Original Article
ISSN (Online): 2454-1907

International Journal of Engineering Technologies and Management Research
July 2024 11(7), 14–25

ANALYSIS OF THE CAUSE AND EFFECT OF CONTRACT CHANGE ORDER ON CONSTRUCTION PROJECTS IN BANYUMAS REGENCY

Taufik Dwi Laksono [1], Dwi Sri Wiyanti [2]

[1] Construction Management, Madyathika Polytechnic Purbalingga, Kedung Menjangan Kecamatan Purbalingga Jawa Tengah, Indonesia
[2] Civil Engineering, Faculty of Engineering, Wijayakusuma University Purwokerto, Jl. Beji Kampus Karangsalam Purwokerto Indonesia

Received 05 June 2024
Accepted 04 July 2024
Published 25 July 2024

Corresponding Author

Dwi Sri Wiyanti,
sriwiyanti2@yahoo.com

DOI
10.29121/ijetmr.v11.i7.2024.1476

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Change Order (CO) in a building construction project can lead to modification in the scope of work, execution time, or cost. Therefore, a Contract Change Order (CCO) is ensued. Many government building projects in Banyumas Regency are going through Contract Change Orders, whether big-scale or small-scale construction projects. An analysis is conducted to investigate the causes and effects of the Contract Change Order on building projects in the Banyumas Regency to anticipate the Contract Change Order so that it occurs as minimally as possible using the Structural Equation Modelling (SEM) analysis method. This study identified ten (10) factors that cause Change Order. The data came from questionnaires from 30 respondents who work on construction projects in Banyumas Regency. Each respondent gave their opinion on the frequency and effect by using a Likert scale of 1-5. Of the ten (10) factors that caused CCO, the most dominant is the contractor's problem. Of the three (3) factors that affect Contract Change Order (CCO), the factor that affects quality the most is regulation and policy changes, the factor that affects cost the most are security and safety obstacles, and the one that affects time the most is the project owner policy.

Keywords: Change Order, Contract Change Order, Construction Project, Structural Equation Modelling (SEM) Analysis

1. INTRODUCTION

Change Order, according to AIA (American Institute of Architects), is a written request signed by the architect, contractor, and owner after the contract is published to adjust the scope of work, contract value, and completion time.

In a building project, problems often occur. One of them is change order in the beginning, the middle, or the end project stage. Change Order in a building project leads to modification in the scope of work, time, or budget. A Contract Change Order (CCO) is an agreement letter between the project owner and the hired worker to emphasize regulation modification and how much cost of the worker's compensation is required for the project after signing the contract Fisk & Reynold (2006).

Contract Change Order (CCO) can also be interpreted as a regulation approved by the project worker, planner, and owner. After the basic agreement is issued, adjustment is made in several work stages according to cost and time. The changes can be additions, subtractions, or changes in work volume negotiated in the initial business contract.

CCO that frequently occurs can have negative effects, both direct and indirect, on the contractor and project owner. Some direct effects are work item costs addition caused by increasing volume and material, overhead, and human resources costs. On the other hand, the indirect effect is a dispute between owners and contractors.

The purposes of CCO are as follows Perwitasari et al. (2020):

1) Modify the contract plan by using a special payment method.
2) To modify work specifications, including payment and contract duration.
3) To approve additional works, including the payment adjustment.
4) For administration purposes, to determine payment methods according to the adjustment.
5) To adjust the contract unit price if there is a specification change.
6) To propose an intensive cost subtraction (*proposal value engineering*).
7) To adjust the project schedule.
8) To avoid disagreement among stakeholders.

In general, there are two types of Contract Change Order (CCO) they are directive change and constructive change.

1) Directive Change

Directive Change is a change written and proposed by the contractor to the owner to change the scope of work, execution time, budget, and other things in the contract. The regulation usually gives one-sided authority where the owner can change the scope of work and force the contractor to follow it. Formal changes generally have been socialized before executing the project.

2) Constructive Change

Constructive change is an order of a contract modification on site. It is requested by the owner, planner, and contractor. This change is also defined as an agreement of change between owner and contractor in terms of cost and time. Construction change is often regarded as the primary cause of disputes between owners and contractors because the project execution differs from the contract documents.

According to Putra & Sulistio (2020), the causes of CCO that are not directly related to construction project stakeholders include weather conditions, health and safety, changes in economic conditions, social and cultural factors, and unpredictable problems. In short, it can be explained as follows :

1) **Weather conditions:** Bad weather can affect outdoor activities in construction projects. The weather has a negative effect that is slowing

down the construction project. The changes are made to compensate for the project delay and cost addition.

