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IDENTIFICATION OF ROAD CONSTRUCTION RISK

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ABSTRACT

Risk identification is an important thing which is the initial identification of risk management. Change Order which causes the cost of contract items to swell, planning errors and omissions as well as changes in scope that can be reduced by sharpening the planning results. This research focuses on identifying risks for change orders for road construction projects in the West Java province. Actual data obtained from 10 road construction projects from the 2013 fiscal year to the 2018 fiscal year to get the frequency of change orders that occur in various road construction work and the results obtained are to produce 313 construction changes with the identification of change order risks in 21 road construction projects with the largest change order risk identification on the work Asphalt Emulsion Absorb Layer, Type 2 Precast Kerb, Masonry with mortar, Low strength concrete f'c 15 MPa, Masonry followed by 16 other construction works.

Keywords: Risk identification, change order, and construction work items, West Java Province

INTRODUCTION

Change orders cause costs to increase contract items, planning errors and omissions, and changes in scope that can be reduced by sharpening the final planning result[1]. Research by Taylor et al., 2012[1] states that the analysis and results of research in Kentucky which identified change orders have a trend based on job offer items, namely contract negligence which is usually caused by the omission of work items, swelling contract costs, in this case, an increase contract funds, requests from the owner that cause changes in the overall work in the contract. A variation or change is any addition, deletion, or other revision to the project's objectives and scope, whether it adds or reduces project costs or schedules [2]. The definition of contract negligence is the reduction of several work items from the original contract so that there is a change in the contract which causes the contract value to decrease. Changes in construction projects always occur and cannot be avoided, [3]. Design changes are a disturbance of performance on a construction project, especially time and cost performance, the most of which are design changes.[3][3]. Many performance problems in construction projects are related to change orders, including decreased productivity[4], project delays [5], and cost overruns[6]. Attempts have been made to explore the root reasons of change orders in order to reduce the need to issue new change orders [7]; Lee et al., 2004 [8]; Terwiesch and Loch 1999[9]; Wu et al., 2005[10]) and investigate the effect of change orders on the impact of change orders. negative outcomes can be reduced (Cox 1997 [11]; Hanna et al. 1999 [12]; Leonard 1988 [13]; Moselhi et al. 2005[4] ; O'Brien 1998[14]). Approximately 10% of the increase in project costs is due to change order processing. (Mrozowski 2004)[15]. Management resources, such as the time commitment of engineers and architects, are not always allocated efficiently to maximize workflow (Yelakanti 2005)[16]. In construction

projects, constant change orders lead to increased planning frequency, increased project management and supervision requirements, overmanning, schedule compression, disorganized work, and lack of available resources to meet change requirements (Hanna et al., 1999) [12]. Perkins (2009)[17] investigated the causes of construction phase changes in 14 design-build and 20 design-bid-build (DBB) projects. Anastasopoulos et al., (2010)[18] investigated the specifications of different models to explain the frequency of change orders on contracted highways and examined the factors associated with the occurrence of change orders according to Keane et al., (2010)[19]

RISK IDENTIFICATION

Risk management contains a four-phase process (Project and Program Management: A Guide to Managing Project Risks and Opportunities, volume 6 of The PMBOK handbook series)[21] consisting of Identification, assessment, response, and documentation. Risk identification is the initial process of the CRMS model. The process involves an investigation into all potential sources of project risk and the potential consequences of the project. Risk identification is defined as a systematic and ongoing process of identifying, categorizing, and assessing the initial significance of risks associated with a construction project. (Al-Bahar and Crandall, 1990)[22]. Other authors such as Zoysa and Russell 2003[23]; Wang et al. 2004)[24] strongly emphasizes the importance of the identification phase in risk management because the next phase (assessment, analysis, etc. is carried out based on the identified risk factors. Risk identification is defined as a systematic process and continuous identification, categorized and becomes the initial significance assessment of risks who join a construction project (Al Bahar & Crandall, 1990[22]; Wideman, 1992)[25]; Zoysa and Russell (2003)[23]; Wang et al. (2004)[24] emphasize the importance of the risk identification phase because the next phase (assessment, analysis, and responding) is done based on the identified risk factors. Leung et al.(1998)[26] formulated a risk identification model that explains the causal relationship between each risk factor and its likelihood of consequences. The factor of high uncertainty in initial estimates, ignorance of k contractors with environmental factors, and the diversity and complexity of interrelationships make risk identification difficult for large overseas projects (Zhi, 1995[27]; Han & Diekmann, 2004)[28]. The purpose of the study was to identify the risk of change orders for road construction projects in the West Java province.

