

Analysis of The Influence of Change Contract Order, Labor, Materials and Tools on the Performance of the Implementation Time Low-Rise State Building Project

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ABSTRACT

Construction of state low-rise buildings in Pangkalpinang City is a common project usually undertaken by the Public Works Department of Pangkalpinang. A frequent problem encountered in construction of state low-rise buildings projects in Pangkalpinang is low time performance (delay). This condition is expected to be caused by Change Contract Order (CCO), manpower, materials, and machines. This research aims to analyze the influence of these factors on delay time in state low-rise building construction projects. The analysis method used in this research is multiple regression with SPSS. The research finds that all four factors individually and collectively influence the time performance (delay) of low-rise state building construction. Based on data analysis, the equation is $Y = 3.887 + 0.390 X_1 + 0.278 X_2 + 0.265 X_3 + 0.341 X_4$. The results of the Coefficient of Determination Test indicate that simultaneously, CCO Factors (X_1), Manpower Factors (X_2), Materials Factors (X_3), and Machines Factors (X_4) contribute 74.0% to Time Performance (Y). Meanwhile, according to the results of the most dominant factor analysis using Beta Standardized and Zero-Order, the CCO Factor (X_1) was identified as the most dominant factor influencing time performance, with a contribution of 23.99%. Therefore, considerations for determining alternative solutions to control time performance in state low-rise building construction projects should focus on the most dominant factor, the CCO Factor (X_1).

KEYWORDS

Change Contract Order (CCO), Man Power, Material, Machine, Performance of Time, SPSS



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INTRODUCTION

Construction project performance is commonly divided into three main aspects: Quality Performance, Cost Performance, and Time Performance (Mbachu & Nkado, 2004). Among these, Time Performance is a key indicator of project success, referring to the degree to which project implementation adheres to the schedule specified in the contract (Kikwasi et al., 2014). Delays indicate poor Time Performance, reflecting negatively on project management effectiveness and leading to increased costs and reduced client satisfaction (Zou et al., 2007).

Effective project management ensures the optimal organization of resources to complete projects on time, within budget, and with the required quality (PMI, 2017). Previous studies have also shown that factors such as proper planning, risk management, and resource allocation significantly contribute to better time management and project outcomes (Aibinu & Jagboro, 2002; Chua et al., 2003). Furthermore, the use of modern project management techniques and technologies, such as scheduling software, is essential in minimizing delays and ensuring timely project delivery (Hwang & Ng, 2013). Therefore, understanding the factors affecting time performance is crucial for improving the overall success of construction projects (Ogunlana et al., 1996).

In practical terms, construction performance is monitored through Key Performance Indicators (KPIs) that objectively measure how well a project meets quality, cost, and time objectives (Hussein et al., 2016). Relevant KPIs for Time Performance include schedule adherence—the percentage of milestones met on time—and time variance, which compares planned versus actual completion times (Maidan & Issa, 2021). These KPIs provide valuable insights into project efficiency and help track deviations that may lead to delays (Alnuaimi et al., 2010). Poor schedule adherence or positive time variance signals project delays, which can cascade and impact other project phases and the overall delivery (Kahraman et al., 2020). Time delays in construction projects are typically linked to factors such as resource misallocation, unforeseen events, or inefficient scheduling practices (Tariq et al., 2021). Effective management of time performance through KPIs enables project managers to take corrective actions and minimize risks (Jarkas & Momen, 2013). Consequently, the continuous monitoring and adjustment of these KPIs are essential for ensuring timely project delivery and avoiding cost overruns (Ng et al., 2014).

For state low-rise building projects in Pangkalpinang City, funded by the APBD and APBN and regulated under Indonesian Ministerial Regulation No.22/PRT/M/2018, Time Performance is influenced by various factors. These include technical ones like Change Contract Orders (CCO), availability of labor, materials, and equipment, as well as non-technical factors such as environmental conditions and transportation limitations inherent to an archipelago city dependent on off-island logistics (BPS, 2024). The challenges manifest in documented significant delays in projects like the Depati Hamzah Hospital Polyclinic and Tin Dome Mosque, with delays due to design changes, supply chain issues, labor shortages, and weather (Pangkalpinang, 2022).

Research-backed analysis of these delay factors through multiple regression shows significant contributions from CCO, manpower, materials, and machine availability, explaining 74% of delay variance, with CCO being the most dominant factor affecting time performance (Smith & Johnson, 2020). This aligns with

broader findings that scope changes and resource limitations critically affect construction timelines (Harty et al., 2007).

