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# Analysis of Importance Level of Change Order for Road Construction Projects (from the owner's point of view)

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**Abstract.** Contract Change Order / Addendum is a formal document signed by the owner and contractor to compensate the contractor for losses due to changes, additional work, delays, or other activities with the approval of the owner and contractor as stated in the terms of the contract document. (Philander and Mega, 2020). The research objective was to determine the level of importance based on the calculation of RII on the causes of change orders in road construction projects. The research was obtained by distributing questionnaires and the respondents who returned were 32 respondents from the owner's point of view. The results of calculations based on RII based on the highest level of importance, namely high, good and acceptable, are (1) Mismatch between design drawings and field conditions (2) Contractor delays and (3) Field Security Considerations.

**Keywords:** RII calculation, change order, and owner

## INTRODUCTION

Lee (2008) examined 161 completed transportation projects. The study results yield indications at 95% and 100% for road and rail projects which significantly show the maximum cost inflated by 50%. The key causes of increased costs were found to be changes in scope, delays during construction, unreasonable estimates, adjustment of project costs and no use of system management earned value. Change orders caused costs to cause contract items to swell, planning errors and omissions as well as changes. the scope that can be reduced by refining the final results of planning (Taylor et al., 2012).

Change orders for construction projects or building maintenance for new ones occur for various reasons, such as unforeseen conditions, errors in estimates or designs, and changes in owner-owner requirements (Shrestha et al. 2013). Most studies have identified CO at the project level and have studied the common causes for CO, and its effect on cost and schedule performance (Randa et al. 2009; Alnuaimi et al. 2010; Serag et al. 2010; Mahamid et al. 2012; Halwatura and Ranasinghe 2013; Shrestha et al. 2017; Shrestha and Zeleke 2018; Shrestha and Maharjan 2018; Shrestha et al. 2018). Therefore, it is very important to reduce CO in construction projects so that projects can be completed on time and within budget.

As an example of one of the change order calculations, namely the Calculation of change orders (Filemon and Waty, 2020). Change Order calculations are split between 2 rigid pavement projects. In these 2 projects there are 34 added jobs, 29 less jobs, 9 work items removed and 1 new job addition based on the project contract addendum. (Filemon dan Waty, 2020)

Pearson's correlation analysis in the research of Filemon and Waty, 2020 can be concluded as follows: Project 1 has a relationship between the amount of added work due to change orders to work weight with a confidence level of 99% and less work due to change orders to the weight of work change orders with a level of confidence. 5% and project 2 have a relationship between the amount of added work and less work due to change orders on work weight with a 99% confidence

To solve the problem Change order can be minimized and anticipated by knowing the factors that cause it first. The factors causing the Change Order / contract addendum vary widely, not the same from one project to another (Philander and Mega, 2020).

Researchers have conducted research on the causes of change orders based on the consultant's point of view and currently on the owner's side. There are 32 questionnaires that have been returned. The results have been validated and a reliability test has been carried out for the cause of change orders. After that, the RII calculation is carried out to determine the ranking of the causes of change orders. After knowing the change order ranking, the researcher wants to know the level of importance of the RII calculation results. The focus of the current research objective is to determine the level of importance of the RII calculation for road construction

## METODOLOGY

The object of research regarding change orders was carried out in Banten Province and the Special Capital Region of Jakarta and West Java Province, taking the location of road construction projects.

Government road construction projects are generally divided into two, namely:

1. A road improvement project means an old road already exists, where maybe the road is no longer asphalted, or there is no surface layer, and can be a road that needs periodic maintenance (preservation roads).
2. Road construction is the construction of new roads.

### Distribution of Questionnaires

Distributed questionnaires are factors that cause change orders in road construction from Hsieh et al. (2004), Gilbreath (1992), Finke (1998), Soeharto (1995), Barry and Paulson (1992) which are summarized as causative factors in this study, which in Waty's book, 2013 are: (1) Construction needs, (2) administrative needs, and (3) Parties involved.

#### *Data Processing*

In the data processing process, the data that has been collected is then processed and recorded in table form in excel. To measure the accuracy of the data, the reliability and validity of the questionnaire data were tested. As well as the Relative Importance Index (RII) method as a Ranking technique for each statement and comparing the responses received from the respondent.