RESEARCH METHODOLOGY

The object of research regarding the identification of change order risks was carried out in West Java Province taking the location of a road construction project. The road project is one of the prioritized infrastructure projects in the province of West Java because it is the closest province to the state capital. Work included in road construction projects.

DATA COLLECTION AND PROCESSING

Collecting data on real data on road construction projects in West Java Province from 2013 to 2018. LORR (Likelihood of Risk Realization), hereinafter abbreviated as LORR, is the risk that the risk is likely to materialize while in the project circle (frequency). The probability of risk realization is marked with a value from zero to five: (Hanna et al, 2013)[29]

0 = Not applicable to the project (0% chance)

1 = Very low chance (<10% chance)
2 = Low chance (10%-35% chance)
3 = Medium chance (35%-65% chance)
4 = High chance (65%-90% chance)
5 = Very high chance (>90% chance)

By referring to the literature, if the frequency is above 35%, it is an intermediate opportunity that must be considered, so the identification of risks that have a frequency above 35% must be considered because it is an intermediate opportunity that gets enough attention at risk.

DATA ANALYSIS

Data analysis was carried out in the following way:

1. Risk identification is carried out using real change order data, including the number of additional project items, the number of work items lacking, the number of work items removed, and the number of work items added to the change order project.
2. Conduct an analysis of the changes in the work of each of the above
3. Carry out a combined recapitulation of job changes
4. Calculate the frequency of changes in road construction work items
5. Frequency that exceeds 35% is categorized in the identification of road construction work

CHANGE ORDER AND CONTRACT DATA

Change order contract data is real data obtained from reliable sources in the form of hard copies and soft copies. Which contains the contract and changes to the work in the contract that has been carried out and the road construction work has been completed.

DISCUSSION AND ANALYSIS

PROJECT DATA

After data collection, 10 real data were obtained from road projects in West Java Province. From 10 projects, the results were as shown in Table 1.

Table 1. Project Data and Contract Value

Num	Project	Contract	Addendum Contract	Year
1	Road Project 1	30.636.607.000	34.713.981.000	2014
2	Road Project2	32.625.419.000	35.853.368.000	2014
3	Road Project3	11.425.860.000	11.425.860.000	2016
4	Road Project	13.402.830.000	13.402.830.000	2015
5	Road Project	38.825.312.000	42.692.277.000	2014
6	Road Project	37.006.518.000	37.006.518.000	2018
7	Road Project	26.090.000.000	28.614.697.000	2015
8	Road Project	25.484.257.000	25.484.257.000	2018
9	Road Project	21.544.837.000	21.544.837.000	2013
10	Road Project 10	67.680.288.000	67.080.288.000	2017

CHANGE ORDER RISK IDENTIFICATION BASED ON CHANGE ORDER CONTRACT DATA

Risk identification is the initial step in risk management in identifying risk, in this case, the risk of change orders. Seeing that the real change order data is data that contains additional work resulting in additional funds so that the contract changes. Change order real data contains omitted work data, namely the omission of work items thereby resulting in contract negligence. There is also additional work where the volume of existing work is added as well as less work, i.e. a work item is reduced in volume based on field conditions. Referring to the research of Taylor et al, 2012 [1] which states that the identification of change orders refers to three things, namely contract negligence, contract additions, and the owner's desire to encourage all aspects of work in construction so that the contract increases, resulting in the addition of new work items, and variations or variations. A change is any addition, deletion, or other revision to the project's objectives and scope, whether it increases or decreases the project cost or schedule (Ibbs et al. 2001)[2] and so the authors combine the two studies by recapitulating in work added, work less, add new items and omission of construction work items from 10 road construction project data in West Java province. The ranking of the biggest changes in the Road No. 2 project is based on the value of the change costs as shown in Table 2. The percentage change in costs in the No. 2 road project shows the percentage change in the change order for the road project.