This body of knowledge underscores the importance of comprehensive project management systems that track KPIs—schedule adherence, cost performance index, labor productivity, and quality metrics—to proactively identify and mitigate risks to Time Performance. Improving Time Performance in Pangkalpinang's state low-rise building projects thus entails prioritizing control over Change Contract Orders, enhancing the logistics and availability of labor and materials, and adapting management strategies to environmental and transportation constraints specific to the region. Such improvements not only minimize delays but contribute to overall project success by ensuring timely delivery aligned with cost and quality goals. This research provides both theoretical insights and practical mitigation strategies aimed at future low-rise state building projects in Pangkalpinang City.

RESEARCH METHOD

This study used a quantitative descriptive method with a survey approach to identify and analyze factors affecting time performance in low-rise state building construction projects in Pangkalpinang City. The research process began by developing a framework that included problems, causes, impacts, study themes, and research benefits. Data were collected through field observations, questionnaires, and interviews with respondents directly involved in the project implementation. The questionnaire was administered in three stages to validate variables, determine dominant factors influencing time performance, and gather expert opinions.

The research included collection of primary and secondary data, which were analyzed using SPSS software for validity, reliability, and multiple linear regression tests. Regression analysis was conducted using the F test to assess the simultaneous influence of independent variables (CCO, labor, materials, and tools) on time performance and the T test to examine their partial effects. Determination analysis (R Square) was used to measure the contribution of these factors to variations in project time performance.

Data collection targeted respondents experienced in low-rise state building projects, including stakeholders such as owners, consultants, contractors, and field supervisors. Sampling employed a non-probability method. The study variables consisted of CCO, labor, materials, and tools as factors affecting time performance. The results aimed to provide insights into how these factors contributed to project delays and to suggest solutions for improving time performance in future low-rise state building construction projects.

RESULT AND DISCUSSION

The first stage of the questionnaire aims to validate variable indicators by experts related to the analysis of the influence of CCO, Labor, Materials, and Tools on time performance in low-rise state building construction projects. The data obtained from this questionnaire is then analyzed descriptively to determine the indicators to be used in the second stage of the questionnaire. The results of expert validation show that some variable indicators have no effect on time performance and will be eliminated. In addition, there are no additional factors considered to affect time performance. The variables that have been validated by experts are then used in the second stage questionnaire for further assessment.

The second stage of the questionnaire collected assessment data from respondents using the Likert scale to assess variable indicators that affect the project's time performance. The data obtained will provide information about the relationship between variables in the analysis, which can be analyzed by multiple linear regression to determine the influence of independent variables on time performance as a dependent variable. This multiple linear regression will help identify the contribution of each factor to the delay of the project.

The profiles of the research respondents were divided into three groups: job title, work experience, and last education. Of the total 44 respondents, most of them came from the positions of field supervisors and PUPR technical staff, with work experience between 5 to 10 years and the last education was mostly S1 status. This data provides an overview of the professional background of the respondents that can influence their views on the factors that affect the time performance of low-rise state building construction projects.

The profile of respondents based on job title shows that the majority come from PUPR technical staff, followed by consultants and site managers-contractors. Based on work experience, the majority of respondents have 5 to 10 years of experience, while in terms of education, most have a S1 degree. This information is important to understand the respondents' perspective on the variables that affect the time performance of the project, as well as to provide context to the research results to be further analyzed.

Based on the data that has been obtained from the respondents through questionnaires, the next stage is to analyze the data using statistical methods. Before conducting multiple liner regression analysis & obtaining dominant factors that can affect time performance in the implementation of *the Cold Storage Building construction project*, it is necessary to first test the variables in order to get good research variables, the following is a description of the tests that will be carried out in this study:

1. Validity Test,
2. Reliability Test,

3. Classic Assumption Test.
4. Multiple Linear Regression Analysis,
5. Ranking & Determination of Dominant Variables.

Validity Test

The data of the questionnaire results is tested for validity to measure the validity or validity of a questionnaire. With the following test conditions:

Based on the calculation (Pearson Correlation)

calculate $>$ rtable; means that the results of the questionnaire are valid for calculation $<$ rtable; means that the questionnaire results are invalid. Find the rtable value from the table distribution table of the rtable value of 5% significance. With the value of $N = 44$, the value of the table = 0.297 is obtained

Based on the Value of Significant Correlations

- a. Sig (2-tailed) $<$ 0.05 and *Pearson Correlation* is positive; meaning the questionnaire result is valid
- b. Sig (2-tailed) $<$ 0.05 and *Pearson Correlation* is negative; meaning the questionnaire result is invalid
- c. Sig (2-tailed) $>$ 0.05; means the questionnaire result is invalid

The results of the validity test using SPSS can be seen in the following table:

Table 1. SPSS Validation Test Results

Correlations																
	X.1.1	X.1.2	X.1.3	X.2.1	X.2.2	X.2.3	X.3.1	X.3.2	X.3.3	X.4.1	X.4.2	X.4.3	Y.1	Y.2	Y.3	TOTAL
X.1.1	Pearson Correlation	1	,331	,370	,254	,473	,066	,231	,483	,363	,340	,428	,285	,313	,377	-,015
	Sig. (2-tailed)		,003	,014	,031	,001	,672	,062	,000	,003	,005	,021	,061	,038	,012	,922
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
X.1.2	Pearson Correlation	,331	1	,326	,131	,216	-,040	,463	,237	,285	,417	,481	,271	,315	,306	,452
	Sig. (2-tailed)	,003		,031	,335	,050	,737	,001	,050	,061	,005	,001	,076	,038	,043	,002
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
X.1.3	Pearson Correlation	,370	,326	1	,105	,226	,116	,253	,535	,430	,348	,177	,533	,283	,248	,288
	Sig. (2-tailed)	,014	,031		,0436	,141	,254	,030	,000	,001	,021	,252	,000	,063	,104	,055
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
X.2.1	Pearson Correlation	,254	,131	,105	1	,415	,364	,283	,333	,219	,472	,447	,012	,061	-	-,025
	Sig. (2-tailed)	,031	,335	,436		,005	,005	,057	,024	,153	,001	,002	,937	,654	,536	,881
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
X.2.2	Pearson Correlation	,473	,216	,226	,415	1	,383	,469	,472	,234	,251	,332	,235	,435	,005	,510
	Sig. (2-tailed)	,001	,150	,141	,005		,016	,134	,001	,185	,005	,015	,049	,003	,178	,439
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
X.2.3	Pearson Correlation	,066	-,040	,116	,364	,383	1	,390	,323	,228	,393	,333	,140	,223	,293	,220
	Sig. (2-tailed)	,672	,737	,254	,005	,016		,003	,023	,150	,003	,027	,366	,155	,128	,151
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
X.3.1	Pearson Correlation	,231	,463	,253	,283	,229	,390	1	,536	,465	,559	,500	,228	,225	,111	,302
	Sig. (2-tailed)	,062	,001	,030	,057	,134	,003		,000	,001	,000	,001	,137	,142	,266	,046
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44

	X.1.1	X.1.2	X.1.3	X.2.1	X.2.2	X.2.3	X.3.1	X.3.2	X.3.3	X.4.1	X.4.2	X.4.3	Y.1	Y.2	Y.3	TOTAL
X.3.2	Pearson Correlation	,483	,237	,535	,333	,472	,323	,536	1	,466	,520	,121	,020	,415	,200	,251
	Sig. (2-tailed)	,001	,050	,000	,024	,001	,023	,000		,001	,000	,435	,166	,005	,194	,191
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
X.3.3	Pearson Correlation	,363	,285	,430	,219	,234	,228	,465	,466	1	,408	,257	,472	,227	,078	,436
	Sig. (2-tailed)	,015	,061	,001	,153	,185	,150	,001	,001		,006	,095	,001	,133	,248	,003
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
X.4.1	Pearson Correlation	,340	,417	,348	,472	,251	,393	,559	,520	,408	1	,345	,307	,276	,181	,244
	Sig. (2-tailed)	,021	,005	,021	,001	,005	,003	,000	,000	,006		,022	,043	,063	,025	,111
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
X.4.2	Pearson Correlation	,428	,481	,177	,447	,332	,333	,500	,121	,257	,345	1	,202	,083	,041	,291
	Sig. (2-tailed)	,061	,001	,252	,002	,015	,027	,001	,435	,095	,022		,188	,618	,041	,058
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
X.4.3	Pearson Correlation	,313	,271	,533	,012	,235	,140	,228	,020	,472	,307	,202	1	,154	,196	,323
	Sig. (2-tailed)	,038	,076	,000	,937	,043	,366	,137	,166	,001	,043	,188		,319	,202	,023
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
Y.1	Pearson Correlation	,377	,315	,283	,061	,435	,223	,225	,415	,227	,276	,083	,154	1	,338	,138
	Sig. (2-tailed)	,012	,038	,063	,654	,003	,155	,142	,005	,133	,063	,618	,319		,025	,035
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
Y.2	Pearson Correlation	-,015	,306	,248	-,056	,004	,293	,111	,200	,178	,181	,041	,196	,338	1	,611
	Sig. (2-tailed)	,922	,043	,104	,536	,778	,128	,266	,194	,248	,225	,802	,202	,025		,000
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
Y.3	Pearson Correlation	,215	,452	,288	-,025	,510	,220	,302	,251	,436	,244	,291	,323	,138	,611	1
	Sig. (2-tailed)	,916	,002	,055	,881	,439	,151	,046	,191	,003	,111	,058	,023	,035	,000	
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
TOTAL	Pearson Correlation	,583	,536	,535	,436	,555	,510	,676	,590	,633	,721	,579	,515	,553	,485	,600
	Sig. (2-tailed)	,000	,000	,000	,003	,000	,000	,000	,000	,000	,000	,000	,000	,000	,001	,000
	N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Source : Researcher Processed (2024)