2) **Health and Safety factors:** Health and Safety are essential in successfully finishing a building project. Disobedience to health and safety rules can lead to changes in project design.
3) **Economic condition change:** Economic condition is one of many factors that affect construction projects. Changes in economic conditions during construction projects lead to CCO to decrease project costs.
4) **Socio-cultural factor:** Inadequate coordination between professionals who have different socio-cultural backgrounds can lead to a Contract Change Order (CCO), and changes may needed for the project team.
5) **Unexpected problems:** Unexpected problems are often faced by professionals in the construction industry. This condition, if not solved, can lead to a Contract Change Order for the project.

Contract Change Order (CCO) has a significant effect if not well anticipated, such as construction cost rise, late completion of work, productivity decline, dispute between contractor and owner, et cetera. Sun & Meng (2009) divided the effect of CCO into five groups, they are:

1) **In relation to time.**

Late completion of work, late logistic arrival, late procurement requirements and materials, rework, demolition, and Re-plan.

2) **In relation to cost.**

Additional cost, overhead cost addition, compensation fund, cash flow changes, profit loss, and additional contractor payments.

3) **In relation to productivity.**

Work productivity decline of human resources and equipment, project schedule compression.

4) **In relation to risk.**

Increased project risk level, hampered project development, decreased project acceleration opportunity, obstacles on site and every work stage

5) **Other relation.**

Low professional relationships, disputes and claims, low quality of work, bad reputation, and bad safety condition

Lela (2022) conducted an Analysis of the cause and effect of a Contract Change Order on the contractor performance in a construction project in South Minahasa Regency. The results show that the dominant factor of cause and effect in the CCO of a construction project in South Minahasa Regency is the addition and subtraction of work factors. However, those factors do not affect the contractor's performance.

Palilati et al. (2022) conducted a study of the factors that cause variation order in building projects in Gorontalo Province, which are Pulubala 1 High School (a physics laboratory) and North Gorontalo 5 High School (three new classrooms). The analysis result, based on descriptive statistics analysis of seventeen variables, the dominant factor is a design change, which is a planning and volume estimation mistake. Based on descriptive statistic analysis with five influence variables, the dominant factor is changing the work execution method.

Rohana (2018) conducted a study of analysis of factors that cause CO in the project of inspection road **improvement.** This study used eleven (11) indicator questions they are: problems in the project location, design change, site condition, cost problem, the contractor's problem, safety and security, work technique change, project documentation mistake, project owner problem, supervising consultant, and regulation change. This study is conducted using a mixed method by distributing a questionnaire to 50 respondents. This study uses descriptive statistic analysis.

Many government construction projects in Banyumas Regency are also experiencing CCO, both big-scale and small-scale projects. An analysis is conducted to investigate the cause and the effect of CO in construction execution in Banyumas Regency to anticipate and minimize CCO.

The difference from the previous analysis lies in the indicators or variables used. In this study, two variables were used: causal variable and influence variable. Ten (10) indicators that were adapted to causal variables are:

1) Problems in project location.
2) Design mistakes
3) Physical condition on site.
4) Project cost problem.
5) Contractor's problem.
6) Security and Safety Obstacles.
7) Changes in scope of work.
8) Project owner policy.
9) Supervising consultant problem.
10) Changes in policies and regulations.

For influence variables there are three of them, they are quality, cost, and time.

2. MATERIAL AND METHOD

Study location is the study object where the study is carried out. Determining the study location is aimed at simplifying or clarifying the location that became the target of the study. The reason for choosing Banyumas Regency as the study location is that a study about the cause and effect of CCO has never been done in Banyumas Regency. Moreover, nowadays, there are many construction projects in Banyumas Regency.

This study uses both qualitative and quantitative data (Mix Methode). This study started from a case study that generated qualitative data input using a questionnaire. The qualitative data was then processed to become quantitative data using Structural Equation Methode (SEM) to find the cause and the effect of CCO on construction projects in the Banyumas Regency.

The sampling method used in the study is nonprobability, which is convenience sampling. Sample collection by convenience sampling is sample collection by freely choosing the sample according to the researcher's will. This method is chosen to simplify the study process because there are a lot of construction service providers available. The convenience sampling method is picked based on the availability of the resources and is easy to get.

