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STUDY OF CONTRACT CHANGE ORDER (CCO) ON IMPLEMENTATION TIME IN BUILDING CONSTRUCTION PROJECT

Tutang Muhtar Kamaludin[1*], Andi Rusdin[2], Nirmalawati[3]
Department of Civil Engineering, Faculty of Engineering, Universitas Tadulako, Palu, Sulawesi Tengah, 94118, Indonesia[1 2 3]
tutang.untad@gmail.com

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**Corresponding Author*

ABSTRACT
The aim of this research is to identify the main causes and effects of CCO in the construction of the Palu State Islamic University (IAIN) campus II building project for the Faculty of Tarbiyah and Teacher Training and the Faculty of Sharia and Islamic Economics Lecture Building. Tasks included conducting a field survey via a questionnaire and interviews with main parties; project owner, contractors and consultants who are directly related to the project. It was determined that the top three causes of CCO from project owner, contractor and consultant. The contractor has do CCO at the beginning of the project of 70% respondent, while consultant has changed contract order at mid-project implementation of 50% respondents and 70% at the end project implementation from the contractor. The results that are quite important from this study are the discovery of volume estimation errors and changes in work methods. Errors in estimating volumes are caused by the planning consultant's inaccuracy in planning so that there is a significant difference in volume from the initial contract with conditions in the field so that some work items experience an increase or decrease in volume.
Keywords: *Contract Change Order, Contractor, Project, Cost, Time*

1. Introduction

Development in the field of education is an effort to educate the nation's life which can give birth to quality and highly competitive human resources (Chiel et al., 2021; Grinenko et al., 2019; Arafat & Buchdadi, 2019; Alliyah et al., 2020). When the earthquake and tsunami occurred in the cities of Palu, Sigi and Donggala on September 28, 2018 with a magnitude of 7.4 on the Richter Scale, Figure 1 shows The size of the Palu-Koro fault slip on Earth Palu, Sigi and Donggala (Takagi et al., 2019; Gusman et al., 2019), it caused a tsunami in coastal areas in the cities of Palu and Donggala (Takagi et al., 2019). The damage caused by the strength of the earthquake caused several buildings and residential areas to be damaged (Laapo et al., 2020; Paulik et al., 2019), including the Palu State Islamic University campus in Sigi Regency which was also significantly affected (Takagi et al., 2019; Gusman et al., 2019; Wekke et al., 2019). As a result of this, of course, resulted in the loss of some learning room facilities. The construction of this lecture building is expected to help provide representative study room facilities for students to use so that the goals of education can be achieved.

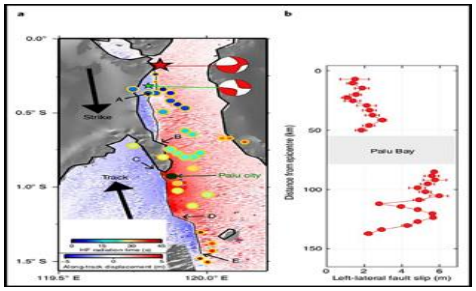

Fig. 1. The size of the Palu-Koro fault slip on Earth Donggala Mw 7.5 on 28 September 2018 (Takagi et al., 2019) (Gusman et al., 2019)

A construction project can be defined as an activity that is temporary in nature with a limited period of time which has an initial time and an end time (Gonçalves et al., 2016)(Bednarczyk, 2017) (Dziadosz & Rejment, 2015), with limited resource allocation to achieve predetermined targets. Construction projects have 3 characteristics, including those that

require resources (human, money, machines, methods, materials), are unique and require organization (Dziadosz & Rejment, 2015; Dosumu et al., 2017; Wali & Saber, 2019).

