THE ROLE OF THE CHANGE ORDER ON TIME PERFORMANCE IN CONSTRUCTION PROJECT

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Abstract. This research was conducted to determine how the conditions change order and time performance on a construction project. The population in this study were employees of one project in Jakarta with a sample of 30 employees. Analysis of the data used in this research is descriptive analysis. The results obtained showed that the change order is included in the not good category with a percentage value of 49.79%. While the time performance included in the category is also not good with a percentage value of 42.67%. Based on the results of calculations in the regression analysis, the results show that change order has a positive effect on increasing the time of implementation of construction project work (time performance). The most dominant change order indicator influencing time performance is the lack of information when planning a project. Based on the calculation of the Pearson Product-Moment Correlation, the change order gives a strong relationship to time performance equal to 0.556. So we can be explaining that the change order affects the time performance equal to 30.9% and the rest influenced by other variables.

1. Introduction

Construction is one of the most dangerous industries because it is unique, dynamic, and temporary [1]. The on-time construction works (at scheduled times) are very important for investors and contractors. In the construction projects, even those that are excellently planning and organizing, run the risk of being delayed. It is due to various changes that exist in the construction project [2]. Change is a reality in industrial processes, and the danger of significant accidents must be well managing. The change order is part of safety management. However, changes are often complex and usually involve technical and organizational aspects [3]. Change orders also play an essential role in ensuring the quality of the final product and moving the organization towards the desired goals. The changes that occur are usually very dependent on humans as the main driver in the success of change order [4]. In addition to human factors, the factor of management strategy and technology is no less critical. In previous studies explained that there is a significant relationship between change order and management strategies as well as technological innovation [5].

There are so many factors that cause change orders, one of which is the change order requested by the owner during the design and construction process. It can lead to budget and schedule overrun and increased uncertainty for shipping goods to the project. Practical strategies for managing change can be
used by the project team to reduce the number of change orders during construction [6]. In other studies also explained related to the development of the concept of successful construction management is accompanied by the management of change orders in detail and well planned [7].

Change orders also significantly affect the effectiveness of project work where its sustainability depends on three interrelated components, namely quality, time, and cost. Not a few of the projects in Indonesia are experiencing delays caused by change orders. It is because the change order process must go through several stages and involve several parties who do have different authority. So this change order often results in additional implementation time and project costs [8].

Change orders often occur in the implementation of construction projects start at the beginning until the end of project implementation. The change order is an effort to improve the performance of the construction process to reach the perfect results of the work by the owner's needs. Although it objective to improve work, this change order can result in additional implementation time and project costs during the construction process [9].

The implementation of work on construction projects also often changes planning, so it is interfering with the time of implementation, the addition or reduction of costs on works, or changes in the scope of work. Changes in the scope of work can result in new requests that direct or indirect effect planned work items. These changes will automatically affect the volume, implementation time, and costs required [10].

The importance of managing change orders in construction projects is growing to make an integrated part of project management. Although change orders seem systematic handling of change orders has not been discussed a lot until the late 1990s. However, there has been progressing in managing the change order since the early 2000s [11].

One of the problems at the time of implementation of the Building Construction Projects in the Jakarta region, which was the object of this study, showed that the change of work methods on pile foundations became bored pile foundations. Given the much of work volume in the construction, it needs to conduct various studies related to change orders about project performance, to be able to manage change orders systematically. Therefore, the study is required to explore more related to the main factors that cause change requests and their effects on project performance, specifically related to the time performance of project implementation.

a. Change Order in Construction Project
Change orders are changes in writing between the owner and the contractor to change the conditions of the initial contract documents, by adding or subtracting work. These changes can change contract costs and project implementation schedules. In short, a change order can define as a modification of the original contract. The change order is an agreement in the form of a written agreement signed between owner and contractor after agreeing to confirm changes and the number of compensation costs and implementation time to the contractor that occurs at the project implementation stage, after the signing of a work contract between the owner and the contractor [6].