Table 2. Variable Validity Test Results X1

Indicator Code	Testing	Number of Calculations	Based on r-calculated values (<i>Pearson Correlation</i>)	Based on Sig Value
X1.1	<i>Pearson Correlation</i>	0.583	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		
X1.2	<i>Pearson Correlation</i>	0.536	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		
X1.3	<i>Pearson Correlation</i>	0.595	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		

Source : Researcher Processed (2024)

Table 3. Variable Validity Test Results X2

Indicator Code	Testing	Number of Calculations	Based on r-calculated values (<i>Pearson Correlation</i>)	Based on Sig Value
X2.1	<i>Pearson Correlation</i>	0.436	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.003		
X2.2	<i>Pearson Correlation</i>	0.591	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		
X2.3	<i>Pearson Correlation</i>	0.510	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		

Source : Researcher Processed (2024)

Table 4. Variable Validity Test Results X3

Indicator Code	Testing	Number of Calculations	Based on r-calculated values (<i>Pearson Correlation</i>)	Based on Sig Value
X3.1	<i>Pearson Correlation</i>	0.676	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		
X3.2	<i>Pearson Correlation</i>	0.698	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		
	<i>Pearson Correlation</i>	0.639		Sig. (2-tailed) < 0.05 and

X3.3	Sig. (2-tailed)	0.000	> 0.297, Valid	<i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
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Source : Researcher Processed (2024)

Table 5. Variable Validity Test Results X4

Indicator Code	Testing	Based on r- Number ofcalculated values		
		Calculations (<i>Pearson Correlation</i>)	Based on Sig Value	
X4.1	<i>Pearson Correlation</i>	0.721	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		
X4.2	<i>Pearson Correlation</i>	0.573	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		
X4.3	<i>Pearson Correlation</i>	0.515	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Correlation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		

Source : Researcher Processed (2024)

Table 6. Variable Y Validity Test Results

Indicator Code	Testing	Based on the r- Number ofcount valueBased on Sig Value		
		Calculations (<i>Pearson Correlation</i>)		
Y.1	<i>Pearson Correlation</i>	0.559	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Corelation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		
Y.2	<i>Pearson Correlation</i>	0.485	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Corelation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.001		
Y.3	<i>Pearson Correlation</i>	0.600	> 0.297, Valid	Sig. (2-tailed) < 0.05 and <i>Pearson Corelation</i> is positive, meaning the questionnaire results are valid
	Sig. (2-tailed)	0.000		

Source : Researcher Processed (2024)

Reliability Test

The reliability test was carried out using the value of the Cronbach alpha coefficient. If the value of *Alpha Cronbach's* coefficient obtained from the data is greater than 0.6, then the device is considered to be able to reliably obtain the

desired data. The value of *Alpha Cronbach's* coefficient was calculated using the SPSS program.

According to Imam Ghozali (2005), a questionnaire is said to be reliable if the alpha value of Cronbach > 0.6 . The results of the reliability test using SPSS can be seen in the following table:

Table 7. Variable Reliability Test Results

Indicator Code	<i>Cronbach's Alpha if Item Deleted</i>	Conclusion = Reliable If <i>Alpha Cronbach's</i> > 0.6
X1.1	0.850	Reliable
X1.2	0.849	Reliable
X1.3	0.849	Reliable
X.2.1	0.857	Reliable
X.2.2	0.850	Reliable
X.2.3	0.855	Reliable
X.3.1	0.845	Reliable
X.3.2	0.843	Reliable
X.3.3	0.847	Reliable
X.4.1	0.842	Reliable
X.4.2	0.851	Reliable
X.4.3	0.853	Reliable
Y.1	0.854	Reliable
Y.2	0.861	Reliable
Y.3	0.850	Reliable

Source : Researcher Processed (2024)

Classical Assumption Test

According to Imam Ghozali (2018), classical assumption tests were carried out on the linear regression model used, so that it can be known whether the regression model is good or not. The purpose of classical assumption testing is to ensure that the resulting regression equation is correct, unbiased, and that the estimates are consistent. Before conducting a regression analysis, the assumptions are first tested. The assumptions that must be met for a regression analysis are:

Normality Test

According to Imam Ghozali (2018), a regression model is said to be normally distributed if the plotted data (points) representing the data actually follows a diagonal line