Several studies related to CCO such as (Taylor et al., 2012; Martanti & Hardjomuljadi, 2018; Khalifa & Mahamid, 2019; Hansen & Nindartin, 2023). Taylor et al., (2012) reviewed the technique of avoiding contract changes by increasing planning early in the project. Meanwhile (Martanti & Hardjomuljadi, 2018) found financing constraints in the contract if there is a change in job orders, where the availability of building materials is a major problem if there is a change in job orders, so additional capital is needed. Furthermore, in research on construction change orders, on the one hand, it creates effects that are not expected by the owners of capital, consultants and contractors. Capital owners feel disadvantaged if there are additional costs due to change order changes. But on the other hand, according to Khalifa & Mahamid (2019), CCO can be a guide for contractors to improve the quality of project work outputs. In general, the existence of a CCO will lead to disharmonious relations between the parties involved, both owners of capital, contractors, sub-contractors, engineers and parties who are not directly involved in the project. In general, research on the causes and effects of CCO in Indonesia is very rarely conducted, as stated by Hansen & Nindartin (2023). This is an indication of why research on the topic of CCO is important. In other words, identifying the causes of change orders is very important in order to avoid potential changes in future projects or to minimize their effects. Therefore, the aim of this research is to identify the main causes and effects of CCO in the construction of the Palu State Islamic University (IAIN) campus II building project for the Faculty of Tarbiyah and Teacher Training and the Faculty of Sharia and Islamic Economics Lecture Building.

2. Literature Review

The implementation of a construction project is often faced with problems (Dosumu et al., 2017; Soon Han et al., 2011; Gunduz & Elsherbeny, 2020), one of which is the occurrence of changes or is called a Contract Change Order (CCO) (Waney et al., 2017). Change orders can occur at any time, which can occur in the early, middle and final stages of construction work (Taylor et al., 2012; Gunduz & Elsherbeny, 2020; Waney et al., 2017). The source of the change can be caused by the owner's request, unexpected field conditions, contractor requests, and consultant errors in the design (Khalim et al., 2016). This causes the planning to be changed and due to field conditions that are not possible so that there is a change in design or commonly referred to as a Contract change order (change in the work contract) (Wali & Saber, 2019; Sunandar & Aszhari, 2021). Fig. 2 shows the vulnerability of the soil in the Palu, Donggala and Sigi areas which must be a technical study in construction work (Mohammad, 2021). These 3 areas are included in the area of Central Sulawesi in Indonesia.

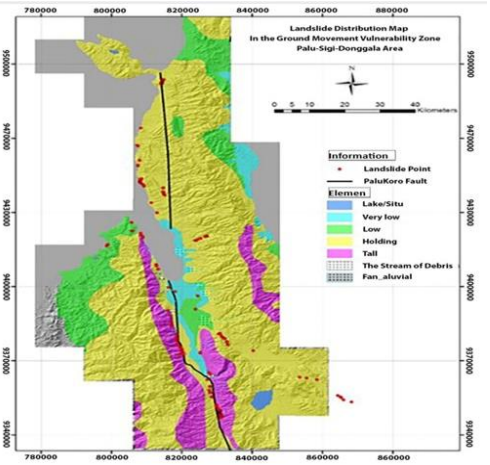

Fig. 2. Distribution Map of Soil Movement Vulnerability Zones in Palu-Donggala-Sigi Region, (Mohammad, 2021).

The effect arising from a change order contract usually occurs in incremental costs which have implications for additional work volume. The five most common effects of CCO are changes in the duration of individual activities, delays in completion schedules, additional money for contractors, and delayed payments (Amin & Mubarak, 2014). Changes during project

implementation occur due to owner wishes that arise during construction project implementation, changes in scope of work, changes in specifications, changes in material types, changes in architectural planning, changes in work methods, and acceleration of work implementation (Alaryan et al., 2014). The most common causes of sequencing variation in public building projects are design changes, impediments to quick decision making, inadequate detailed job descriptions, and specification changes (Sapulete, 2009). The main consequences of change orders are work delays, disputes and increased costs from the initial contract (Yadeta, 2016; Martanti & Hardjomuljadi, 2018). The most important causes of change are ownership finances, scope changes, design factor changes, the most important effect of the changes in order to increase project costs, increase in individual activity duration, schedule completion delays and the most important control for change is to review the gray area in contract documents, negotiation of change order, timely approval of change order (Alnuaimi et al., 2010). Contracts that do not change in value have an impact on the completion of the buildings required in the contract (Desai et al., 2015). Some unusual change orders often lead to decreased productivity. This enables all related parties to better manage their own rights and responsibilities during the handling of variation orders (El-adaway et al., 2016)

3. Research Methods

Project activity is a temporary activity that lasts for a limited period of time (Juhasz, 2011), with the allocation of certain resources and is intended to carry out tasks whose targets have been clearly outlined. In addition to resources, a construction project also needs to pay attention to cost, quality and time (Kamaludin et al., 2019). In the process of achieving a construction project goal, there are limitations that must be met, namely the amount of costs (budget) allocated, the schedule, and the quality that must be met.