Types of change orders can be grouping into Direct Change (Formal Change) and Construction Change (Informal Change). Direct Change is a change submitted in written form, proposed by the contractor to the owner to change the scope of work, implementation time, costs, or other things that are different from those specified in the contract document. These provisions usually give the owner unilateral freedom to change the scope of work and require the contractor to keep up with these changes. Formal changes know before doing the work. Constructive Change is an informal action to order a modification of a contract in the field that occurs due to the request of the owner, planner, or contractor [12].

b. The Factors Affect of Change Orders
Change orders also often occur in contracts. Based on the previous study can be known several factors that cause Change orders on contracts lead to three variables, namely changes in contract value, changes in contract completion time, changes in contract administration. Of the three variables, changes in contract administration are the main of all changes. The most frequent amendments are changes in
contract value caused by escalation (price adjustment), lack of work added based on calculations, and design changes [13].

In the other studies also found 5 (five) dominant factors causing change orders. There is the owner's request to optimize building functions, mismatches between drawings and field conditions, design errors or drawings from planning consultants, significant differences in volume between drawings and field conditions (bill of quantity), and the state of the change order is not apparent in the construction contract. The dominant influence of change orders on the performance of contractors is the availability of material, disruption of cash flow, availability of labor, funding or capital that must be spent by service providers or contractors, and the availability of work equipment [14].

In a study related to other construction, also found 5 (five) the most dominant factors causing change orders is the contractor's problems, the physical condition of the field, Change of scope, the problem of the consultant superintendent or internal supervisor, and errors or omissions in the design. Besides the problems at the project site related to the policy of the project owner, security or safety constraints, and project financing problems are some of the elements that cause Change Orders, which are mostly caused by service providers [15].

Whereas 6 (six) Change Order factors that contribute to minimizing resistance to change, namely project scope, project size, project duration, organizational expectations in implementing faster changes, the establishment of official units to handle of change, and unit involvement which handles changes with the implementation of activities [16].

c. Impact of Change Orders
The impact of change orders occurs on costs because the cost increases have implications for additional work volumes. The impact on time, every time there is an increase in the scope of work or the volume, may not have an impact on the adding of implementation time. The most dominant effect with change orders is project implementation delays, disputes, and cost overruns [14].

In another study also explained that due to frequent change orders, where the administrative process was not carried out according to procedures, there were often disputes between owners and contractors. Change orders also result in projects being delayed and costs soaring [17].

Change orders are often carried out on construction projects, resulting in increased costs on some works and an impact on completion time (as well as) quality of work. These results occur in additional work from the initial contract [10].

There are five most common Change Order impacts in the construction, namely increasing project costs, increasing the duration of activities of each work, delaying completion of work schedule, adding a budget for the contractor, and delay in payment. So companies or organizations in construction projects must collect data and information about their projects to support their decision making to achieve cost efficiency, and this is usually the reason for delays in the completion of work schedules [15].

d. Project Time Performance
Project scheduling is one of the elements of planning results, which can provide information about the planned schedule and project progress of resource performance in the form of costs, labor, equipment, and materials as well as the project duration plan and progress time to complete the project. Schedule or time control is the main factor in achieving goals, providing resources such as materials, equipment, and labor [18].

Performance interpreted as the ratio of input to output, where the input of project performance is a series of activities measured from its output. Performance in the construction industry interpreted as efficiency in organizations or individuals. The economic value measured from the output produced by the material, equipment, and effort of labor in creating a product [9].