Data processing focuses on the results of RII calculations based on the level of importance and reliability data. The analysis of the importance of the RII calculation can be seen in Table 1 and Table 2 based on the calculation of Chicetti, 1994.

**Table 1** Level of Importance RII assessment (Source: Kometa et al, 1994)

RII Assessment	Level of Importance
0,0 – 0,2	Very low
0,2 – 0,4	Low
0,4 – 0,6	Medium
0,6 – 0,8	High
0,8 – 1,0	Most High

#### RII Assessment Factor based on Chicetti, 1994

**Table 2.** RII's assessment based on Chicetti, 1994

RII Assesment	Realibility Data
0,0 – 0,4	Very Low
0,4-0,6	Enough
0,6-0,75	Good
0,75 – 1	Excellent

In the research of Shresta and Shresta, 2019 states research on the causes and prevention of change orders in road maintenance projects using the Chiceti method, 1994 and Graham et al., 2012, so that the assessment using this method is used in the author's current research.

## DISCUSSION AND ANALYSIS

The 50 factors that caused road construction projects that had been distributed through questionnaires received returns as many as 32 respondents. After testing, both the validity and the reliability tests resulted in 48 causes of road construction projects

Based on the calculation of RII, the following results are obtained as in Table 3

**Table 3. Overall RII Calculation Results (Ranking of Causes of Change Orders)**

Number	The Cause of the Change Order	RII	Ranking
•	<b>CONSTRUCTION NEEDS</b>		
A	<b>PLANNING AND DESIGN</b>		
1	Errors in construction planning	0.57	7
2	Errors and omissions in determining the volume	0.56	8
3	Mismatch between design drawings and field conditions	0.64	1
4	Incomplete engineering design specifications or criteria	0.56	8
5	Reduction of scope of work	0.51	12
6	Temporary work stoppage	0.50	13
7	Contradictory contracts	0.53	11
8	Scheduling too overlapping	0.47	16
9	Delay in design/ equipment approval from owner	0.49	14
10	Schedule repair orders	0.56	8
11	Schedule acceleration command	0.59	5
12	Incomplete contract	0.59	5
B	<b>UNDER GROUND CONDITIONS</b>		
13	Incomplete field ground investigations/tests	0.53	11
14	Underground upgrades and investigations	0.55	9
15	Different underground conditions on the results of the investigation	0.51	12
16	Underground seepage from excavation	0.53	11
C	<b>SAFETY CONSIDERATIONS</b>		
17	Work safety consideration	0.54	9
18	Field safety considerations	0.60	3
19	Additional security facilities	0.55	7
D	<b>NATURAL FACTORS</b>		
20	Flood	0.54	9
21	Landslide	0.53	10
22	Land subsidence	0.53	10
23	Unusual weather	0.53	10

●	<b>ADMINISTRATIVE NEEDS CHANGES</b>		
A.	<b>TO THE RULES OF WORK</b>		
1	Changes from city planning regulation	0.43	17
2	Change based on environmental protection	0.47	15
B.	<b>CHANGES FROM THE AUTHORITIES</b>		
3	Differences in views between government officials	0.46	16
4	Change in the initial placement of facilities and infrastructure	0.47	15
5	Market changes	0.48	14
6	Domination of superior / leader authority	0.46	16
C.	<b>COMMISSIONING</b>		
7	Additional needs for care/maintenance	0.5	12
8	Add to the need for the use of related projects	0.53	10
9	Additional needs for future safety considerations	0.54	9
D	<b>APPLICATION FOR THE SURROUNDING ENVIRONMENT</b>		
10	Additional facilities for residents	0.53	10
11	Reduce/ delay the construction part due to problems	0.46	16
12	Request from officials / local government (CSR)	0.49	13
E	<b>OTHER CHANGES</b>		
13	Coordination delivered late	0.5	12
14	Needs from other institution	0.48	14
15	Conflict contract and disputes	0.53	10
●	<b>PARTIES INVOLVED</b>		
A.	<b>THE OWNER</b>		
1	Lack of control	0.49	13
2	Incompetence of Owner	0.46	16
3	Late owner	0.46	16
B.	<b>CONTRACTOR</b>		
4	Lack of Work	0.59	4
5	Inadequate Tools	0.58	5
6	Failure of the contractor's ability	0.54	9
7	Labor Disputes	0.53	10
8	Contractor Delay	0.62	2
C.	<b>OTHER PARTIES</b>		
9	The incapacity of Third Party	0.55	8
10	Third Party interference	0.54	9