Contract Document

The contract document is a written document that explains the rights and obligations of the project owner and the implementing/contractor (Wali & Saber, 2019; Pooworakulchai et al., 2017), the project owner and the supervisory consultant as agreed by each party.

Construction contract forms

A. Aspects of cost calculation
   1. Fixed price (fixed lump sum price)
   2. Unit Price (Unit Price)
B. Aspects of calculating services
   1. Cost without service
   2. Cost plus service (cost plus fee)
   3. Cost plus fixed fee
C. Payment Aspect
   1. Monthly payment method
   2. Method of payment for achievements (stage payment)
   3. Full pre-payment method of payment from the service provider (contractor's full pre-financed) (Dosumu et al., 2017; Waney et al., 2017; Asadi et al., 2019).

Contract Change Order (CCO)

Contract change orders or changes to the work contract (Wali & Saber, 2019) are changes that occur in the contract implementation process by increasing or decreasing the volume of work to adjust the volume in the field or changing the schedule without changing the contract articles and is poured into an addendum that must be agreed by both parties, namely the project owner and service provider.(Waney et al., 2017; Sunandar & Aszhari, 2021).

Change order is a letter of agreement between the project owner (Wali & Saber, 2019; Sunandar & Aszhari, 2021) and the contractor to confirm that there are plan revisions, and the amount of cost compensation to the contractor that occurs during construction, after the signing of the work contract between the owner and contractor (Waney et al., 2017; Desai et al., 2015).

Change Order Type

In general, there are two types of change, namely directive change and constructive change (Waney et al., 2017; Asadi et al.,2019)

1. Directive changes are changes that are submitted in written form, which are proposed by the contractor to the owner to change the scope of work, implementation time, costs or other things that are different from those specified in the contract documents(Dosumu et al., 2017). These provisions usually give the owner unilateral freedom to change the scope of work and require the contractor to follow those changes that are known before work is carried out Al-Harbi, 2001).
2. Constructive change is an informal action to order a field contract modification that occurs at the request of the owner, planner or contractor (Dosumu et al., 2017). Constructive change is also described as a change agreement between the owner and contractor in terms of time costs. These changes often cause conscious or uncertain work to reduce motivation, slow down production and increase costs (Rodrigues-da-Silva & Crispim, 2014).

Purpose of Change Order

The purpose of the change order must be adjusted to the construction work contract system used by the contractor, can make changes to the contract which include (Wali & Saber, 2019; Rodrigues-da-Silva & Crispim, 2014).

a. Increase or decrease the volume of work stated in the contract.
b. Adding and/or subtracting job types.
c. Change the technical specifications of the work according to the needs of the field.
d. Change the implementation schedule.
e. In addition, in paragraph 2, a change order can be carried out with the following conditions
f. Do not exceed 10% of the price stated in the initial agreement/contract
g. Availability of budget.

The cause of the change order is the owner's desire to change the construction specifications after the original contract price is signed between the owner and contractor (Sears et al., 2008), the desire to speed up work due to market, public, and political considerations (Waney et al., 2017).

The impact that occurs due to the effect of change orders on project implementation in the form of direct costs (S.Keoki Sears et al., 2008), time extensions and impact costs, the effect of change orders on a construction project often results in productivity loss, if there is a productivity loss there will be a significant increase in project time and costs. change order will occur additional workforce accompanied by the addition of project equipment (Gonçalves et al., 2016; Dziadosz & Rejment, 2015; Pooworakulchai et al., 2017).

Processing and data analysis

The research location is on the Palu State Islamic University Campus in the Construction Work Project for the Faculty of Tarbiyah and Teacher Training, the Construction of the Faculty of Sharia and Islamic Economics Lecture Building, which is located on Jalan Poros Palu Palolo, Sigi Regency, Central Sulawesi in Indonesia. This study used qualitative research methods, so the tasks included conducting a field survey via a questionnaire and interviews with main parties; project owners, contractors and consultants who are directly related to the project being carried out. There are 2 types of data sources used.