Table 2. Ranking of Total Change by Price of Change

Nu	Project name	Total	Change Value	Ra
1	Road Project 2	60.7	21,779,486,925	1
2	Road Project 6 Major	46.8	18,198,976,747	2
3	Road Project 10 Major	17.	9,741,596,416	3
4	Road Project 1	31.5	9,677,797,785	4
5	Road Project 8 Major	34.	9,133,785,070	5
6	Road Project 4	24.2	3,248,175,851	6
7	Road Project 5	19.	2,572,003,077	7
8	Road Project 7	10.	2,857,247,931	8
9	Road Project 9	7.49	1,013,620,519	9
10	Road Project 3	8.2	938,748,658	10

The amount of job changes, namely reduction, addition, removal of work items, and adding new work items is taken into account in this discussion. Road project data as many as 10 projects resulted in the most work changes in road project number 4 which contained additions, subtractions, omissions, and the addition of 51 new items which can be seen in Table 3.

Table 3. Road Project Contract 4

Description	Added	Less work	Added new items	New it
Division 1. General				
Casting, including SPT and Report	1			
Sondir including reports			1	
Division 2.Drainage				

Excavation for drainage ditches and drains		1		
Masonry with mortar		1		
U channel type DS 2		1		
U channel type DS 3	1			
* U channel type DS 3			1	
Concrete K250 (f'c 20) for minor concrete structures			1	
Reinforcing steel for minor concrete structures				1
Porous material for filtering material (filter)		1		
Prefabricated Box Culvert measuring 2 m x 2 m installed	1			
Division 3 Earthworks				
Ordinary digging		1		
Excavation of the structure with a depth of 0-2 m		1		
Excavation of asphalt pavement without cold machine		1		
Excavation of concrete pavement		1		
Selected Fill from excavated sources		1		
Division 4 Pavement and Road Shoulder Widening				
Class A . Aggregate Foundation Layer	1			

Description	Added	Less work	Added new items	New it
Cement concrete pavement		1	1	
Lean concrete foundation layer			1	
Concrete pavement for traffic opening, the age of concrete is more than 3 days and less than 7 days		1		
Lean concrete foundation layer	1			
Provision of a micropile/concrete culvert the size of dia. 15x15cm	1			
Micropile piling/concrete cone size 15x15 cm			1	
Division 6. Asphalt Pavement				
Asphalt Emulsion Adhesive Coating		1		
Laston Lapis Aus modification (AC-WC Mod)		1		
Division 7 Structure				
High strength concrete f'c 45		1		
Medium quality concrete f'c 20 MPa		1		
Low strength concrete f'c 15 MPa		1		
Low strength concrete f'c 10 Mpa		1		
Reinforcement steel u 24			1	
Reinforcement steel u 39			1	
Installation of bj 27 structural steel (melting point 240 MPa)			1	
Pile integrity test with pile integrated test (PIT)	1			
stone couple		1		

Expantion Joint type asphaltic		1		
Synthetic elastometric placement size 450 x 450 x45 mm				
Bridge nameplate		1		
Stone masonry demolition		1		
Concrete demolition	1			
Concrete inspection and tightening		1		
Bolt replacement			1	
External stressing (3 wires)			1	
Division 8. Return of conditions and minor work				
Thermoplastic road marking		1		
Type 2 precast paperboard		1		
3 type preprinted paper		1		
Restoration of structural steel surface coating condition	1			
Division 9. Daily work				
Foreman		1		
Ordinary worker		1		
carpenter, mason, etc		1		
Dump truck, capacity 3-4 m3		1		
Jack hammer				1
Total	10	29	11	2

Referring to the 10 road projects that underwent changes, both removing work items, adding new work items, adding existing jobs, and reducing existing jobs, the total job changes were 313 changes as shown in Table 4.

