2015), Anggraini (2019), Yunita&Oties (2020)
X1	5	Inadequate planning	Faith (2015)
X1	6	Delay in approval of design/working drawings	Memon et al (2011), Aji (2015), Anggraini (2019)
X1	7	Lack of communication between the planning consultant and the executing consultant regarding the application of a working method based on the existing design	Faith (2015)
X1	8	Design inaccuracies that require design review	Yunita&Oties (2020)
X1	9	Poor design/ non-applicable design	Memon et al (2011), Anggraini (2019), Yunita&Oties (2020)
X1	10	Most delays in the distribution of working drawings	Balavenkatesh (2017), Memon et al (2011), Yap et al (2021), Yurianto and Trihono

Table 2. Sub Factor X2 Material Availability

No.	***Sub Factors***		***References***
X2	***Material*** Availability		
X2	1	Material procurement delays	Karning et al (1997), Azhar (2008), memon et al (2010), Aji (2015), Anggraini (2019) (2017)
X2	2	Errors in deviations	Watimury (2015)
X2	3	Material Theft	Memon (2013)

X2	4	Increase in material prices in the market and from suppliers from the previous period	Santoso (1999), Memon et al (2010), Aji (2015), Fahirah et al (2016), Anggraini (2019), Yap et al (2021), Al-Hazim et al (2017), Kassa (2020)
X2	5	Shortage of manufacturing materials in the local market	Kasimu (2012), yap et al (2021), Al-Hazim et al (2017)
X2	6	Delivery delays due to transportation	Memon et al (2011), Fahirah et al (2016), Anggraini (2019), Yap et al (2021), Kassa (2020)
X2	7	Quality of materials that do not meet standards	Azhar (2008), Amusan (2011), Aji (2015), Anggraini (2019), Yap et al (2021), Imran Latif et al (2020), Al-Hazim et al (2017)
X2	8	Shortage of materials delivered to the site	-
X2	9	Procurement of materials from abroad	-
X2	10	Delay	-

Table 3. Sub Factor X3 Labor Productivity

No.	***Sub Factors***		***References***
X3	***Labor*** Productivity		
X3	1	Manpower shortage	Fahira et al (2005), Sahusil awane et al (2011), Memon et al (2010), Aji (2015), Anggraini (2019)
X3	2	There was an increase in labor wages	Fahira et al (2005), Sahusil awane et al (2011)
X3	3	Poor quality of labor	Santoso (1999), Sahusil awane et al (2011)
X3	4	Low labor productivity	Memon et al (2013)
X3	5	Lack of proper personal placement of projects	Wattimurry et al (2015)
X3	6	Inadequate skilled personnel	Yap et al (2021), Imran Latif et al (2020), Kassa (2020), Al-Hazim et al (2017)
X3	7	Workforce safety & health	Purnomo (2016), Anggraini (2019)
X3	8	Workforce Management & Supervision	Yunita &; Oties (2020)
X3	9	Number of workers	Purnomo (2016), Anggraini (2019)
X3	10	Lack of communication between workers	Memon et al (2010), Aji (2015), Anggraini (2019)

Table 4. Sub Factor Y Cost Performance

No.	***Sub Factors***	***References***
Y	***Cost*** Performance	
	1 Material Cost	Asiyanto (2005)
	2 Wage Cost	Asiyanto (2005)
	3 Baiaya Tools	Asiyanto (2005)
	4 Overhead Costs	Asiyanto (2005)
	5 Indirect Costs	Asiyanto (2005)

a. Data Reliability Test

Test the reliability of the data to find out if the data collection tool basically shows the level of accuracy, accuracy, stability or consistency (Ong, 2012). A reliable instrument is an instrument that, when used several times to measure the same object, will produce the same data. Priyatno says that "A variable construct or instrument is said to be reliable, if it gives the value of *Cronbach's Alpha* coefficient greater than 0.6 (as the general standard value for the reliability of a research instrument). In general, the reliability of a research instrument in the range of > 0.60 to 0.80 can be said to be good, if in the range of > 0.80 to 1.00 is considered very good.