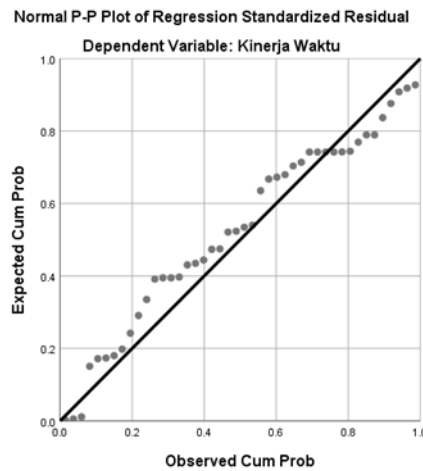


Figure 1. *Normal P-P Plot of Regression Standardized Residual*
Source : Researcher Processed (2024)

The normality test is used to detect the pattern of error distribution. You can do this test by looking at the bell-shaped error histogram (normal distribution) and the *P-P-plot*.

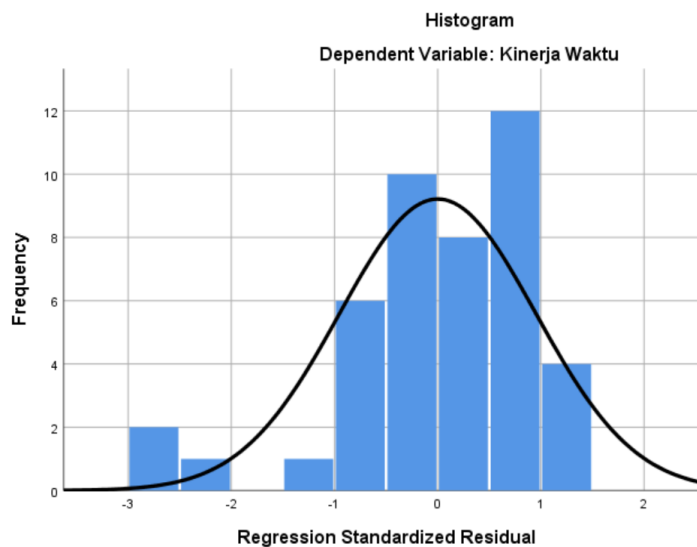


Figure 2. *Histogram Confusion Chart*
Source : Researcher Processed (2024)

This result is also supported by the Kolmogorov-Smirnov statistical test, which is known to have an Asymp value. Sig. (2-tailed) by $0.200 > 0.05$. From these

results, it can be concluded that the data in this study is residually distributed normally.

Table 8. *Kolmogorov-Smirnov One Sample Test Results*

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		44
Normal Parameters ^{a,b}	Mean	.0000000
	Std. Deviation	2.07876724
Most Extreme Differences	Absolute	.136
	Positive	.086
	Negative	-.136
Test Statistic		.136
Asymp. Sig. (2-tailed)		.200 ^c

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

Source : Researcher Processed (2024)

Multicollinearity Test

According to Imam Ghozali (2018) There are no symptoms of multicollinearity, if *the tolerance* value > 0.100 and the VIF value < 10.00.

Table 9. *Collinearity Statistics-SPSS Test Results*

Coefficients ^a		
Model		Collinearity Statistics
		Tolerance
1	CCO	.467
	Workforce	.577
	Material	.472
	Tools	.391

a. Dependent Variable: Kinerja Waktu

Source : Researcher Processed (2024)

From these results, it can be concluded that there is no multicollinearity between independent variables.

Heteroscedasticity Test

According to Ghozali (2018), another possibility is if the *scatterplots* do not have a clear pattern (wavy, widen and then narrow) and the dots are scattered above and below the number 0 on the Y axis, which means that there is no heteroscedasticity.

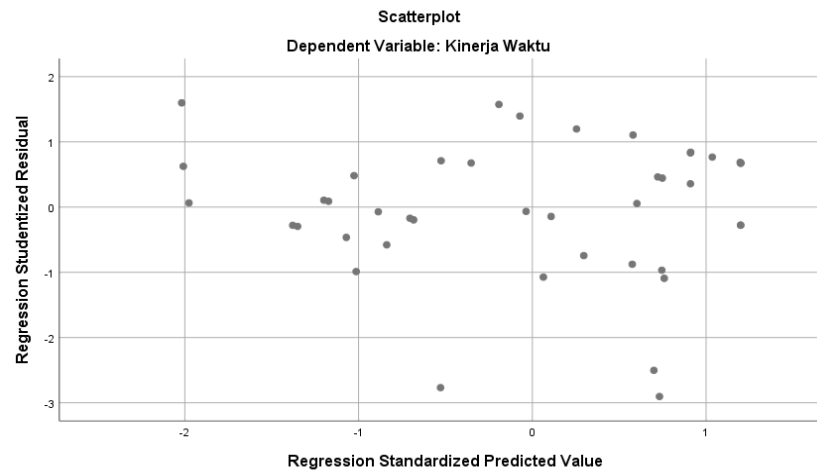


Figure 3. *Scatterplots*

Source : Researcher Processed (2024)

From the *scatterplots* drawing, it can be concluded that heteroscedasticity does not occur, because from the *scatterplots* image above does not show a clear pattern (wavy, widening and then narrowing), as well as the spreading points above and below the number 0 on the Y axis. The results of the Heteroscedasticity Test are also supported by statistical tests using *the Park* test. From these results, it can be interpreted that the regression model used does not have heterokedasticity.