Time performance is a comparison between the time planned, and the agreed time between the owner and the contractor with the actual work, the differences of smaller percentage is the better the performance. Delay in completion of works can occur due to the late start of the activity or an extension of the duration of the activity. Delay of an activity that is on the critical path of the project will be able to make the overall project delay [19].
Based on the study from several countries can be explained about several factors that influence project time performance. Delays in infrastructure projects are caused by 20 factors, namely terrain conditions, weather conditions, variation of orders, availability of labor, design errors, planned costs for project development, market conditions (availability of resources), fluctuations in material prices, time planned for project construction, Emergency work, quality of equipment and raw materials, Late payment, Variation Order Costs, Government requirements, Poor processing of material quality, Delay in decision making, Management of work relations, Sequence of work on schedule, Poor project management, and Delays in decision making [20]. In another study, it explained that the most significant factor influencing delays in construction work was the error factor in design documentation [2]. Project delays are also affected by several factors, which include: inadequate contractor experience, inadequate planning, inflation, an incessant sequence of variations, and changes in project design [21]. Construction materials that are not available for installation are also a cause of delays in the construction project supply chain and pose a risk to overall project delays [22].

2. Methodology
The method used to explain the contribution of a change order to time performance is Descriptive Analysis, Simple Linear Regression Analysis, Multiple Linear Regression Analysis, Hypothesis Test, Correlation Analysis, and Determination Coefficient Test. Then the results of research calculations are compared with data in the field which objective to strengthen the answers to the research problem. Based on the comparison between the calculated data with the interview data and the observation data in the field, it can be concluding that this is a match the calculated data with the project data.

a. Independent Variable
Based on various references, the independent variable used in this study is a change order which consists of seven indicators, namely:
1. Design
2. Natural
3. Work added or less
4. Information
5. Schedule
6. Method
7. Contract

b. Dependent Variable
Based on various references, the dependent variable also used in this study is time performance which consists of five indicators, namely:
1. Equipment and materials
2. SHE
3. Mobilization
4. Damage
5. Complexity

Descriptive analysis was conducted to find out the respondents' answers about the variables that exist so that an overview of change orders and time performance in the research object can be known. The responses of respondents regarding existing variables measured from respondents' answers to the questionnaire, accompanied by five possible answers to be chosen and considered according to the respondent. From these answers, the assessment criteria for each item based on percentage are then prepared using the following steps:
1. Cumulative value is the sum of the values of each statement item, which is the answer of 30 respondents. The percentage of cumulative value divided by the frequency value multiplied by 100%.
2. The number of respondents is 30 people with the highest measurement scale is five, and the lowest measurement scale is one, so the highest cumulative number is obtained $30 \times 5 = 150$ with the lowest cumulative number $30 \times 1 = 30$.

The highest percentage value is 100%. While the lowest percentage value is 20%. The range value is $100\% - 20\% = 80\%$. If the range value is divided by 5 measurement scales, a percentage interval value of 16% will be obtained. So that obtained percentage rating classification that can be seen in Table 1.

| Value | Percentage | Value Category |
|-------|------------|----------------|
| 1     | 20\% - 36\% | Bad            |
| 2     | >36\% - 52\% | Not Good       |
| 3     | >52\% - 68\% | Good Enough    |
| 4     | >68\% - 84\% | Good           |
| 5     | >84\% - 100\% | Very Good     |

Table 1 Interpretation Value Category

The results of the total value of each variable can see in Figure 1.

3. Results and Discussion

a. Descriptive Change Order Analysis (X)

Based on the analysis of respondents' responses regarding Change Order, it shows that the total value obtained is 1195, then after being entered into the continuum line (Figure 1) the following values are obtained:

1. Maximum Index Value $= 5 \times 16 \times 30 = 2400$
2. Minimum Index Value $= 1 \times 16 \times 30 = 480$
3. Interval Distance $= \frac{[\text{maximum value} - \text{minimum value}]}{5}$
   $= \frac{2400 - 480}{5}$
   $= 384$
4. Value Percentage $= \left(\frac{\text{total value}}{\text{maximum value}}\right) \times 100\%$
   $= \left(\frac{1195}{2400}\right) \times 100\%$
   $= 49.79\%$