The following are the results of data processing through *the SPSS program version 21.0.*

Table 5. Reliability Test Results (variable X1) from SPSS program *version 21.0*

	Scale Mean if Item deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
X1_01	36.22	13.849	.080	.791
X1_02	36.93	10.392	.786	.694
X1_03	36.68	13.485	.188	.776
X1_04	36.23	12.534	.359	.758
X1_05	36.94	10.408	.748	.699
X1_06	36.29	13.179	.286	.765
X1_07	36.78	13.996	.048	.794
X1_08	36.93	10.392	.786	.694
X1_09	36.33	12.902	.255	.772
X1_10	36.93	10.392	.786	.694

Table 6. Reliability Test Results (Variability X2, X3) from *SPSS program version 21.0*

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
X2_01	36.62	10.738	.083	.708
X2_02	37.32	9.191	.375	.659
X2_03	37.30	9.656	.332	.667
X2_04	36.68	9.603	.385	.658
X2_05	37.06	9.967	.299	.673
X2_06	36.70	9.450	.485	.643
X2_07	37.17	10.028	.238	.684
X2_08	36.74	9.196	.465	.642
X2_09	36.74	9.196	.465	.642
X2_10	37.32	9.191	.375	.659

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
X3_01	35.36	12.558	.095	.766
X3_02	36.00	10.735	.416	.725
X3_03	35.99	10.014	.688	.682
X3_04	35.42	11.541	.295	.742
X3_05	35.75	11.953	.258	.745
X3_06	35.45	11.869	.315	.737
X3_07	35.86	12.038	.190	.756
X3_08	35.99	10.014	.688	.682
X3_09	35.99	10.014	.688	.682
X3_10	35.99	10.573	.475	.715

It can be seen that the sub-factor data X1, X2, X3 entered into the SPSS Cronbach's Alpha values are all > from the minimum requirement of 0.6. So the data above is **reliable.**

b. Test Data Validity

The basic validity test of decision-making is to compare r_{count} and r_{table} using the *product-moment* correlation coefficient formula proposed by Pearson, with the following criteria:

a. If r counts > r table then the statement can be declared valid.

b. If r counts < r_{table} then the statement can be declared invalid.

Meanwhile, to get the r table is done with the r *product moment* $_{table}$, which determines alpha (α) = 0.05 then n (sample) = 69 respondents, the coordinates are r (0.05; n-2) = r (0.05; 67) so that the table r value is 0.2369. In the SPSS process, $r_{calculate}$ coded *Pearson Correlation* whose value if > from r_{table} is said to be valid data.

There is another binding as a basis for the decision that whether the data is valid or not is that the value of sig. (significance) coded *Sig. (2-tailed)* from the SPSS calculation result must be < of 0.05 said the data is valid. Basically, the significance value is related to the $_{r\ count}$, the smaller the sig value, the greater the calculated r value.

The following are the results of data processing through the SPSS program version 21.0.

Table 7. Validity Test Results (variable X.1) from *SPSS program version 21.0*

		Change Design
X1_01	Pearson Correlation	.243
	Sig. (2-tailed)	.044
	N	69
X1_02	Pearson Correlation	.853
	Sig. (2-tailed)	.000
	N	69
X1_03	Pearson Correlation	.333
	Sig. (2-tailed)	.005
	N	69
X1_04	Pearson Correlation	.503
	Sig. (2-tailed)	.000
	N	69
X1_05	Pearson Correlation	.829
	Sig. (2-tailed)	.000
	N	69
X1_06	Pearson Correlation	.415
	Sig. (2-tailed)	.000
	N	69
X1_07	Pearson Correlation	.213
	Sig. (2-tailed)	.079
	N	69
X1_08	Pearson Correlation	.853
	Sig. (2-tailed)	.000
	N	69
X1_09	Pearson Correlation	.419
	Sig. (2-tailed)	.000
	N	69
X1_10	Pearson Correlation	.853
	Sig. (2-tailed)	.000
	N	69
Design Changes	Pearson Correlation	1
	Sig. (2-tailed)	
	N	69