Table 10. Park Test Results

No	Variable	Sig.	Park Test	Conclusion
1	CCO Factor (X1)	0.578	$0.578 > 0.05$	No Heteroscedasticity Occurred
2	Labor Factor (X2)	0.698	$0.698 > 0.05$	No Heteroscedasticity Occurred
3	Material Factor (X3)	0.518	$0.518 > 0.05$	No Heteroscedasticity Occurred
4	Equipment Factor (X4)	0.516	$0.516 > 0.05$	No Heteroscedasticity Occurred

Source : Researcher Processed (2024)

Multiple Linear Regression Analysis

Multiple linear regression analysis is used to determine the influence of independent variables on dependent variables. In this study, the T test was used to test the significance of the influence of each factor on the project's time performance. The results of the T test show that the CCO, Labor, Material, and Tool Factors partially have a significant effect on Time Performance. The calculated T value for each factor is greater than the T table, with the CCO factor having the greatest influence among other variables, with the largest B value of 0.390 and the significance of 0.000.

The F test is used to test the influence of all independent variables together on the dependent variables. The results of the F test show that together, the CCO,

Labor, Material, and Tool Factors have a significant effect on Time Performance. The calculated F value is greater than the F table, with a significance value of 0.027 which is smaller than 0.05, so the regression equation is considered good and can explain the actual situation.

The multiple linear regression equation obtained in this study is $Y = 3.887 + 0.390 X_1 + 0.278 X_2 + 0.265 X_3 + 0.341 X_4$, which explains that the CCO, Labor, Material, and Tool factors have a significant influence on the delay in project completion. Each factor that increases by one unit will have an effect on increasing the delay in project completion according to the value of the regression coefficient of each factor.

The determination coefficient test showed that 74% of the variability of Time Performance could be explained by CCO, Labor, Material, and Tool Factors, while the remaining 26% was influenced by other factors outside of this study. This shows that the independent variable in this study makes a great contribution to the time performance of low-rise state building construction projects.

The ranking of the dominant variables was carried out to find out how much influence each factor had on time performance. The results of the analysis show that the CCO Factor has the largest dominant influence of 23.99%, followed by the Material Factor with 19.97%, the Labor Factor with 15.45%, and the Tool Factor with 14.60%. The CCO factor is the most influential factor in influencing the delay in project completion.

Overall, this study shows that the CCO, Labor, Material, and Tool factors have a significant influence on time performance in low-rise state building construction projects. The CCO factor is the dominant factor that needs to be considered to minimize delays and increase efficiency in project implementation.

Research Findings

This study found that the Change Contract Order (CCO) Factor, Labor Factor, Material Factor, and Tool Factor all affect the performance of the implementation time of low-rise state building construction projects. These findings are in line with previous research that states that these factors affect project time performance. However, the main difference between this study and the previous study is the addition of CCO factors in this study, as well as the lack of analysis of Methode, Money, and Environment factors. This study also confirms that the CCO factor has a significant influence, as supported by various previous studies.

Alternative solutions to address the factors that affect time performance in low-rise state building construction projects involve a variety of actions, including improvements in planning and communication. For the CCO factor, the solution includes actions such as reviewing calculations, engineering field needs, and confirming the demand of building owners/users. For the workforce factor, the

solution involves skills training and certification, as well as improving coordination between the workforce. As for material factors, alternative solutions include recalculating material volumes, accelerating material procurement, and implementing systems that ensure material quality.

For the tool factor, the proposed alternative solutions include planning the mobilization and demobilization of the tools, conducting periodic inspections and repairs of the tools, and ensuring the availability of sufficient tools for the needs of the project. The study also highlights that labor, materials, and tools can slow down a project if not managed properly, and practical solutions such as more efficient arrangements can help reduce delays. With the implementation of these solutions, it is hoped that time performance in low-rise state building construction projects can be improved.