Based on Figure 1, percentage of the Change Order Continuous Line can see the ideal value obtained for respondents' answers to 16 statements is 2400. From the recapitulation of respondents' data shows the value obtained is 1195 or 49.79% of the maximum value of 150. It shows that the Change Order on the projects, which are the objects of this research in the not good category.

b. Descriptive Analysis of Time Performance (Y)

Based on the analysis of respondents' responses regarding Time Performance, it shows that the total value is 764, then after being entered into the continuum line (Figure 1) the following value are obtained:

1. Maximum Index Value $= 5 \times 12 \times 30 = 1800$
2. Minimum Index Value $= 1 \times 12 \times 30 = 360$
3. Interval Distance $= \frac{[\text{maximum value} - \text{minimum value}]}{5}$
   $= \frac{1800 - 360}{5}$
   $= 288$
4. Value Percentage $= \left(\frac{\text{total value}}{\text{maximum value}}\right) \times 100\%$
   $= \left(\frac{764}{1800}\right) \times 100\%$
   $= 42.67\%$
Based on Figure 1, Percentage of Time Performance Continuous Line can be seen the ideal value obtained for respondents' answers to 12 statements is 1800. From the calculations in the table shows the value obtained 764 or 42.67% of the maximum value of 150. This shows that the Time Performance on the projects, which are the objects of this research also in the not good category.

c. Regression Analysis

Simple Linear Regression

The effect of change order (X) to time performance (Y) simple linear regression analysis with the following equation used:

\[ Y = a + bX \]

Where:
- \( Y \) = Time Performance
- \( a \) = constant
- \( b \) = direction of the regression coefficient
- \( X \) = Change Order

The SPSS software processing results for simple linear regression analysis is presenting in table 2.

### Table 2 Simple Linear Regression

| Model               | Unstandardized Coefficients | Standardized Coefficients | t     | Sig.  |
|---------------------|-----------------------------|---------------------------|-------|-------|
|                     | B  | Std. Error | Beta |       |       |
| 1 (Constant)        | .389 | .229  |       | 1.698 | .101  |
| Change Order        | .792 | .016  | .994 | 48.749 | .000  |

Dependent Variable: Time Performance

Based on the calculation results in table 2, the simple linear regression equation obtained as follows:

\[ Y = 0.389 + 0.792X \]

The simple linear line equation above, a constant of 0.389, means that if there is no increase in the value of the change order variable, it is worth 0.389. The regression coefficient of 0.792 states that each addition of one value to the change order variable, the addition of time will increase by 0.792. A positive coefficient means that there is a positive influence between change order to time performance. Change orders affect the increase in the time of implementation of construction project work (performance time).

The calculation results of Simple Linear Regression Analysis, to determine the normal distribution or not is to use the normal probability plots. The graph of normal probability plots can see in Figure 2.
Figure 2 Normal Probability Plots

Based on Figure 2, Normal Probability Plots show that the data spread around the diagonal line and follow the direction of the diagonal line. The data processed is normally distributed data, so the linearity test is accepted.

Multiple Linear Regression

To see the contribution of change order (X) to time performance (Y) used multiple linear regression analysis with the following equation:

\[ Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + e \]

Where:
- \( Y \) = Time Performance
- \( \alpha \) = Constant
- \( \beta \) = direction of the regression coefficient
- \( X \) = Change Order

The results of SPSS software processing for multiple linear regression analysis are presented in Table 3.

| Model | Unstandardized Coefficients | Standardized Coefficients | t | Sig. | Collinearity Statistics |
|-------|-----------------------------|---------------------------|---|------|------------------------|
|       | B                      | Std. Error    | Beta |       | Tolerance | VIF |
| 1 (Constant) | 9.069            | 5.554         | 1.633 | .117  |            |    |
| X1    | .094               | .637          | .036  | .148  | .884      | .319 | 3.139 |
| X2    | 1.251             | 1.849         | .144  | .677  | .506      | .410 | 2.438 |
| X3    | .345              | .549          | .178  | .628  | .536      | .230 | 4.357 |
| X4    | 2.177             | 1.820         | .246  | 1.196 | .245      | .436 | 2.293 |
| X5    | -.702             | 1.819         | -.073 | -.386 | .703      | .514 | 1.945 |
| X6    | -.319             | 1.573         | -.034 | -.203 | .841      | .644 | 1.554 |
| X7    | 2.033             | .775          | .443  | 2.623 | .016      | .647 | 1.545 |