Table 8. Validity Test Results (variable X.2) from *SPSS program version 21.0*

		X2_10	Material Availability
X2_01	Pearson Correlation	. 135	.267
	Sig. (2-tailed)	. 270	.027
	N	69	69
X2_02	Pearson Correlation	1. 000	.559
	Sig. (2-tailed)	.000	.000
	N	69	69
X2_03	Pearson Correlation	. 235	.502
	Sig. (2-tailed)	. 052	.000
	N	69	69
X2_04	Pearson Correlation	. 301	.536
	Sig. (2-tailed)	.012	.000
	N	69	69
X2_05	Pearson Correlation	. 104	.458
	Sig. (2-tailed) 2N	. 394	.000
		69	69
X2_06	Pearson Correlation	. 116	.609
	Sig. (2-tailed)	. 394	.000
	N	69	69
X2_07	Pearson Correlation	. 109	.420
	Sig. (2-tailed)	. 374	.000
	N	69	69
X2_08	Pearson Correlation	049	.610
	Sig. (2-tailed)	687	.000
	N	69	69
X2_09	Pearson Correlation	. 049	.610
	Sig. (2-tailed)	. 687	.000
	N	69	69
X2_10	Pearson Correlation	1	.559
	Sig. (2-tailed)		.000
	N	69	69
Material Availability	Pearson Correlation	.559	1
	Sig. (2-tailed)	.000	
	N	69	69

The results of the data entered into the SPSS correlation value $r_{calculate}$ > from the minimum requirement, namely r_{table} 0.237. And sig value. (significance) from the SPSS calculation results of all respondents < from 0.05, so the data above X3 is **Valid**.

Table 10. Validity Test Results (variability Y) from *SPSS program version 21.0*

Y_01	Pearson Correlation	1
	Sig. (2-tailed)	
	N	69
Y_02	Pearson Correlation	-.031
	Sig. (2-tailed)	.799
	N	69
Y_03	Pearson Correlation	.947**
	Sig. (2-tailed)	.000
	N	69
Y_04	Pearson Correlation	-.099
	Sig. (2-tailed)	.417
	N	69
Y_05	Pearson Correlation	.133
	Sig. (2-tailed)	.275
	N	69
Y_06	Pearson Correlation	.617**
	Sig. (2-tailed)	.000
	N	69
Kinerja Biaya	Pearson Correlation	.720**
	Sig. (2-tailed)	.000
	N	69

The results of the data entered into the SPSS correlation value $r_{calculate}$ > from the minimum requirement, namely r_{table} 0.237. And sig value. (significance) from the SPSS calculation results of all respondents < from 0.05, so the data above Y is **Valid.**

Normality Test

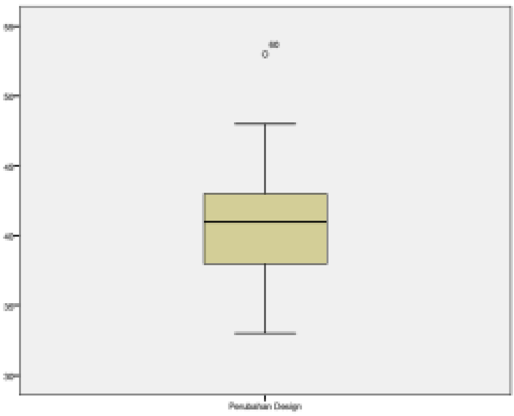
The normality test consists of:

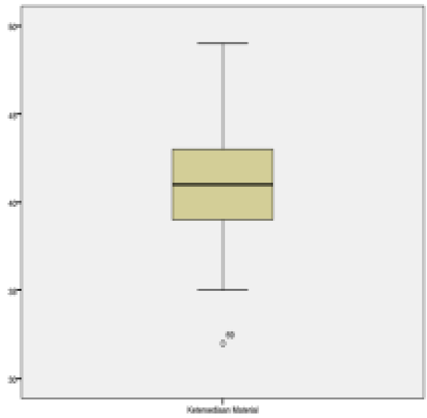
1. *Outlier* Test (looking for abnormal data)

To find out abnormal data in SPSS is visible if the image is clean, the data means normal, less normal marked round moon and abnormal if marked with an asterisk.

For the moon sign the data is indeed less normal but still tolerable, asterisk data we can remove it or add respondents by distributing additional questionnaire data if the number of respondent data is slightly above the minimum.