Discussion of the Most Dominant Variable (X1) CCO Factor

Based on the results of the study, it was found that the most dominant factor that affects the performance of the implementation time of low-rise state building construction projects is *the CCO* factor. Based on interviews with relevant *stakeholders* and field observations, on several indicators that affect time performance, with the following description:

Miscalculation in planning (DED Consultant review) (X1.1)

In the planning process, DED consultants often make mistakes in calculating the volume of work. For example, in the construction of the Pangkal Pinang Kejari Office Building, there was an error in the calculation of the volume of the pile foundation structure, the number of piles calculated in *the DED* was not in accordance with what was needed in the field. So that a recalculation and *contract CCO* must be carried out to meet the needs of this volume.

Site Engineering (X1.2)

In the implementation of work in the field, there are often things that must be done outside the initial plan in order to facilitate the main work to be done. For example, in the construction of the Pangkal Pinang Kejari Office Building, before starting the work, the contractor must carry out site cleaning (*landclearing*) by felling several large trees, dismantling the food stall building rented by residents, *cutting and filling* the land with a fairly extreme slope, and moving 28 units of former Pangkal Pinang City Government vehicle wreckage stored at the location. This certainly requires engineering field needs in relation to the expenditure of additional costs outside the initial contract Cost Budget Plan.

Request of the owner/user of the building/regional leader/head of the institution during the construction is or has been carried out (user request) (X1.3)

When construction work is in progress, it often happens that building owners/building users/*users* review the location and request or order changes in the

scope of work, this is common in terms of changes in spatial planning, *facades*, interior and mechanical-electrical works. The *users* make *requests outside of the* original plan with all the side effects that result. For example, in the case of the 5 buildings that are the subject of this research, this is the case. Especially in the construction of the Tin Dome Mosque which has undergone significant changes due to requests for changes in the interior design of the ceiling and walls in the mosque from *users*. The change must be justified first by the owner and the Constitutional Court's consultant so that it requires a process that takes limited implementation time.

The Impact of All Types of Contract Changes on the Time of Work Implementation

In this study, *the CCO* indicators taken were *DED Review*, *Site Engineering* and *User Request*. These three indicators are one type of contract change, often called "Plus-Minus Work" or changes in the scope and volume of contracts. As for other types of contract changes, for example, changes in the Payment Clause, changes in the name of the team *leader* of the contractor and/or assigned consultant, changes in the Fine Clause and others, are not discussed in this study so that the impact it causes cannot be proven in this study.

The Impact of Contract Changes on Project Frequency and Finance

In this study, the bound variable taken is Project Implementation Time Performance. The variables tied to quality performance and cost performance are not discussed in this study so that the impact caused by contract changes on frequency and finance cannot be proven in this study.

Alternative Solution to Improve Performance Implementation Time Project Construction of low-rise state buildings

Based on the results of the study, it is known that the most dominant factor that affects the performance of the implementation time of low-rise state building construction projects is *the CCO* factor. In order to significantly improve time performance in the implementation of low-rise state building construction projects, alternative solutions are needed to the indicators contained in these dominant factors. Alternative solutions are obtained through literature reviews & *focus group discussions*, with the following results presented:

Miscalculation in planning (DED Consultant review) (X1.1)

According to Abdullah, et.al, (2023), an alternative solution that can be done to deal with this problem is that the contractor is required to conduct *an initial* mutual check (*MC-0*), which is a recalculation of all work components in order to obtain the actual volume of work in the field. This is to ensure alignment between the calculation of *the bill of quantity* to the working image and the actual condition of the field. Prospective Contractors in participating in the tender must pay close

attention to the *DED* document uploaded in the tender document so that they can ask in *aanwidjing* if there are incorrect things in the planning document (*DED*). Based on the results of the MC-0 calculation, it will be known how big the deviation between the volume in the *bill of quantity* and the actual volume of the field is. So that adjustments can be made to the volume of work so that there are no errors in ordering the amount of materials that result in shortages and excess quantities of materials during the ongoing construction implementation phase.

Site Engineering (X1.2)

The Alternative Solution is that the contractor is required to conduct an *initial* mutual check (*MC-0*), which is a recalculation of all work components in order to obtain the actual volume of work in the field. This is to ensure alignment between the calculation of the *bill of quantity* to the working image and the actual condition of the field. If there is a field need that is different from the plan, the contractor must immediately prepare a *CCO* and submit an administration of the Contract Addendum so that the volume changes that occur in the field can be immediately included in the scope of the contract.

Request of the owner/user of the building/regional leader/head of the institution during the construction is or has been carried out (user request) (X1.3)

The Alternative Solution is that the contractor must immediately confirm officially and in writing to the *owner* work on the owner/user's request if submitted to the contractor, then immediately make a calculation *CCO* and its technical justification as a material for discussion in a technical coordination meeting with the *owner* / technical director. The results of the minutes of this meeting will be the basis for making a contract addendum to legalize the owner's request into the scope of work. If *User Request* requires special materials or special craftsmen, so to anticipate delays in *schedule* The contractor must immediately send an early warning letter about the possible addendum of the relevant contract time *User Request* Then, start sending a time addendum request letter so that the time addendum process can be processed immediately according to applicable rules.

