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CALCULATION OF CHANGE ORDER FOR ROAD PROJECTS IN JAKARTA

Mega Waty *, Hendrik Sulistio

Civil Engineering Department, Faculty of Engineering,
Universitas Tarumanagara

*mega@ft.untar.ac.id

Abstract. Change order is a written agreement to modify, add or provide alternatives to the work that has been arranged in the contract document between the owner and contractor, where the change can be considered to be within the scope of the original / original project, in other words this is a modification contract required. This study aims to obtain a large percentage of change orders both added work and underemployed work and get the largest change order in the form of changes in public works and added work and underworked on road projects in Jakarta. From the 10 projects studied, the results obtained include: The largest average percentage (COR) of Road Projects in Jakarta is: Hot Asphalt Mixture (44, 72%), average percentage (CORS) of road projects in Jakarta is: Medium quality concrete f ' c 20 MPa for roads 54.9231%, (CORA) road projects in Jakarta is: Laston Lapis Antara (AC-BC Mod) (Asbuton) 21.55%

1. Introduction

Change Orders cause costs to cause contract items to swell, planning errors and omissions as well as changes in scope which can be reduced by sharpening the final results of planning. (Taylor et al., 2012). Lee (2008) examined 161 completed transportation projects. The results of the study produce indications at 95% and 100% for road projects and railroad projects which significantly indicate a maximum cost of swelling of 50%. The key causes of cost overruns found were changes in scope, delays during construction, unwarranted estimates, adjustments to project costs and no use of earned value management systems. Hanna et al, (2002) state that the varied causes of a project with the highest probability are its impact and significant loss of productivity. They calculated the lost productivity of 54.8% of a project with various impacts.

2. Definition and purpose of the change order

Change order is a written agreement to modify, add or provide alternatives to the work that has been arranged in the contract document between the owner and contractor, where the change can be considered to be within the scope of the original / original project, in other words this is a modification contract required (Fisk, 2010). According to Fisk (2010) change order is a work order to confirm the revisions of the plan, and the amount of compensation costs to the contractor that occurred during the



construction, after the signing of the contract between the owner and the contractor. Understanding change order according to the Directorate General of Highways (1999), the Department of Public Works is an additional / less work to adjust the volume of the field or schedule changes without changing the provisions of the contract. According to Barrie and Paulson (1992), change orders are formal documents signed by the owner and contractor to compensate the contractor for losses due to changes, additions to work, delays or other activities with the agreement of the owner and contractor as stated in the terms of the contract document.

3. Road projects

The road project is one of the priority infrastructure projects in the Special Capital Province of Jakarta because it is the State capital, it is of course very necessary to pay attention to the infrastructure that continues to be built and also as a barometer of development in Indonesia.

4. Research objectives

This study aims to get a large percentage of change orders both added work and less work and get the largest change order in the form of changes in public work and added work and less work.

5. Research methods

This research was conducted using real data by asking the owner of the project owner to the relevant agency namely the Technical Justification data or commonly called the Contract Addendum. Getting real data is not easy because getting data that is very difficult to get out is usually stored even archived in secret. Even have to convince the parties that we keep the data kept confidential. In addition to the data, question and answer interviews were also conducted with trusted parties. Real data, namely contract addendum data held by the implementing contractor.

Calculation of percentage change order is done by 4 calculations namely COR (Change Order Ratio), Change Order Ratio in Addition (CORA), Change Order in Substraction (CORS) (Hsieh et al., 2004)

1. Change Order Ratio (COR)

This index measures the ratio of the total cost of variance to projects where change orders occur:

$$\text{COR} = (\text{Amount of value added and less change order for a project} / \text{contract price of original project}) \times 100\%$$

The COR calculation is in the form of the total COR of the project and the COR per each project and the average COR of the work of the project as well as the CORA and CORS.

2. CORA calculations

This index measures the ratio of the total added cost of a project to change order

$$\text{CORA} = (\text{Amount of value added work order change} / \text{project original contract price}) \times 100\%$$

3. CORS Calculations

This index measures the cost of less than a project's work in which a change order occurs:

$$\text{CORS} = (\text{Amount of work order less change value} / \text{project original contract price}) \times 100\%$$

6. Results and discussion

6.1. Data Acquisition

From the data obtained as many as 10 real project data located in DKI Jakarta Province

The data obtained can be written in Table 1 as shown below.

Table 1. Data for Jakarta project contract packet

| Num | Packet Name | First Contract | Addendum Contract | Budget Year |
|-----|-------------|----------------|-------------------|-------------|
| 1 | Road 1 | 33.692.994.000 | 37.062.203.950 | 2015 |
| 2 | Road 2 | 9.839.252.000 | 9.839.252.000 | 2014 |

| | | | | |
|----|---------|----------------|----------------|------|
| 3 | Road 3 | 17.514.000.000 | 17.514.000.000 | 2013 |
| 4 | Road 4 | 13.805.000.000 | 13.805.000.000 | 2013 |
| 5 | Road 5 | 58.800.101.000 | 60.466.381.000 | 2017 |
| 6 | Road 6 | 11.998.507.000 | 12.198.491.000 | 2016 |
| 7 | Road 7 | 46.752.381.600 | 46.752.381.600 | 2016 |
| 8 | Road 8 | 22.781.100.000 | 22.781.100.000 | 2013 |
| 9 | Road 9 | 18.783.884.000 | 18.783.884.000 | 2013 |
| 10 | Road 10 | 19.167.792.500 | 21.080.743.000 | 2015 |

From the data obtained, it is found that there are 4 packet that have increased funds as shown in Table 2 which can be interpreted that 80% of change order packages have increased funds.