Table 11. Outlier Test Results (variable X) from *SPSS program version 21.0*





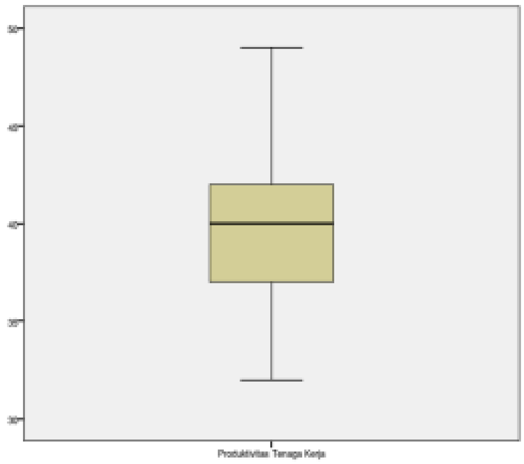
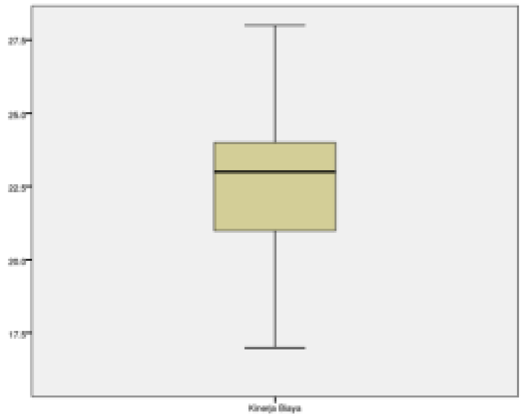


Table 12. Outlier Test Results (variable Y) from *SPSS program version 21.0*



Kolmogorov Smirnov Test (KS)

The basis for decision making, the magnitude of Kolmogorov Smirnov's value is with significance above 0.05. In other words, if it is greater than 0.05 the value of KS is not significant, it means that the residual is normally distributed.

Table 13. Kolmogorov Smirnov (KS) Test Results X variability from *SPSS program version 21.0*

One-Sample Kolmogorov-Smirnov Test

		Perubahan Design
N		69
Normal Parameters[a,b]	Mean	40.70
	Std. Deviation	3.824
Most Extreme Differences	Absolute	.078
	Positive	.078
	Negative	-.068
Kolmogorov-Smirnov Z		.651
Asymp. Sig. (2-tailed)		.790

One-Sample Kolmogorov-Smirnov Test

		Ketersediaan Material
N		69
Normal Parameters[a,b]	Mean	41.07
	Std. Deviation	3.388
Most Extreme Differences	Absolute	.100
	Positive	.088
	Negative	-.100
Kolmogorov-Smirnov Z		.832
Asymp. Sig. (2-tailed)		.493

One-Sample Kolmogorov-Smirnov Test

		Produktivitas Tenaga Kerja
N		69
Normal Parameters[a,b]	Mean	39.75
	Std. Deviation	3.656
Most Extreme Differences	Absolute	.121
	Positive	.081
	Negative	-.121
Kolmogorov-Smirnov Z		1.006
Asymp. Sig. (2-tailed)		.264

Table 14. Kolmogorov Smirnov (KS) Test Results Y variability from *SPSS program version 21.0*

One-Sample Kolmogorov-Smirnov Test

		Produktivitas Tenaga Kerja
N		69
Normal Parameters[a,b]	Mean	39.75
	Std. Deviation	3.656
Most Extreme Differences	Absolute	.121
	Positive	.081
	Negative	-.121
Kolmogorov-Smirnov Z		1.006
Asymp. Sig. (2-tailed)		.264

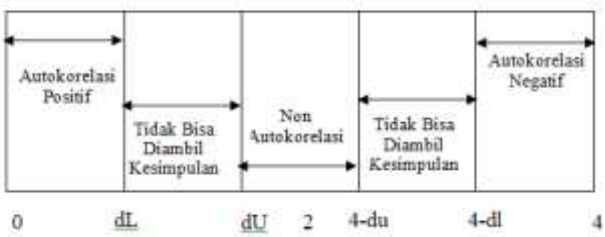
Linear Regression Analysis

Linear Regression Analysis consists of:

1. Durbin-Watson Test

Autocorrelation Test: to prove there is no residual correlation in period t with the previous period (t-1)

Table 15. Durbin-Watson test parameters



Analysis results

Table 16. Durbin-Watson Test

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.605[a]	.365	.336	2.158	1.704

a. Predictors: (Constant), Produktivitas Tenaga Kerja, Perubahan Design, Ketersediaan Material

b. Dependent Variable: Kinerja Biaya

Basic decision-making by looking at the Durbin-Watson table:

N = 69 (number of respondents)

K = 3 (number of independent variables)

dL= 1.5205

dU= 1.7015

4-dU= 4 - 1.7015= 2.2985

4-dL= 4 - 1.5205= 2.4795

Durbin-Watson's count (d) is 1.704

(dU) < (d) < (4-dU)

1.7015 < 1.704 < 2.2985

There seems to **be no autocorrelation problem.**

2. Multicollinearity Test

The multicollinearity test aims to test whether in the regression model there is a high or perfect correlation between independent variables.