This study collected data from a questionnaire and processed it using the SEM method, considering population size, limited time, and cost, and applied it to 30 contractors who had worked on a building project in Banyumas Regency.

The data in this study is in the form of primary and secondary data. Primary data is first-hand data obtained by the researcher related to the variable of interest and specifically aimed for the study. Primary data in this study used a questionnaire to find the respondent's opinions on the cause and effect of CCO on construction projects. In this questionnaire, respondent opinion is stated by the Likert scale. Secondary data is data that indirectly gives information to the researcher, such as literature, journals, and books related to the study.

The data was collected to investigate the cause and effect of CCO on construction projects in the Banyumas Regency. In this study, a questionnaire was made and distributed to 30 respondents who were contractors who had worked on a construction project in Banyumas Regency. The questionnaire consists of several questions, and respondents must choose one of the available answer choices by the measurement scale of this study. This study uses five (5) points Likert Scale.

Variables in this study consist of one exogenous latent variable (the cause of CCO and one endogenous latent variable (the effect of CCO) obtained from the previous study about the cause factors of CCO with the title of Analysis of the Cause Factors of Change Order on the Project on Inspection Road Improvement Novia et al. (2018).

The next is determining the variables of the study. Each latent variable is measured with indicators, as seen in Table 1.

Table 1

Table 1 Variables of Study	
The causes of CCO (η)	
X1	Problems in project location
X2	Design mistakes
X3	Physical condition on site
X4	Project Cost Problem
X5	Contractor's problem
X6	Security and safety obstacles
X7	Changes in Scope of Work
X8	Project Owner's policy
X9	Supervising consultant problem
X10	Changes in policy or regulation
The effects of CCO (ξ)	
Y1	Quality
Y2	Cost
Y3	Time

The questionnaires were directly distributed to the respondents, and the questions were divided into two parts. Part A consists of individual data, they are name, work position, and company name. Part B consists of questions and the collection of the data that will be used as a reference in data processing. The questions are about the factors that caused CCO and the effect of CCO on construction projects in Banyumas Regency with frequency levels of Never to Very Often.

The analysis stages that were carried out to achieve the purpose of the study are as follows:

1) Data collection through questionnaires.
2) Validity and reliability test of the questionnaire data.

- Validity is a precision degree that accurately measures what will be measured Hair et al. (2010). The validity measurement method used is product correlation of rough moment or Pearson correlation.
- Reliability is an index that shows a variable or a set of consistent variables in a measurement so that if the measurement is carried out multiple times, the value is consistent Hair et al. (2010).

3) Testing the assumption of a normal multivariate distribution. If there is an unfulfilled assumption (one of them is the assumption of normal multivariate), an alternative method will be used, one of them is SEM-PLS.
4) Carried out an analysis using the SEM-PLS method.
5) Concluding.

3. RESULT AND DISCUSSION

In this study, 30 respondents were used as a sample of service providers. In this case, the contractors who had worked on construction projects in Banyumas Regency. To obtain a valid and consistent answers from the respondents, a test of validity and reliability is carried out on each indicator. In this test, a critical correlation coefficient is obtained from the r distribution table that uses a 5% signification rate so that the r table = 0,361.

The following Table 2 is a questionnaire result table.

Table 2

Table 2 Questionnaire Results

Variable	Question	Indicator	> 10 Times	6 - 10 Times	2 - 5 Times	< 2 Times	0 Times
			1	2	3	4	5
	Problems in project location	X1	3	4	13	8	2
	Design mistakes	X2	2	3	16	7	2
	Physical condition on site	X3	4	4	14	4	4
	Project Cost Problem	X4	2	3	9	10	6
X	Contractor's problem	X5	2	3	7	7	11
	Security and safety obstacles	X6	2	3	6	9	10
	Changes in Scope of Work	X7	1	5	6	15	3
	Project Owner's policy	X8	3	4	11	9	3
	Supervising consultant problem	X9	5	1	14	5	5
	Changes in policy or regulation	X10	3	3	10	8	6
Y	Quality	Y1	0	5	7	10	8
	Cost	Y2	1	4	12	12	1
	Time	Y3	0	6	15	7	2

With the help of a computer program, namely SPSS Statistic 26, the following are the results of the indicators validity and reliability test of the study variables as presented in Table 3:

Table 3

Table 3 Questionnaire Validity Test

Number	Question	Corrected item - Total Correlation	r table	Note
	The Cause of CCO (X)			
1	Problems in project location	0.862	0.361	Valid
2	Design mistakes	0.521	0.361	Valid
3	Physical condition on site	0.67	0.361	Valid
4	Project cost problem	0.778	0.361	Valid
5	Contractor's problem	0.798	0.361	Valid
6	Security and safety obstacles	0.891	0.361	Valid
7	Changes in scope of work	0.791	0.361	Valid
8	Project owner's policy	0.871	0.361	Valid
9	Supervising consultant problem	0.821	0.361	Valid
10	Changes in policy or regulation	0.803	0.361	Valid
	The Effect of CCO (Y)			
11	Quality	0.820	0.361	Valid
12	Cost	0.868	0.361	Valid
13	Time	0.745	0.361	Valid

If the value of $r$calculated> $r$table, then the question is valid. $r$calculated can be seen in *the corrected item-total correlation* column.

From Table 3, it can be concluded that all the indicators are valid, the value of $r$calculated > 0,361 or $r$table and can be used for further analysis.

Furthermore, a test of reliability was carried out to find out how far the level of consistency of each respondent's questionnaire result.

Table 4

Table 4 Questionnaire Reability Test

Variable	*Cronbach's Alpha*
X	0,930
Y	0,734

Table 4 shows the result of the questionnaire reliability test is valid. The result of the X instrument (the Causes of CCO) reliability is 0,930, and the result of the Y instrument (the Effects of CCO) is 0,734. On the other hand, *Cronbach's Alpha* value of the two variables are above 0,7, so those variables meets the requirements.

Before an analysis of the Respondent's Level of Achievement is carried out, a calculation of the number of respondents for each item's score was done to find out the respondent's perception of the indicators. The application of SPSS 26 was used to help with the calculation.

The loading factor is the number that shows a correlation between a question's score and the Konstrak indicator's score. Loading factor value over 0,7 is considered valid. However, according to Hair (1998), a loading factor value of approximately 0.3 is considered to have met the minimum level, and greater than 0.5 is considered significant.

The results of the Loading Factor value are presented in Table 5.

Table 5

Table 5 Loading Factor Value

Variable	Indicator	*Outer Loading*
The Causes of CCO	X1	0.855
	X2	0.514
	X3	0.646
	X4	0.776
	X5	0.805
	X6	0.908
	X7	0.810
	X8	0.866
	X9	0.809
	X10	0.811
The Effects of CCO	Y1	1.000
	Y2	1.000
	Y3	1.000

Table 5 show that the the indicators of each variable is > 0,5. So, it can be stated that they are valid.

After processing the data using SmartPLS 3.0, the results of cross-loading are shown in the following Table 6.

Table 6

Table 6 Cross-Loading Results

	The Cause (X)	Quality (Y1)	Cost (Y2)	Time (Y3)
X1	0,855	0,393	0,336	0,184
X2	0,514	0,425	0,101	0,191
X3	0,646	0,473	0,279	0,141
X4	0,776	0,589	0,446	0,127
X5	0,805	0,639	0,489	0,110
X6	0,908	0,654	0,562	0,381
X7	0,810	0,460	0,344	0,397
X8	0,866	0,866	0,315	0,302
X9	0,809	0,809	0,315	0,308
X10	0,811	0,679	0,524	0,209
Y1	0,679	1,000	0,579	0,333
Y2	0,679	0,579	1,000	0,556
Y3	0,309	0,333	0,556	1,000

Table 6 show the correlation value of the construct with its indicators is higher than the correlation value with another construct. Therefore, all constructs or latent variables already have good discriminant validity where the indicators within the construct block are better than the indicators of another block. The cross-loading value of each construct was evaluated to make sure that the construct correlation with the measurement item was the highest among the other construct. The expected cross-loading value is over 0,7 Ghozali & Latan (2015).

Table 6 shows the construct correlation values of X1 to X10 indicators are higher than Y1, Y2, and Y3 indicators, the correlation value of Y1 is higher than X, Y2, and Y3, the correlation value of Y2 is higher than X, Y1, and Y3, and the correlation value of Y3 is higher than X, Y1, and Y2.

