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Impact of Contract Change Order (CCO) on Cost and Time Performance of the Eretan Coastal Flooding (Rob) Mitigation Project, Indramayu Regency

Edi Ujang Purnomo[1*], Randy Adidaya Eliza[1], Ibnu Toto Husodo[1], Putri Anggi Permata Suwandi[1]

[1]Department of Civil Engineering, Universitas PGRI Semarang, Indonesia

*ediujangpurnomo@gmail.com

Abstract. Contract Change Order (CCO) is a formal mechanism for accommodating construction contract changes during project execution. This study analyzes the causes of CCO and its impact on cost and time in the Eretan Coastal Flood (Rob) Handling Project, Indramayu Regency, where the initial concrete-cube breakwater design was revised into an L-Shape precast structure. A descriptive qualitative method with a quantitative approach was applied: NVivo identified causal factors from interviews and technical justification documents, Microsoft Project with the Critical Path Method (CPM) assessed schedule impact, and a Bill of Quantity comparison before and after the amendment evaluated cost impact. The CCO was caused by the need to adjust the design to actual field conditions. Although the work-item composition changed significantly, the total contract value remained IDR 18,911,932,131.39 (0% change) and the duration remained 280 calendar days ($\Delta T = 0$). The CCO was thus managed as a constructive, cost- and time-neutral change.

Keywords: coastal flood handling, construction cost, construction schedule, contract change order, critical path method

1. Introduction

The implementation of construction projects does not always proceed according to the initial plan. Field conditions that differ from planning assumptions often require changes to the contract documents, known as a Contract Change Order (CCO) a formal mechanism used to accommodate changes in the scope of work, technical specifications, construction methods, and/or work schedules during project execution [1][2][3][4].

In the Eretan Coastal Flood (Rob) Handling Project, Indramayu Regency, a contract change occurred because the initial coastal protection structure (a concrete-cube breakwater) was not able to adequately anticipate the tidal-flood (rob) conditions occurring at the project site. Based on the technical justification documents and the contract addendum, the initial structural form and elevation were not

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fully suited to the field conditions and the evolving flood-control requirements during implementation, so the design was changed from a concrete-cube breakwater to an L-Shape precast structure.

Previous studies generally show that CCO tends to cause cost overrun and/or time overrun [1][2][3][4][5][6][7][8][9]. However, the actual impact of a CCO on project performance depends on the cause, the management, and the timing of the change, so the impact is not always negative. This gap is the basis for an in-depth study on a coastal flood-handling project, given the characteristic dynamic soil and water conditions, tidal influence, and relatively high design uncertainty of coastal projects.

Based on the above, this study aims to: (a) identify the factors causing the CCO in the Eretan Rob Handling Project; (b) analyze the impact of the CCO on implementation cost; and (c) analyze the impact of the CCO on implementation time. The analysis is limited to changes in the breakwater/major work item under Amendment 1, with the CCO type being a constructive change.

2. Methods

This study uses a descriptive qualitative method with a quantitative approach [10]. Primary data consist of structured interviews with four key informants: the Commitment-Making Official (PPK), the Technical Implementer, the Team Leader, and the Project Manager, who were directly involved in the process of proposing, approving, and implementing the amendment. Secondary data include the Budget Plan (RAB), the contract and amendment documents, technical justification, the Unit Price Analysis (AHSP), and the S-Curve.

2.1. Analysis of the causes of CCO

Identification of the factors causing the CCO was carried out using the NVivo application through manual and automatic coding (Word Frequency Query) of the interview results and technical justification documents, then visualized as a Project Map to reveal patterns and relationships among themes.

2.2. Analysis of cost impact

Cost analysis was performed by comparing the value of the Bill of Quantity (BOQ) for the construction work under the original contract condition with the condition after the CCO. The analysis stages included compiling the list of work items, calculating volumes, preparing the AHSP with reference to the Ministry of Public Works and Housing (PUPR) guidelines, preparing the BOQ, and calculating the cost difference. The cost difference and percentage of cost change were calculated using the following equations:

$$\Delta\text{Cost} = \text{Total CCO Price} - \text{Total Contract Price} \quad (1)$$

$$\%\ \text{Cost Change} = \frac{\Delta\text{Cost}}{\text{Total Contract Price}} \times 100\% \quad (2)$$

2.3. Analysis of time impact

Time analysis was carried out using Microsoft Project software based on the Critical Path Method (CPM) to identify the critical path of the work under the original contract condition and after the CCO. The change in project duration was calculated using the following equation:

$$\Delta T = T_{CCO} - T_{Original} \quad (3)$$

where ΔT is the change in project duration (days), T_{CCO} is the project duration after the CCO (days), and $T_{Original}$ is the project duration based on the original contract (days).

3. Results and Discussion

3.1. Causes of the contract change order

The NVivo coding results on the interview data and technical justification documents show that the main cause of the CCO in this project was the need to adjust the work design to actual field conditions, along with a design change that took into account existing conditions with an emphasis on technical

aspects. The initial concrete-cube breakwater design was considered not fully capable of anticipating the evolving rob conditions at the project site, so the design was changed to an L-Shape precast structure. This finding is consistent with previous studies that identify design change as a dominant factor causing CCO in construction projects [2], [4], [5], [9].