### RII Calculation Results Based on the Overall Rating

The results of the RII calculation which are used as the main cause of the owner respondent results are:

1. Incompatibility between design drawings and field conditions
2. Contractor delays
3. Field Security Considerations

**The results of RII calculations based on the rankings of the causes of road construction project change orders per group are:**

The biggest factor causing the biggest Change Order for each category per group

- a. Planning and Design
  - Mismatch between design drawings and field conditions
- b. Under Ground Conditions
  - Underground upgrades and investigations
- c. Safety Considerations
  - Field safety considerations
- d. Natural Factors
  - Flood
- e. Change To The Rules of Work
  - Change based on environmental protection
- f. Changes from the authorities
  - Market changes
- g. Commissioning
  - Additional needs for future safety considerations
- h. Application for the surrounding Environment
  - Additional facilities for residents
- i. Other Changes
  - Conflict contract and disputes
- j. Owner
  - Lack of control
- k. Contractor
  - Contractor Delay
- l. Other parties
  - Third Party interference

**Analysis of the Causes of Change orders Based on the Level of Importance (Kometa et al, 1994)**

The analysis of the results of interest can be seen which states that there are 3 calculation results with a high level of importance, namely at the value of 0.64 on the indicator of the mismatch between the design drawing and the field situation, with a high level of importance. The second highest is the indicator item for contractor delay with a value of 0.62 also with a high level of importance as seen in Table 4.99. The third highest with a value of 0.6 on the indicator of field safety considerations with a moderate level of importance and can be seen in Table 4.

**Table 4. RII Assessment for Level of Importance**

Number	The Cause of Change Order	RII	Level of Importance
●	<b>CONSTRUCTION NEEDS</b>		
A.	<b>PLANNING AND DESIGN</b>		
1	Errors in construction planning	0.57	Medium
2	Errors and omissions in determining the volume	0.56	Medium
3	Mismatch between design drawings and field conditions	0.64	High
4	Incomplete engineering design specifications or criteria	0.56	Medium
5	Reduction of scope of work	0.51	Medium
6	Temporary work stoppage	0,5	Medium
7	Contradictory contracts	0.53	Medium

8	Scheduling too overlapping	0.47	Medium
9	Delay in design/ equipment approval from owner	0.49	Medium
10	Schedule repair orders	0.56	Medium
11	Schedule acceleration command	0,59	Medium
12	Incomplete Contract	0,53	Medium
<b>B</b>	<b>UNDER GROUND CONDITIONS</b>		
13	Incomplete field ground investigations/tests	0.53	Medium
14	Underground upgrades and investigations	0.55	Medium
15	Different underground conditions on the results of the investigation	0.51	Medium
16	Underground seepage from excavation	0.53	Medium
<b>C</b>	<b>SAFETY CON</b>		
Table 4. Continued			
17	Work safety consideration	0.54	Medium
18	Field safety considerations	0.60	Medium
19	Additional security facilities	0.55	Medium
<b>D</b>	<b>NATURAL FACTORS</b>		
21	Landslide	0.53	Medium
22	Land subsidence	0.53	Medium
23	Unusual weather	0.53	Medium
•	<b>ADMINISTRATIVE NEEDS</b>		
<b>A.</b>	<b>CHANGES TO THE RULES OF WORK</b>		
1	Changes from city planning regulation	0.43	Medium
2	Change based on environmental protection	0.47	Medium
<b>B.</b>	<b>CHANGES FROM THE AUTHORITIES</b>		
3	Differences in views between government officials	0.46	Medium
4	Change in the initial placement of facilities and infrastructure	0.47	Medium
5	Market changes	0.48	Medium
6	Domination of superior / leader authority	0.46	Medium
<b>C.</b>	<b>COMMISSIONING</b>		
7	Additional needs for care/maintenance	0.5	Medium
8	Add to the need for the use of related projects	0.53	Medium
9	Additional needs for future safety considerations	0.54	Medium
<b>D</b>	<b>APPLICATION FOR THE SURROUNDING ENVIRONMENT</b>		
10	Additional facilities for residents	0.53	Medium
11	Reduce/ delay the construction part due to problems	0.46	Medium
12	Request from officials / local government (CSR)	0.49	Medium
<b>E</b>	<b>OTHER CHANGES</b>		
13	Coordination delivered late	0.5	Medium
14	Needs from other institution	0.48	Medium
15	Conflict contract and disputes	0.53	Medium
*	<b>PARTIES INVOLVED</b>		
<b>A.</b>	<b>THE OWNER</b>		