The recommended result is that the AVE root value must be higher than the correlation between construct value (Yamin and Kurniawan, 2011). In this study, the AVE value and AVE square root of each construct are shown in Table 7 as follows:

Table 7

Table 7 AVE Value and AVE Square Root	
Average Variance Extracted (AVE)	
The Cause (X)	0,621
Quality (Y1)	1,000
Cost (Y2)	1,000
Time (Y3)	1,000

According to Table 7, all constructs show an AVE value higher than 0,50. The lowest value is 0,621, which is the value variable of the cause of CCO (X). That value has met the requirement of a minimum AVE value of 0,50.

The results of the correlation between constructs with AVE quarter root value are presented in Table 8 below:

Table 8

Table 8 Correlation Value Between Construct with AVE Quarter Root Value

	Cost(Y2)	Quality(Y1)	The Cause(X)	Time(Y3)
Cost (Y2)	1,000			
Quality (Y1)	0,579	1,000		
The Cause (X)	0,496	0,679	0.788	
Time (Y3)	0,556	0,333	0,309	1,000

Table 8 shows that the AVE quarter root value of each construct is higher than its correlation value, so the construct in this study can be said to have good discriminant validity.

According to Hair et al. (2014), the composite reliability coefficient must be higher than 0,7. The output result of SmartPLS for composite reliability are shown in Table 9.

Table 9

Table 9 Composite Reability (CR) Value of Each Variable

	Composite Reability
Cost (Y2)	1,000
Quality (Y1)	1,000
The Cause (X)	0,941
Time (Y3)	1,000

Table 9 shows the composite reliability value is higher than 0,7. This shows that all the indicators used to measure latent variables are reliable.

All indicators have been tested on the outer model, and the results are that all indicators fulfill the validity and reliability requirements. So, the next step is to analyze the inner model.

The measurements that can be used to evaluate the structural model (inner model) are R2. The criteria for R Square values of 0.67, 0.33, and 0.19 as strong, moderate, and weak Chin (1998) in Ghozali & Latan (2015).

Variant Analysis (R2) or Determination Test is shown in Table 10.

Table 10

Table 10 R - Square

	R Square	R Square Adjusted
Quality (Y1)	0,461	0,442
Cost (Y2)	0,246	0,219
Time (Y3)	0,095	0,063

Based on above Table 10, the R Square value of effects together or the simultaneous indicators of X against Y1, Y2, and Y3 are as follows:

1) R Square value X against Y1 is 0,461 with an adjusted r square value of 0,442 (moderate). Therefore, the effect of all exogenous constructs on Y is considered moderate.
2) R Square value X against Y2 is 0,246 with an adjusted r square value of 0,219 is considered weak.
3) R Square value X against Y3 is 0,095 with an adjusted r square value of 0,063 is considered weak.

Figure 1

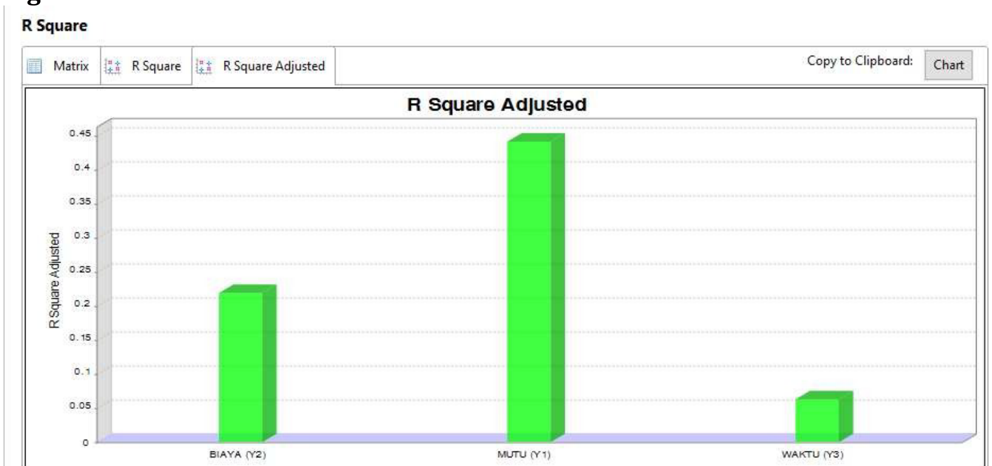

Figure 1 R square Graphic

Figure 1 shows the R square value with green color, so that model is good enough to explain the variables of the study.

Apart from looking at the large R Square value, where the Q2 value is between the value range 0 to 1, so it can be said that the model is appropriate.