Dependent Variable: Time Performance

Based on the results of calculations in Table 3, Multiple Linear Regression Analysis, obtained the form of multiple linear regression equations as follows:

\[ Y = 9.069 + 0.094X_1 + 1.251X_2 + 0.345X_3 + 2.177X_4 - 0.702X_5 - 0.319X_6 + 2.033X_7 \]

The equation of the multiple linear lines above, a constant of 9.069, means that if there is no increase in the value of the change order variable, it is worth 9.069.

a) Every increase of 1 unit of variable X1 will increase the value of the variable Y by 0.094 units.

b) Every increase of 1 unit of variable X2 will increase the value of the variable Y by 1.251 units.

c) Every increase of 1 unit of variable X3 will increase the value of the variable Y by 0.345 units.

d) Every increase of 1 unit of variable X4 will increase the value of the variable Y by 2.177 units.

e) Every increase of 1 unit of variable X5 will decrease the value of the variable Y by -0.702 units.

f) Every increase of 1 unit of variable X6 will decrease the value of the variable Y by -0.319 units.

g) Every increase of 1 unit of variable X7 will increase the value of the variable Y by 2.033 units.

A positive coefficient means that there is a positive contribution between change order and time performance. More of the change order (changes in construction work) will increase the time performance (increase in the time of the construction project work).

To find out the most dominant variable contributing can be determined by the largest regression coefficient. Based on the results of calculations on the Multiple Linear Regression Analysis table, the largest regression coefficient is 2.177. It shows that the most dominant independent variable contributing to the dependent variable is the X4 variable, namely the lack of information when planning the project.
The related contribution of Change Orders to Project Time Performance can be seen in Figure 3 as follow.

Figure 3 shows that change order has a relation to project time performance in linear regression. If the change order increased will cause additional time in the project.

d. **Hypothesis Testing**

The t statistic test shows how far the partial effect of the independent variable on the dependent. The t-test is done with comparing count with t-table and significance level. The hypothesis as follow:

1. \( H_0: \rho_ = 0 \) Change orders do not have a significant contribution to time performance.
2. \( H_1: \rho_ \neq 0 \) Change order has a significant contribution to time performance.

This research was conducted by looking at the significance value of each variable in the output of the regression results using SPSS. If the profitability value of t-count <0.05, then there is a significant influence between the independent variable and the dependent variable, and vice versa, if the value of profitability t-count> 0.05, then there is no significant effect between the independent variable and the dependent variable. The table of t-test partial result also can be seen in table 2.

Based on table 2 shows that the t-count for change orders is 48.749, so t-count> t-table (48.749> 2.042) and a significant level of 0.000 <0.05. Based on the results of the analysis, it knows that \( H_0 \) is not accepted, meaning that change orders have a significant contribution to time performance.

e. **Correlation Coefficient (R)**

Pearson Product Moment Correlation Analysis (R) is a value used to measure the magnitude of the literature relationship between two or more variables. Pearson Product Moment Correlation obtained from the correlation coefficient. Correlation value (R) obtained is 0.556. The results of the calculation of the coefficient of determination can see in table 4.

| Model | R   | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-----|----------|-------------------|---------------------------|
| 1     | 0.556 | 0.309    | 0.284             | 7.27262                   |

Predictors: (Constant), Change Order
Dependent Variable: Time Performance
Based on table 4, Pearson Product Moment Correlation shows that the correlation obtained from the value of R is 0.556. The results of the correlation value obtained to compare with the value of the R Correlation Coefficient Interpretation Table R. This shows that the change order provides a strong enough relationship of 0.556 to time performance.

f. **Coefficient of Determination (R^2)**
The coefficient of determination (R^2) is the value used to determine whether there is an influence relationship between two variables. The coefficient of determination obtained from the results of the square of the correlation coefficient. The R Square coefficient value obtained a figure of 0.309. The results of the calculation of the coefficient of determination can see in table 4.