Table 4. Total Changes in Road Construction Projects

Nu	Project name	Number of
1	Road Project 1	36
2	Road Project2	20
3	Road Project3	38
4	Road Project 4	59
5	Road Project 5	37
6	Road Project 6	49
7	Road Project 7	18
8	Road Project 8	20
9	Road Project 9	19
10	Road Project 10	17
	Total change	313

By looking at a large number of changes, further research was carried out to identify the risk of change orders in the 10 projects. Changes in work that occur in each change in each project will be identified so that the results of the analysis can be used as an identification of the risk of change orders in various jobs on a number of projects as follows, as shown in one of the tables below, namely Table 10 which is one of the 10 risk identifications for road construction projects, where

the identification of 10 road projects is one of the few with the fewest job changes, namely only 17 job changes, either added work, less work, removal of work items or the addition of new work items. Sometimes in 1 job, there are changes several times or also in 1 job where the location is different because most road projects are not only focused on one location point, so changes in 1 item can occur in several parts of the work location, especially if the location is a bit far away, it is called a job. soil excavation A, soil excavation work B, and so on. After identifying each item of construction work per each project, a recapitulation of the whole is carried out with different frequencies, from a frequency of 4 to 15 changes, then the frequency is obtained in Table 5. After obtaining the overall frequency, a selection is made on the frequency that has a percentage above 35%. According to Hanna et al., 2013[29] state that the frequency value between 35-60% is an intermediate scale in risk identification which is the basis for calculating change order frequency. The results of frequencies that exceed 35% (according to Hanna et al., 2013)[29] as in Table 5 are as follows:

Table 5. Frequency of Road Project Change Orders

Numb	Type of work	Frequency (%)
1	Excavation for sewers and waterways	70
2	Masonry with mortar	90
3	Asphalt Emulsion Absorb Layer	100
4	Asphalt excavation with Cold Milling Machine	80
5	Class A. Top Foundation	50
6	S . Grade Top Foundation	60
7	B Class Top Foundation	70
8	wear layered laston	70
9	Low strength concrete f'c 15 MPa	90
10	Laston Lay	60
11	Hot Mix Asphalt for minor works	80
12	Low strength concrete f'c 10 MPa	60
13	Thermoplastic Road Marking	80
14	Cement concrete pavement	80
15	stone couple	90
16	Steering Peg	40
17	Precast Kerb Type 2	100
18	Concrete Demolition	40
19	Filing of choice	80
20	Kerb and median painting	40
21	Hectometer Peg	70

The frequency of construction work items varies from 4 changes to 10 changes in road construction work, so look for jobs that get a portion that exceeds 35% of road construction work items where out of 10 road projects this work has a frequency of work items that exceeds 35%. If

it is assumed in road work for example an ordinary excavation work item where this work changes in more than 4 projects out of 10 projects, it means that the frequency is more than 35% because 4/10 * 100 = 40 %. If the frequency is more than 35% (Hanna et al, 2013)[29] then it is used as a change order risk identification as a whole, which can be seen in Table 6 which is a tabulation of the change order risk identification for road construction projects as many as 21 road work items. On the other hand, if the frequency is less than 35%, it cannot be used as an identification of the risk of change orders for road construction projects in order from high to low, which can be seen in Table 6, namely:

Table 6. Identification of Change Order Risk

Num	Type of Work	Frequency (%)
1	Asphalt Emulsion Absorb Layer	100
2	Precast Kerb Type 2	100
3	Masonry with mortar	90
4	Low strength concrete f'c 15 MPa	90
5	Couple of stones	90
6	Thermoplastic Road Marking	80
7	Cement concrete pavement	80
8	Hot Mix Asphalt for minor works	80
9	Asphalt excavation with Cold Milling	80
10	Filing of choice	80
11	B Class Top Foundation	70
12	Wear layered laston	70
13	Excavation for sewers and waterways	70
14	Hectometer Peg	70
15	S . Grade Top Foundation	60
16	Laston Layer Between (AC-BC)	60
17	Low Strengh Concrete f'c 10 MPa	60
18	Class A. Top Foundation	50
19	Steering Peg	40
2	Concrete Demolition	40
2	Kerb and median painting	40

CONCLUSION

After conducting the analysis, the conclusions obtained are:
Identification of the risk of change in construction work occurs in 21 construction works, including;
- Coating Asphalt Emulsion Absorb
- Prefabricated Kerb Type 2
- Masonry with mortar
- Low strength concrete f'c 15 MPa
- Stone pair
- Thermoplastic road markings
- Cement Concrete Pavement

- Hot Asphalt Mix for minor works
-Asphalt excavation with Cold Milling Machine
- Preferred Heaps

SUGGESTION

The suggestions obtained in this study are: pay more attention to the 21 items of road construction work so that the risk of change orders and change orders can be reduced.

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