- Looking at the Tolerance value: if the tolerance value is greater than > 0.10 then it means that there is no multicollinearity.
- Looking at the VIF value: if the VIF value is smaller than < 10.00 then it means that there is no multicollinearity.

Table 17. Multicollinearity Test

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	7.810	3.190		2.449	.017		
	Perubahan Design	.459	.144	.663	3.184	.002	.226	4.424
	Ketersediaan Material	.390	.194	.496	2.009	.049	.159	6.307
	Produktivitas Tenaga Kerja	.302	.146	.416	2.072	.042	.242	4.132

a. Dependent Variable: Kinerja Biaya

Basis of decision making:

- Tolerance variable value X1: 0.226 > 0.10 then it means that multicollinearity does not occur.
- Tolerance variable value X2: 0.159 > 0.10 then it means that multicollinearity does not occur.
- Tolerance variable value X3: 0.242 > 0.10 then it means that multicollinearity does not occur.

- The value of VIF 4.434 < 10.00 means that there is no multicollinearity.
- The value of VIF 6.307 < 10.00 means that there is no multicollinearity.
- The VIF value of 4.132 < 10.00 means that there is no multicollinearity.

3. Test t

The effect of variable X partially on Y (Test T)

The variable X1 (*Design Change*) has a positive and significant effect on Y, this is illustrated by sig. (X1) 0.02 < 0.05

Coordinate value t_{table} = t(a/2; n-k-1) = t(0.05 /2; 69-3-1) = t(0.025; 65)

See the table that t_{table} = 1.997; t_{count} = 3.184

The value of t_{count} = 3.184 > 1.997, then H0 is rejected and H1 is accepted

The variable X2 (*Material Availability*) has a positive and significant effect on Y, this is illustrated by sig. (X2) 0.049 < 0.05

Coordinate value t_{table} = t(a/2; n-k-1) = t(0.05 /2; 69-3-1) = t(0.025; 65)

See the table that t_{table} = 1.997; t_{count} = 2.009

$_{Calculated}$ t value = 2.009 > 1.997, then H0 is rejected and H2 is accepted

The variable X3 (*Labor Productivity*) has a positive and significant effect on Y, this is illustrated from sig. (X3) 0.042 < 0.05

Coordinate value t_{table} = t(a/2; n-k-1) = t(0.05 /2; 69-3-1) = t(0.025; 65)

See table t_{table} = 1.997; t_{count} = 2.072

$_{Calculated}$ t value = 2.072 > 1.997, then H0 is rejected and H3 is accepted

Put into coefficient number from column B to equation :

$$Y = 7,810 + 0.459 X_1 + 0.390X_2 + 0.302X_3$$

Test F

The effect of variable X simultaneously on Y (Test F)

Table 18. Anova Output F Test

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	174.395	3	58.132	12.480	.000[b]
	Residual	302.764	65	4.658		
	Total	477.159	68			

a. Dependent Variable: Kinerja Biaya

b. Predictors: (Constant), Produktivitas Tenaga Kerja, Perubahan Design, Ketersediaan Material

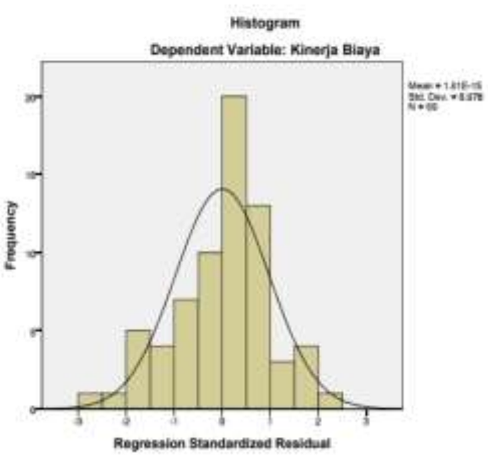
The basis of decision making by comparing f_{table} and $f_{calculate}$:

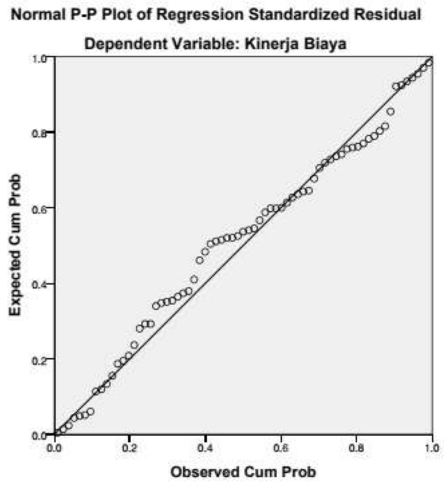
- Variables X1,X2,X3 have a positive and significant effect on Y, this is illustrated from sig. (F) 0.000 < 0.05
- Coordinate value f_{table} = f(k; n-k) = t(3; 69-3) = t(3; 66)

See the table that f_{table} = 2.74, ; f count = 12.480

The value of f_{count} = 12.480 > 2.74, then H0 is rejected and Ha is accepted

Normal distribution histogram:





One-Sample Kolmogorov-Smirnov Test

		Perubahan Design
N		69
Normal Parameters[a,b]	Mean	40.70
	Std. Deviation	3.824
Most Extreme Differences	Absolute	.078
	Positive	.078
	Negative	-.068
Kolmogorov-Smirnov Z		.651
Asymp. Sig. (2-tailed)		.790

The distribution of the normal distribution is close to the diagonal line, so it can be concluded that the residual data in the regression model are normally distributed. This result is also supported using the Kolmogorov-Smirnov statistical test From the table above known Asymp value. Sig. (2-tailed) of 0.790 > 0.05. From these results, it can be concluded that the data in this study are normally distributed.

Mean &; Ranking

From the factor data of variable X, the order of the most influential factors is obtained, as follows:

Table 19. Output Mean Ranking

Item Statistics

	Mean	Std. Deviation	N
X1_01	4.48	.633	69
X1_02	3.77	.731	69
X1_03	4.01	.581	69
X1_04	4.46	.655	69
X1_05	3.75	.755	69
X1_06	4.41	.551	69
X1_07	3.91	.636	69
X1_08	3.77	.731	69
X1_09	4.36	.685	69
x1_10	3.77	.731	69
X2_01	4.45	.631	69
X2_02	3.75	.755	69
X2_03	3.77	.667	69
X2_04	4.39	.623	69
X2_05	4.01	.606	69
X2_06	4.38	.571	69
X2_07	3.90	.667	69
X2_08	4.33	.657	69
X2_09	4.33	.657	69
X2_10	3.75	.755	69
X3_01	4.39	.623	69
X3_02	3.75	.755	69
X3_03	3.77	.667	69
X3_04	4.33	.679	69
X3_05	4.00	.594	69
X3_06	4.30	.551	69
X3_07	3.90	.667	69
X3_08	3.77	.667	69
X3_09	3.77	.667	69
X3_10	3.77	.731	69
Y_01	3.64	.707	69
Y_02	3.84	.656	69
Y_03	3.70	.734	69
Y_04	3.87	.684	69
Y_05	3.75	.755	69
Y_06	3.67	.798	69

CONCLUSION

Partial test results through t-tests, X1 (design change), X2 (material availability) and X3 (labor productivity) **have an effect** on improving poor cost performance. Test results based on the F test, it can be concluded that the hypothesis is accepted which means that changes in design, material availability and labor productivity have a significant influence on improving poor cost performance.

Based on the multiple linear regression equation $Y = 7.810 + 0.459 X_1 + 0.390X_2 + 0.302X_3$. So it can be concluded that the factor that is most influential and contributes the most to poor cost performance is the X1 factor (design change), characterized by the largest value of the X1 coefficient, which is **0.459.** In its application, that the more often there are design changes (in this case changes that are not in the context of value engineering, but changes that occur during project implementation), it will affect the increase in cost performance that is not good, or there will be an increase in costs or cost overruns.

Based on the ranking table, the order of factors affecting cost performance is X1.1 (design error/working drawing); X1.4 (frequent design changes); X2.1 (delay in material procurement);

X1.6 (Delay in approval of designs/working drawings), X2.4 (Increase in material prices in the market and at suppliers from the past) and X3.1 (labor shortages).

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