1. Primary data
   Primary data collection(Waney et al., 2017) was obtained from the results of questionnaires and interviews with contractors and consultants who are directly related to the project (Waney et al., 2017; Mantha et al., 2016).
2. Secondary data
   The secondary data collected in this study were obtained from the agencies or parties responsible for implementing the construction work of the campus of the Islamic University of Palu, including:
   a. Study of literature related to contract change orders (CCO)
   b. Budget Plan (RAB) change order.
   c. Project time schedule and other supporting data.

Analysis of the main causes (Daas, 2012) of change orders using descriptive statistics (Sunandar & Aszhari, 2021) which describe the change orders that occurred in the construction project of the construction work of the Palu State Islamic University campus which includes the causes and impacts of the change order contract (Dosumu et al., 2017; Sunandar & Aszhari, 2021)

4. Results and Discussions

Filling out the questionnaire is done by sorting the statements based on the most influential to the least influential. To find out the causes of change orders in terms of 3 aspects, namely the factors that are the main causes of change orders, the main parties related to change orders and the phase of change orders as shown in Table 1 and 2.

Table 1 - Factors that are the main causes of contract change orders

Factors Causing Contract Change Order		Research questionnaire							
CCO factors		Order							
		1	2	3	4	5	6	7	8
1	Design changes								✓
2	Errors in planning and design			✓					
3	Planning drawings / specifications are not clear					✓			
4	Changes in work methods sequences of implementation		✓						
5	Errors and omissions in volume calculation/estimation	✓							
6	Incompatibility of drawings and contracts with field conditions				✓				
7	There is additional work						✓		
8	There is less work							✓	

Table 2 - Results of the Questionnaire of the Main Causes of the Occurrence of CCO

CCO factors		order of questions							
		1	2	3	4	5	6	7	8
1	Design changes					1	2	1	6
2	Errors in planning and design		1	2	1	2		4	
3	Planning drawings/ specifications are not clear			1		4	2	2	1
4	Changes in work methods/sequences of Implementation		6		2			1	1
5	Errors and omissions in volume calculation/estimation	10							
6	incompatibility of drawings and contracts with field conditions		1	2	5	1	1		
7	There is additional work		2	5	1		2		
8	There is less work				1	2	3	2	2
	Number of Questionnaires	10	10	10	10	10	10	10	10

Calculation of the data results of each factor cco as follows:

a. Change of work method

Table 3 - Order of Answers to the CCO factor

CCO factors	Number of respondents who choose Change of Work Method
Design changes	0
Errors in planning and design	6
Planning drawings/specifications are not clear	0
Changes in work methods/sequences of implementation	2
Errors and omissions in volume calculation/estimation	0

Incompatibility of drawings and contracts with field conditions	0
There is additional work	1
There is less work	1

Based on Table 3, it can be seen that the factors for changing work methods were 6 respondents answered for the 2nd order, 2 respondents answered the 4th order, 1 respondent answered the 7th rank and 1 respondent answered the 8th order.

To be clearer, the results of the questionnaire are made in percentages, which can be seen in Fig. 3.