Table 2. Addition of project budget funds in Jakarta

| Number | Project Name | First Contract | Added Contract | Budget Year | Added/Balance Budget |
|--------|--------------|----------------|----------------|-------------|----------------------|
| 1 | Road 1 | 33.692.994.000 | 37.062.203.950 | 2015 | Added Budget |
| 2 | Road 2 | 9.839.252.000 | 9.839.252.000 | 2014 | Balance Budget |
| 3 | Road 3 | 17.514.000.000 | 17.514.000.000 | 2013 | Balance Budget |
| 4 | Road 4 | 13.805.000.000 | 13.805.000.000 | 2013 | Balance Budget |
| 5 | Road 5 | 58.800.101.000 | 60.466.381.000 | 2017 | Added Budget |
| 6 | Road 6 | 11.998.507.000 | 12.198.491.000 | 2016 | Added Budget |
| 7 | Road 7 | 46.752.381.600 | 46.752.381.600 | 2016 | Balance Budget |
| 8 | Road 8 | 22.781.100.000 | 22.781.100.000 | 2013 | Balance Budget |
| 9 | Road 9 | 18.783.884.000 | 18.783.884.000 | 2013 | Balance Budget |
| 10 | Road 10 | 19.167.792.500 | 21.080.743.000 | 2015 | Added Budget |

6.2. Change Order Calculation (COR)

COR is the Change Order Ratio, which is the change order calculation based on the change order ratio. The COR calculation consists of the total COR of the project and the COR per each project and the average COR of work in all projects undergoing changes in work.

- COR calculation of total projects is the calculation of total COR in projects where all work items undergoing change orders are totaled, can be seen in Table 3.

Table 3. Average COR road projects

| Num | Project Name | COR Total (%) |
|-----|----------------------------------|---------------|
| 1 | Road 1 | 73,14025 |
| 2 | Road 2 | 22,06554 |
| 3 | Road 3 | 23,686125 |
| 4 | Road 4 | 25,70115 |
| 5 | Road 5 A | 90,30263 |
| | Road 5 B (Routine Condition) | 174,97 |
| | Road 5 C (Minor Rehabilitation) | 191,93 |
| | Road 5 D (Routine Maintenance) | 104,0263 |
| 6 | Road 6 A (Complex Road) | 179,90846 |
| | Road 6 B (Local Road) | 10,42983 |
| 7 | Road 7 A (Major) | 43,62467 |
| | Road 7 B (Preventive) | 147,65 |
| 8 | Road 8 | 2,978274 |
| 9 | Road 9 | 17,66212 |
| 10 | Road 10 | 22,9744 |

- COR Total Projects produced the largest value of change in Project number 5 C of 191.93% and the smallest in Project number 8 of 2.97%. COR Total Projects amounting to 191.93% occurred due to changes in COR Total Projects amounting to 191.93% occurred due to changes in project field conditions that caused changes in work on the project. Project field conditions change because usually project planning is done a year earlier and the Regulations change so that construction work also changes. Change order ratio that exceeds the 10% increase is of an allowable change in change order changes based on Presidential Regulation No. 54 of 2010 article 87.
- COR each project shows the largest ratio in Table 4. consists of the largest calculation which is -74.66%. This calculation ratio is an absolute calculation both positive and negative. The largest percentage ratio on Laston Lapis Aus (AC-WC) work occurs because the project field conditions change which causes changes in work on the project.

Table 4. COR road project 7 B

| Number | Task | COR (%) |
|--------|------------------------------|---------|
| | Division 6. Asphalt Pavement | |
| 6.3.5a | Laston Lapis Aus (AC-WC) | -74,66 |

- COR Average Project

Change Order Ratio of the average project produces the smallest of -0,0001% up to the largest calculation which is 44.72%. The smallest percentage of work on Single Road Signs with Engineer Grade Surface and the largest in Hot Asphalt Mixed work occurs because the project field conditions change which causes changes in work on the project.

Table 5. Average COR road project

| Number | Task | COR (%) |
|-----------|---------------------|---------|
| Skh 1.10a | Hot Asphalt Mixture | 44.72 |

6.3. CORA Jakarta Project

CORA Jakarta Project generates value added work changes to construction projects. Of the 10 projects that produce work added to change orders CORA projects are also divided into total CORA projects, individual CORA projects and CORA average work in all projects that experience additional work.

- CORA Total Jakarta Project.