Based on table 4, the coefficient of determination shows that the coefficient of determination obtained from the R square value of 30.9%. It shows that change order has an effect of 30.9% for time performance, and the rest influenced by other variables not explained in this study.

g. **Overview of Change Orders and Project Time Performance**
The change order conditions in the project that was the object of this study included in the not good category with the acquisition value of 49.79%. Change orders that occur in this project caused by changes in plan drawings, changes in work methods, and changes in work. To find out the condition of time performance on this project is also included in the category that is not good, with a value of 42.67%. The time performance that occurred in this project was due to a lack of good communication, lack of employee performance, material delays, and delays in carrying out the work.

Based on the results of the analysis, compared with data in the field, it was done to strengthen the results of the analysis. Based on the comparison between the data analysis results with interview data and observation data in the field, it concluded that there is a match between the results of the analysis with the conditions in the field. The situation on the ground also shows a time delay due to several change orders that occur during implementation.

h. **Contribution of Change Orders to Project Time Performance**
Simple Linear Regression Analysis Results obtained equation Y = 0.389 + 0.792X. In the simple linear regression equation, there is a constant of 0.389, meaning that if there is no increase in the value of the change order variable, the time performance is 0.389. The regression coefficient of 0.792 states that each addition of one value to the change order variable, time performance increases by 0.792. A positive coefficient means that there is a positive contribution between change order and time performance. The more change order (changes in construction work), the more time the construction project implementation time (performance time) will also increase.

Results of Multiple Regression Analysis obtained by the equation Y = 9.069 + 0.094X1 + 1.251X2 + 0.345X3 + 2.177X4 - 0.702X5 - 0.319X6 + 2.033X7. Based on these equations, it can see that the biggest regression coefficient value is X4 of 2.177. It shows that the most dominant change order variable contributing to time performance is the X4 variable, namely the lack of information when planning a project.

The Pearson Product Moment Correlation Analysis results show that the correlation obtained from the R-value of 0.556. The results of the correlation value obtained show that change order provides a strong enough relationship of 0.556 to time performance. The Determination Coefficient Test results show that the coefficient of determination obtained from the R square value of 30.9%. It shows that change order contributed 30.9% to the time performance, and the rest was influenced by other variables not explained in this study such as costs, lack of communication between owner and contractor, employee performance, etc.

The results of the Hypothesis Test using the t-test obtained t value > t table (48.749 > 2.042) and a significance level of 0.000 <0.05 means that there is a positive contribution between change order to time performance, meaning that change order affects increasing the time of construction project work (time performance).
4. Conclusion
Based on the results of the analysis, can concluded that are,

a. Change orders that occur in the Building Construction Project in the Jakarta region, which is the object of this study, are included in the not good category with the acquisition of a value of 49.79%. Change orders in this project caused by changes in the plan drawing, the work methods, and the addition of works. Time Performance on this project also included in the not good category with a value of 42.67%. The time performance that occurred in this project caused by a lack of communication, lack of employee performance, materials delays, and works delays.

b. The results of the Regression Analysis shows that the most dominant independent variable contributes to the dependent variable is the lack of information project planning, so have affected changes in the plan drawing. In the regression equation, it can be explaining that there is a positive influence between change orders to time performance. The change order had a substantial impact on the on-time performance of 0.556. The results of the correlation analysis obtained the results that the change order contributed to the time performance of 30.9%.

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