4. CONCLUSION AND RECOMMENDATION

From the results of this study, it can be stated that of the ten (10) factors that caused CCO and three (3) factors that affect CCO, all are valid and reliable. The ten (10) factors that cause CCO can be sorted from the most dominant based on descriptive analysis as follows:

1) Contractor's problem
2) Security and safety obstacles
3) Project cost problem
4) Changes in scope of work
5) Changes in policy or regulation
6) Project owner's policy
7) Design mistakes
8) Supervising consultant problem
9) Problems in project location
10) Physical condition on site

The results of SEMPLS analysis of three (3) factors that affect CCO: quality, cost, and time are as follows :

1) The effect of quality, from the said ten (10) factors, the most influential is changes in policy or regulation.
2) The effect of cost, from the said ten (10) factors, the most influential is security and safety obstacles.
3) The effect of time, from the said ten (10) factors, the most influential is project owner's policy.

From the study result, it can also be stated that the structure model of the study is pretty good. This can be seen from the value of Q2 = 0,632 > 0, which means the model has predictive relevance where the closer it is to 1, the better the model.

By using the SEM-PLS method, this study shows that the factors that cause CCO have a significant effect on the effect variables of a CCO and provides an overview of the factors that cause and affect the existence of a Contract Change Order in the Banyumas Regency. Therefore, it is recommended that service providers improve their quality so that they can minimize CCO on other construction projects so that project work can run more effectively, both in terms of time and costs.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

Chin, W.W. (1998). The Partial Least Squares Approach for Structural Equation Modelling. Modern Method for Business Research. London: Lawrence Erlbaum Associates, 295-236.

Fisk, E., & Reynold, W. (2006). Contruction Project Administration (8th Ed.). New Jersey, Pentice Hall Inc.

Ghozali, I. (2012). Aplikasi Analisis Multivariate dengan Program IBM SPSS. Yogyakarta: Universitas Diponegoro.

Ghozali, I. (2016). Aplikasi Analisis Multivariate dengan Program IBM SPSS Semarang: Undip.

Ghozali, I., & Latan, H. K. (2015). Teknik dan Aplikasi Menggunakan Program SmartPLS 3.0. Semarang: Undip.

Hair, J. F. (1998). Multivariate Data Analysis (5th Ed.). Prentice Hall, Upper Saddle River: New Jersey.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate Data Analysis (7th Ed.). New York: Prentice Hall.

Hair, J. F., Hult, G. T., Ringle, C. M., & Sarstedt, M. (2014). A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). United States of America: SAGE Publication, Inc.

Lela, J. C. (2022). Analisis Penyebab Dan Pengaruh Contract Change Order Terhadap Kinerja Kontraktor Pada Proyek Konstruksi Di Kabupaten Minahasa Selatan. Jurnal Ilmiah Media Engineering, 12(1), 21-24.

Palilati, P. M., Hadi, A. K., & Musa, R. (2022). Analisis Faktor-Faktor Penyebab adanya Variant Order pada Proyek Geduung Pendidikan di Provinsi Gorontalo. Jurnal Konstruksi Makasar, 1(6).

Perwitasari, D., Rahadianto, D., & Parapat, N. (2020). Identifikasi Dampak Contract Change Order Terhadap Biaya dan Kualitas Pada Proyek Gedung Laboratorium Teknik 2 Institut Teknologi Sumatra, 1-8.

Putra, H. E., & Sulistio, H. (2020). Pengaruh Change Order Terhadap Biaya, Mutu, Dan Waktu Pada Proyek Konstruksi Gedung Bertingkat. JMTS: Jurnal Mitra Teknik Sipil, 3(4), 1349. https://doi.org/10.24912/jmts.v3i4.8233

Rohana, N. S. (2018). Analisa Faktor-Faktor Penyebab Change Order Pada Proyek Peningkatan Jalan Inspeksi. Jurnal Rab Construction Research. Universitas Internasional Batam, 3(2).

Sugiyono (2011). Metode Penelitian Kuantitatif, Kualitatif dan R&D. Bandung: Alfabeta.

Sugiyono (2012). Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.

Sugiyono (2014). Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.

Sugiyono (2015). Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.

Sugiyono (2019). Statistika untuk Penelitian. Bandung: CV Alfabeta.

Sun, M., & Meng, X. (2009). Taxonomy for Change Causes and Effects in Construction Projects. International Journal of Project Management, 27(6), 560-572. https://doi.org/10.1016/j.ijproman.2008.10.005