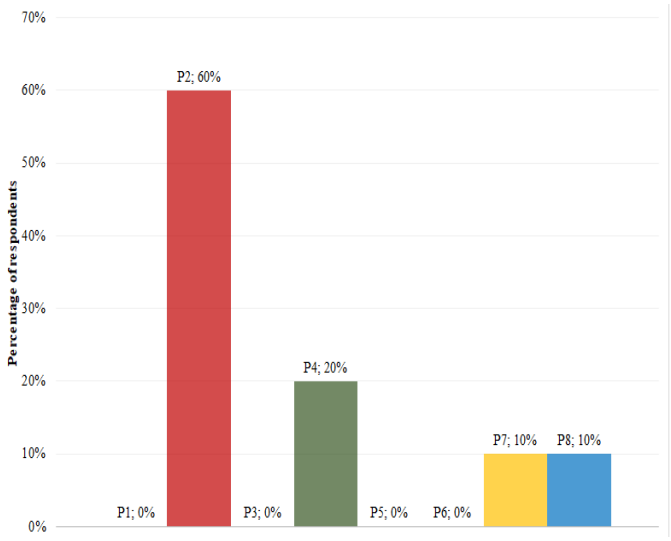

Fig. 3. Work change method

From the calculation of the descriptive statistical analysis in Fig. 4 and 5, it can be seen that the most respondents placed changes in work methods in the 2nd order, namely as many as 60% of respondents. Furthermore, the results of the elaboration and calculation of each of the CCO factors for the whole can be seen in the Table 4 and Figure 4.

Table 4 - CCO Factors Recapitulation

Order	CCO factors	Total
1	Errors and omissions in volume calculation/estimation	100%
2	Planning drawings / specifications are not clear	60%
3	There is less work	50%
4	Incompatibility of drawings and contracts with field conditions	50%
5	Incompatibility of drawings and contracts with field conditions	40%
6	There is additional work	30%
7	Errors in planning and design	40%
8	Design changes	60%

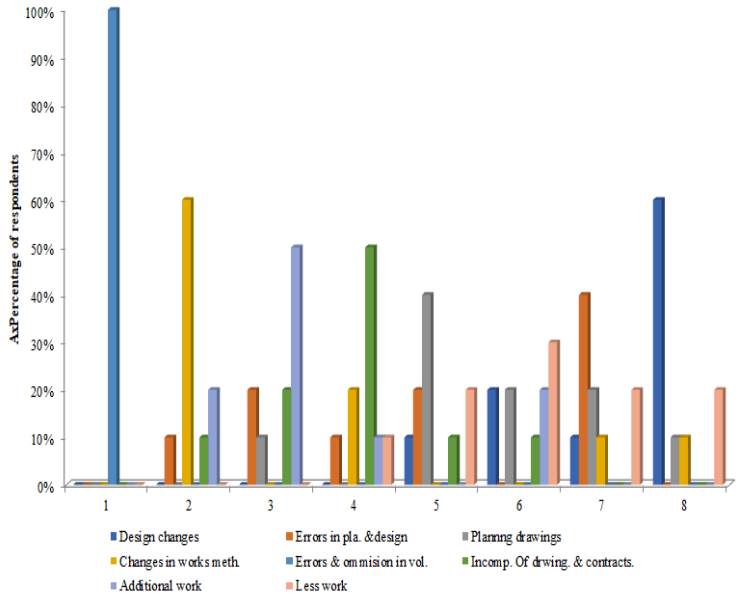

Fig. 4. The Main Causes of CCO

The contract change order (CCO) factors that became the main factor in the construction project of the Palu State Islamic University lecture building were errors and omissions in the calculation/estimation of volume, as many as 100% of respondents answered in 1st place. The cause of the change order factor for the 2nd order as much as 10% answered errors in planning and design, as much as 60% answered the factor of changing work methods, as much as 10% answered the factor of image incompatibility, 20% answered the factor of additional work, it can be concluded that the 2nd order of causes of CCO is the factor of changing work methods. Main Parties Influencing CCO (Fig. 5).

Table 5 - Questionnaire Results of Main Parties Affecting CCO

	CCO Related Parties	Order		
		1	2	3
1	Project Owner/Owner		3	7
2	Contractor	7	2	1
3	Consultant	3	5	2

Table 6 - Recap of the order of parties that have an effect on CCO

No	CCO Related Parties	Total of Respondents
1	Project Owner/Owner	70%
2	Contractor	50%
3	Consultant	70%