3.2. Identification of changed work items

Identification of all work items in the original contract document and the CCO document shows a fairly significant replacement at the work-item level. Nine work items under the original design (concrete-cube breakwater, filter layer, core layer of rubble stone, geotextile, bamboo mattress, bamboo piles, excavation, and backfilling) were removed or had their volume reduced, and were replaced by eight new work items related to the L-Shape precast structure, dolken piles, and reinforcement fill, as presented in Table 1.

Table 1. Identification of work items changed due to the CCO

No.	Work Item	Unit	Status
1	Supply & installation of filter layer (rubble stone, dia. 30-40 cm)	m3	Removed
2	Fabrication of concrete cube K-350 (0.6x0.6x0.6 m)	Unit	Volume reduced
3	Installation of concrete cube K-350 (0.6x0.6x0.6 m)	Unit	Volume reduced
4	Supply & installation of core layer (rubble stone, dia. 10-20 cm)	m3	Removed
5	Geotextile installation	m2	Volume reduced
6	Bamboo mattress installation	m2	Volume reduced
7	Bamboo pile (cerucuk) installation	m’	Removed
8	Excavation with heavy equipment	m3	Removed
9	Soil backfilling	m3	Removed
10	Driving of dolken piles, dia. 10-12 cm	m’	New item
11	Excavation of mixed rock and soil (existing)	m3	New item
12	Backfilling of mixed rock and soil (existing)	m3	New item
13	Dewatering works	hour	New item
14	Reinforcement fill with selected material	m3	New item
15	Supply of L-Shape precast, H=3.00 m (K-500 fc’ 41.5 Mpa)	Unit	New item
16	Installation of L-Shape precast, H=3.00 m (K-500 fc’ 41.5 Mpa)	Unit	New item
17	Finishing of existing rock revetment	m’	New item

3.3. Impact of the contract change order on cost

Based on the volume calculations, the AHSP, and the BOQ, the value of the construction work before the CCO was IDR 18,911,932,131.39, and the value of the construction work after the CCO was also IDR 18,911,932,131.39, so the cost difference (ΔCost) according to Equation (1) is IDR 0.00, with a percentage change of 0% (Table 2). The value of added work and deducted work in the post-CCO BOQ is exactly the same, at IDR 16,906,122,136.97 each, so the two offset one another and the total contract value remains unchanged.

Table 2. Recapitulation of cost change due to the CCO

Item	Value (IDR)
Original contract value	18,911,932,131.39
Value after CCO	18,911,932,131.39
Cost difference (ΔCost)	0.00
Percentage of cost change	0%
Value of added work	16,906,122,136.97
Value of deducted work	(16,906,122,136.97)

This offsetting pattern indicates that the CCO in this project was likely designed in a controlled manner to keep the contract value unchanged (a cost-neutral change), rather than being a mere technical coincidence. Nevertheless, the unchanged total contract value may conceal changes in risk, quality, and implementation complexity at the work-item level, given that major work items such as the K-350 concrete cube and the filter/core rubble-stone layers were fully replaced by the L-Shape precast structure, dolken piles, and reinforcement fill.

3.4. Impact of the contract change order on time

The scheduling analysis results using Microsoft Project with the CPM method show that the implementation duration under the original contract condition and after the CCO remained 280 calendar days, so ΔT according to Equation (3) is 0 days (Table 3). Critical path identification shows that excavation with heavy equipment, bamboo pile installation, bamboo mattress installation, and geotextile installation remained on the critical path both before and after the CCO, and these are work items that were not among those replaced.

Table 3. Comparison of project duration and critical path

Item	Original Contract	After CCO
Project duration	280 calendar days	280 calendar days
Duration difference (ΔT)	–	0 days
Critical path activities	Excavation with heavy equipment, bamboo pile, bamboo mattress, geotextile	Unchanged

This finding indicates that the breakwater/L-Shape design change did not substantially affect the sequence of activities that determine project duration, so the total project duration could be maintained despite a significant design change at the work-item level. This result differs from most previous studies, which generally show that CCO tends to extend project implementation duration [2], [3], [9], and indicates that CCO management accompanied by sound technical justification and an orderly approval process can minimize the negative impact of work changes on project performance.

4. Conclusion

The cause of the Contract Change Order (CCO) in the Eretan Coastal Flood (Rob) Handling Project, Indramayu Regency, was the need to adjust the breakwater work design to actual field conditions, taking into account existing conditions with an emphasis on technical aspects. This CCO had no impact on the total contract value, which remained IDR 18,911,932,131.39 (0% change), nor on the total project implementation duration, which remained 280 calendar days (ΔT = 0 days), even though a fairly significant replacement of work items, volumes, and methods occurred at the work-item level, along with a change in the composition of work on the critical path. Thus, the CCO in this project was a

technical adjustment (constructive change) that was managed in a controlled manner, so it did not result in a cost overrun or time overrun as is commonly found in previous CCO studies.

Implementation control should continue to focus on excavation with heavy equipment, bamboo pile installation, bamboo mattress installation, and geotextile installation, since these four activities consistently remain on the project's critical path. Future research is recommended to involve more than one rob-handling project for comparison and to analyze the impact of CCO on quality, productivity, and project risk more comprehensively.

Declaration of AI and AI-assisted Technologies in the Writing Process

During the preparation of this work the author(s) used Google Translate in order to Translate from Indonesian to . After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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