CORA Total Projects produced the highest value added work changes in the 10 D Road Project (Routine Maintenance) of 90.76318% and the smallest added work on the Road Project 13 was 1.517388%. CORA Total Projects amounting to 90.76318% due to changing field conditions. Changing field conditions caused changes in work on the project.

Table 6. Total CORA Jakarta projects

| Number | Project Name | CORA Total (%) |
|--------|--------------------------------|----------------|
| 1 | Road 1 | 6,606847 |
| 2 | Road 2 | 11,0071 |
| 3 | Road 3 | 11,818587 |
| 4 | Road 4 | 14,38719 |
| 5 | Road 5 A(Major Rehabilitation) | 45,63605 |
| | Road 5 B (Routine Condition) | 35,16556 |
| | Road5 C (Minor Rehabilitation) | 72,72 |

| | | |
|----|--------------------------------|------------|
| | Road 5 D (Routine Maintenance) | 90,76318 |
| 6 | Road 6 A (Complex Road) | 81,699416 |
| | Road 6 B (Local Street) | 6,451222 |
| 7 | Road 7 A (Major) | 26,750672 |
| | Road 7 B (Preventive) | 70,34 |
| 8 | Road 8 | 1,517388 |
| 9 | Road 9 | 9,24098577 |
| 10 | Road 10 | 11,533 |

- CORA Each Project

CORA The biggest Road Project

The CORA calculation for each project shows the largest ratio in Table 7 which consists of the largest calculation which is 69.87735%. This calculation ratio is an absolute calculation both positive and negative. The highest percentage ratio is the highest occupation in Laston Lapis Aus (AC-WC) work. occurs because the changing project field conditions cause changes in work on the project and changing regulations

Table 7. CORA road project 6 A

| Number | Task | CORA (%) |
|----------|------------------------------|----------|
| | Division 6. Asphalt Pavement | |
| 6.1 (2a) | Laston Lapis Aus (AC-WC) | 69,87735 |

6. 4. CORS Jakarta Project

The ratio of underemployment (CORS) projects in Jakarta is obtained from 10 projects in Jakarta that produce change orders. CORS projects are also divided into total CORS projects, individual CORS projects and CORS average work in all projects that experience less work

- CORS Total Jakarta Project

The total project work ratio (CORS) is the total CORS calculation for the project as a whole, can be seen in Table 9.

Table 8. Total CORS Jakarta projects

| Number | Project Name | CORS Total (%) |
|--------|---------------------------------|----------------|
| 1 | Road 1 | 66,5334 |
| 2 | Road 2 | 11,0584 |
| 3 | Road 3 | 11,8675 |
| 4 | Road 4 | 11,314 |
| 5 | Road 5 A (Major Rehabilitation) | 44,7666 |
| | Road 5 B (Routine Condition) | 139,803 |
| | Road 5 C (Minor Rehabilitation) | 59,20 |
| | Road 5 D Routine Condition) | 13,2631 |
| 6 | Road 6 A (Complex Road) | 98,20905 |
| | Road 6 B (Local Road) | 3,9786 |
| 7 | Road 7 A (Major) | 16,8739978 |
| | Road 7 B (Preventive) | 77,31 |
| 8 | Road 8 | 1,4609 |
| 9 | Road 9 | 8,42113 |
| 10 | Road 10 | 11,441 |

CORS Total Project resulted in the largest value of changes in underemployment on the Road Project 5 B of 139.803% and the smallest less work on the Road Project 8 of 1.4609%. CORS Total Projects amounting to 139,803% due to changing project field conditions which caused changes in work on the project. Project field conditions have changed because project planning is usually done a year before.

- **CORS Each Project**

The calculation of each project in 10 projects produces a ratio of less change order work in Table 9 consisting of the smallest of -0.08% up to the highest calculation of -74.66%. The smallest percentage is asphalted pavement work without Cold Milling Machine and the biggest is on the Laston Lapis Aus (AC-WC) job.

Table 9. COR road project 7 B

| Number | Task | COR (%) |
|--------|------------------------------|---------|
| | Division 6. Asphalt Pavement | |
| 6.3.5a | Laston Lapis Aus (AC-WC) | -74,66 |

- **CORS Average Road Project**

The CORS average of the less work on the road project produced the greatest change value is 54.9231% and the smallest was 0.0001% on the Single Road Signs with Engineer Grade Surface. CORS Total Projects amounting to 54.9231% on the work of Concrete of medium quality f'c 20 Mpa for the road. The biggest CORS occurs because the project field conditions change which causes changes in work on the project

Table 10. Average CORS road project

| Number | Task | CORS(%) |
|----------|---|---------|
| | Division 7. Structure | |
| 7.1 (5a) | Medium quality concrete f'c 20 Mpa for the road | 54.9231 |

7. Conclusion

- The largest average percentage (COR) of Road Projects in Jakarta is:
Hot Asphalt Mixture (44, 72%)
- The average percentage (CORS) of road projects in Jakarta is:
Medium quality concrete f'c 20 MPa for road 54.9231%
- The average percentage (CORA) of road projects in Jakarta is:
Laston Lapis Antara (AC-BC Mod) (As-button) 21.55%

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