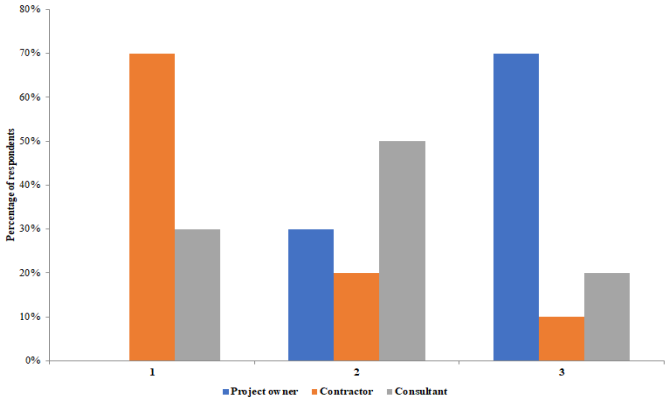

Fig. 5. Main Parties Related to CCO

Contract change orders that occur in a construction project are submitted by the project owner (owner), contractors and other parties. The main party that influences the change order in order 1 as many as 70% of respondents answered contractors and as many as 30% of respondents answered consultants, it can be concluded that the 1st party that has the most influence on change orders at the lecture building of the State Islamic University of Palu is the contractor.

Phase Occurrence of CCO

Table 7 - Questionnaire Results of CCO Occurrence Phase

Number	Project Time	Order		
		1	*2*	*3*
1	Beginning of Project Implementation	8	2	
2	Mid-Project Implementation	2	8	
3	End of Project Implementation			10

Table 8 - Recap of the phase sequence of the occurrence of CCO

Number	Project Time	Total of Respondent
1	Beginning of Project Implementation	80%
2	Mid-Project Implementation	80%
3	End of Project Implementation	100%

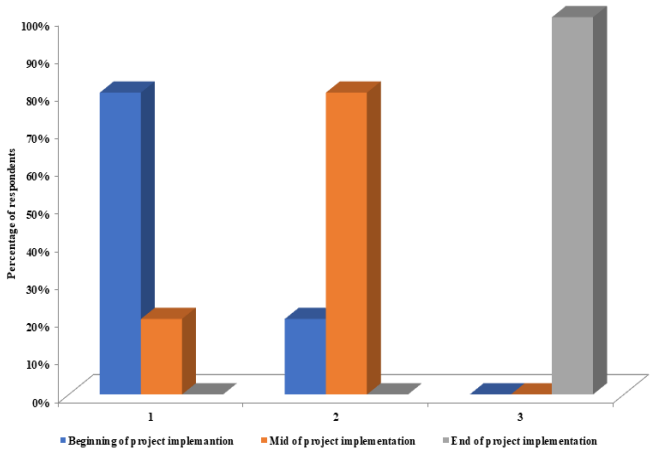

Fig. 6. Phases of CCO

From the table and Figure 6 above, it can be seen that the CCO in the construction project of the Palu State Islamic University lecture building occurred in the early stages of project implementation where the presentation was 80% of respondents at the 1st level, can be seen in Figure 6. Change orders occur at the beginning of the implementation because the projects carried out generally do not carry out a feasibility study beforehand, so that at the time of implementation it is often not in accordance with field conditions.

Impact of CCO on Costs

Table 9 - Contract Change Order Value

No	Job description	Contract	CCO	Work Add	Less Work
		IDR	IDR	IDR	IDR
1	Foundation work	1,402,320,199	1,274,854,824	201,332,200	328,797,575
2	Floor job	691,858,149	591,334,328	11,713,512	112,237,333
3	Wall work	1,149,461,608	1,005,962,317	191,140,825	334,640,117
4	Concrete works	1,302,412,168	926,411,810	85,188,956	461,189,314
5	Heavy Steel Structure Work	3,900,570,912	4,641,796,865	782,689,862	41,463,910
6	Door and Window Works	406,699,000	406,699,000		
7	Roofing, Hood and Ceiling Works	469,300,069	494,369,215	37,262,806	12,193,660
8	Painting Job	185,020,584	166,283,002		18,737,582
9	Electrical Installation Works	157,880,000	157,880,000		
10	Sanitary Work etc	494,696,000	494,696,000		
	Total	10,160,218,690	10,160,287,361	1,309,328,162	1,309,259,491
	10% VAT	1,016,021,869	1,016,028,736	130,932,816	130,925,949
	Total number	11,176,240,559	11,176,316,097	1,440,260,978	1,440,185,440
	Rounded up	11,176,240,500	11,176,316,000	1,440,260,978	1,440,185,440
	Conclusion				
	Initial Contract Value	**11,176,240,500**			
	Contract Value After CC	**11,176,316,000**			

From the Table 9, it can be seen that the contract change orders that experienced the biggest changes for additional work occurred in heavy steel structure work and for less work on foundation work. Changes that occur in heavy steel structure work are caused by errors in volume calculations and changes that occur in foundation work occur due to the disclosure of new conditions that cause changes in work methods. In some work items the value changes, but for the overall contract value and the contract change order value remains the same where there is no increase or decrease in value.