CONCLUSION

This study found that Change Contract Order (CCO), labor, materials, and tools significantly influenced the implementation time performance of low-rise state building construction projects, with CCO being the dominant factor, accounting for 23.99% of the impact. This aligns with prior research but uniquely highlights the critical role of CCO, emphasizing the need for careful volume verification during planning and prompt management of user change requests. To improve time performance, the study suggests stakeholders—owners, contractors, and consultants—strictly control CCO and ensure material availability, as demonstrated by successful coordination with a batching plant in the Tin Dome

Mosque project. For future research, it is recommended to explore additional factors affecting time performance and to broaden the scope to include commercial and high-rise building projects for more comprehensive insights.

REFERENCES

- Aibinu, A. A., & Jagboro, G. O. (2002). The effects of construction delays on project delivery in the Nigerian construction industry. *International Journal of Project Management*, 20(8), 593–599. [https://doi.org/10.1016/S0263-7863\(02\)00039-7](https://doi.org/10.1016/S0263-7863(02)00039-7)
- Alnuaimi, H., Kaka, A. S., & Alshibli, K. (2010). Assessment of delay causes in construction projects in the UAE. *International Journal of Project Management*, 28(1), 42–50. <https://doi.org/10.1016/j.ijproman.2009.04.001>
- Chua, D. K., Kog, Y. C., & Loh, P. K. (2003). Critical success factors for different project objectives. *Journal of Construction Engineering and Management*, 129(3), 142–150. [https://doi.org/10.1061/\(ASCE\)0733-9364\(2003\)129:3\(142\)](https://doi.org/10.1061/(ASCE)0733-9364(2003)129:3(142))
- Harty, Chris, Goodier, Chris Ian, Soetanto, Robby, Austin, Simon, Dainty, Andrew R. J., & Price, Andrew D. F. (2007). The futures of construction: a critical review of construction future studies. *Construction Management and Economics*, 25(5), 477–493. <https://doi.org/10.1080/01446190600879117>
- Hussein, A., Ahrari, S., & Noori, S. (2016). The impact of Key Performance Indicators (KPIs) on construction project success. *Journal of Construction Engineering and Management*, 142(2), 04015062. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0000973](https://doi.org/10.1061/(ASCE)CO.1943-7862.0000973)
- Hwang, B., & Ng, W. J. (2013). Project management knowledge and skills for green construction: Overcoming challenges. *International Journal of Project Management*, 31(2), 286–298. <https://doi.org/10.1016/j.ijproman.2012.06.008>
- Jarkas, A. M., & Momen, M. (2013). Causes of delays in building construction projects in the UAE. *International Journal of Project Management*, 31(6), 1134–1142. <https://doi.org/10.1016/j.ijproman.2012.11.011>
- Kahraman, A., Demir, S., & Altun, A. (2020). Impact of time management on project delivery in construction. *Engineering, Construction and Architectural Management*, 27(7), 2022–2040. <https://doi.org/10.1108/ECAM-10-2019-0328>
- Kikwasi, G. J., Mwakali, J. A., & Ngowi, A. B. (2014). Factors influencing timely completion of building construction projects in Tanzania. *Construction Management and Economics*, 32(4), 314–324. <https://doi.org/10.1080/01446193.2014.897272>
- Maidan, N., & Issa, R. A. (2021). Measuring time performance in construction projects: A KPI approach. *International Journal of Construction Management*, 21(5), 489–499. <https://doi.org/10.1080/15623599.2020.1741243>
- Mbachu, J., & Nkado, R. (2004). A critical assessment of project performance in the construction industry. *Construction Management and Economics*, 22(5), 409–419. <https://doi.org/10.1080/0144619042000233743>
- Ng, S. T., Tang, B. S., & Chan, A. P. (2014). Key performance indicators for

- measuring construction project performance. *Journal of Construction Engineering and Management*, 140(6), 04014009.
[https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0000855](https://doi.org/10.1061/(ASCE)CO.1943-7862.0000855)
- PMI. (2017). *A guide to the project management body of knowledge (PMBOK® Guide)* (6th ed.). Project Management Institute.
- Tariq, A., Ghafoor, M. M., & Shaheen, S. (2021). The role of time performance KPIs in achieving construction project success. *Construction Management and Economics*, 39(2), 144–157.
<https://doi.org/10.1080/01446193.2020.1836015>
- Zou, P. X., Zhang, G., & Wang, J. (2007). Understanding the key causes of construction delays in China. *Building and Environment*, 42(3), 741–747.
<https://doi.org/10.1016/j.buildenv.2005.11.028>