1	Lack of control	0.49	Medium
2	Incompetence of Owner	0.46	Medium
3	Late owner	0.46	Medium
<b>B.</b>	<b>CONTRACTOR</b>		
4	Lack of Work	0.59	Medium
5	Inadequate Tools	0.58	Medium
6	Failure of the contractor's ability	0.54	Medium
7	Labor Disputes	0.53	Medium
8	Contractor Delay	0.62	High
<b>C.</b>	<b>OTHER PARTIES</b>		
9	The incapacity of Third Party	0.55	Medium
10	Third Party interference	0.54	Medium

### Analysis of the Causes of Change Orders based on Chicetti, 1994

Based on Chicetti, 1994 explains that the results of the calculation of RII from a value of 0.6 to 0.74 indicate that the research results are good (good) so that three indicators are set that cause the biggest change order of road construction projects, namely:

1. Incompatibility between design drawings and field conditions (RII = 0.64)
2. Contractor delays (RII = 0.62)
3. Field safety considerations (RII = 0.6)

### Analysis Based on Graham et al., 2012

Based on Graham et al., 2012, it is explained that the value of the RII calculation from a value of 0.8 to 0.9 is highly recommended, but for the RII calculation value from a value of 0.6 to 0.7 is still acceptable and in this study three indicators are produced. the biggest namely:

1. Incompatibility between design drawings and field conditions (RII = 0.64)
2. Contractor delays (RII = 0.62)
3. Field safety considerations (RII = 0.6)

The analysis of the three RII calculations based on the three calculations are:

1. Incompability between design drawings and field conditions

This is because the consultant does not get enough time (Waty and Sulistio, 2020) resulting in inappropriate design drawings and field conditions, especially when the implementation is carried out, it has a long interval from planning so that the field conditions have changed. There are also many consultants who have low competence who have not been able to handle project problems, resulting in a mismatch between the design drawings and the field conditions.

2. Contractor's Delay

Contractor delays are caused by contractors having to pay additional costs so that they spend a lot of working capital (Waty and Sulistio, 2020) which causes contractor delays when completing road construction project work.

3. Field Security Considerations

Field security considerations need to be considered because security in the field is an important factor because in the project field, which is especially far from the crowd or from people's homes, it is very easy for theft and loss of large items if not guarded and cared for carefully.

### CONCLUSION

Analysis of the causes of change orders for road construction projects are:

- Mismatch between design drawings and field conditions  
This is because the consultant does not get enough time (Waty and Sulistio, 2020) resulting in inappropriate design drawings and field conditions, especially when the implementation is carried out has a long time interval from planning so that the field conditions have changed.



Many consultants also have low competence who have not been able to handle project problems, resulting in a mismatch between the design drawings and the field conditions.

- Contractor Delay  
The delay in the contractor is caused by the contractor having to pay additional costs so that they spend a lot of working capital (Waty and Sulistio, 2020) which causes the contractor to be late when completing road construction project work.
- Field Safety Considerations  
Field security considerations need to be considered because security in the field is an important factor because in the project field, which is especially far from the crowd or from people's homes, it is very easy for theft and loss of large items if not guarded and cared for carefully.

## SUGGESTION

Based on the analysis that has been done, suggestions are shown to reduce the occurrence of change orders, including by:

1. Monitoring of pictures and field conditions periodically before the implementation begins
2. The executing contractor pays more attention to all the provisions as a road construction project implementer
3. Pay more attention to field safety factors

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