Impact of CCO on Time

In the construction project of the Palu State Islamic University Building, a contract change order occurred at the beginning of project implementation. The main causes of CCO in this project include volume estimation errors and changes in work methods. The volume estimation error was caused by the planning consultant's lack of accuracy in planning, resulting in a significant volume difference from the initial contract with conditions in the field, so that some work items experienced an increase or decrease in volume. In the foundation work, CCO occurs where the causative factor is a change in work methods due to additional work, namely pre-boring work. This was due to the fact that at the time of implementation, the piles were shallow enough to only enter at a depth of 3 meters which was not in accordance with the plan, which was 9 meters, resulting in a change in the working method by pre-boring to a depth of 6 meters and continued with driving. The CCO on this foundation work can affect the project implementation time, but the contractor works overtime to avoid delays to avoid adding to the overall work time.

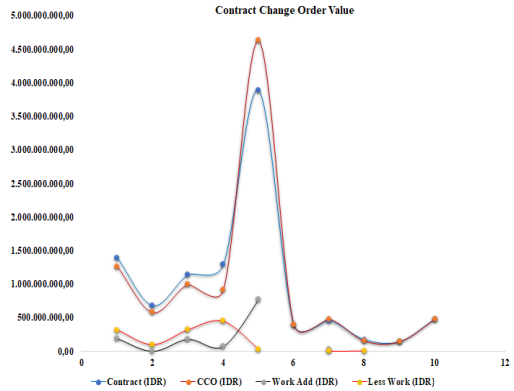

Fig 7. Contract Change Order Value Diagram

In this project, CCO occurred in the early stages of project implementation so that the change order process did not result in time delays. The occurrence of CCO at the beginning of project implementation, this can minimize work time so that it can be completed according to the time of the initial contract work. Based on the results of the CCO which can see in Figure 7 about

contract change order value diagram, the final cost of completing the entire work remains in accordance with the initial contract, this does not affect the time schedule so that the completion time of the work is completed according to the initial schedule.

The important result of this research is that there was an error in estimating volume and a change in project work methods which resulted in CCO. This means that the planning consultant was not careful in planning so that there was a significant difference in volume from the initial contract with conditions in the field so that several work items experienced an increase or decrease in volume. These results add to the references to the results of the case study research conducted by (Hansen et al., 2020) on building construction in Indonesia, where planning consultants who were less thorough in changing design specifications and non-technical factors, such as delays in imported materials arriving at the location, were less anticipated in the design. estimated project time.

Fortunately, the influence of CCO on the costs of the IAIN II Palu lecture building construction project was that there was no increase or decrease in value between the initial contract value and the CCO value. Even though it has an impact on time, namely with a change order, overtime work occurs on several jobs, this does not affect the time schedule so that the implementation time is still completed according to the initial schedule made.

5. Conclusion

The important issue focused on in this study are the parties that influence the change order and the phase of the change order, There are 3 main issues. Firstly, of the 8 change order factors, the main change order factors in this project are errors and omissions in the calculation/estimated volume where as many as 100% of respondents' answered.. This is because the consultant planner is less careful in calculating the volume of work. Secondly, the main party that has the most influence on change orders is due to contractor requests till 70% of respondents. Finally, the change order phase in this project occurred at the beginning of project implementation where as many as 80% of respondents.

Identifying the causes of change orders is very important in order to avoid potential changes in future projects or to minimize their effects. Therefore to minimize the CCO, professional involvement in creating and improving the quality of detailed engineering design (DED) and improving the performance and commitment of service providers and understand project administration. Consultants and contractors should make use of the first meeting moment which is usually called the kick off meeting (KM). Thus basically, the initial meeting or KM is to discuss the plan drawings and design review and recalculate the volume according to the contract and the implementation strategy to avoid CCO.

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