INTERNATIONAL JOURNAL ON ADVANCED TECHNOLOGY, ENGINEERING, AND INFORMATION SYSTEM (IJATEIS)

ANALYSIS OF CONTRACT CHANGE ORDER (CCO) COSTS IN BUILDING CONSTRUCTION PROJECTS

Wahyu Pratondo W[1*], Budi Witjaksana[2], Hanie Teki Tjendani[3]
[1-3]Master of Civil Engineering Study Program, Faculty of Engineering,
Universitas 17 Agustus 1945 Surabaya
E-mail: [1)] wahyupratondo@gmail.com, [2)] budiwitjaksana@untag-sby.ac.id,
[3)] hanie@untag- sby.ac.id

Abstract

In project implementation, change orders frequently arise post-contract signing between the owner and contractor. These changes often stem from design modifications or budget adjustments by the owner. Contractor-initiated change orders result from disparities between design plans and bill of quantities, insufficient design details, impractical field conditions, complex design execution, and challenges in material mobilization. Poorly managed change orders can lead to increased costs, delays, and diminished contractor performance. To mitigate change orders, this study employs change order correlation analysis using original data, evaluating change order ratio (COR), change order ratio in addition (CORA), and change order ratio in subtraction (CORS). Analyzing six construction projects, the study concludes that the average Change Order Ratio Index (COR) is 26%, indicating a 26% change from the original contract value. The average Change Order Ratio in Addition (CORA) is 16%, signifying 16% of changes result from additional work. The average Change Order Ratio in Subtraction (CORS) is 10%, indicating 10% of changes stem from work being less than the original contract value.

Keywords: *Change Order, Contract, Building Construction Project*

1. INTRODUCTION

Construction projects are understood as a combination of various resources such as people, materials, equipment and costs that are gathered in a temporary organizational container to achieve certain goals and objectives. Construction projects are classified as complex work, because they have unique characteristics, are dynamic, full of risks and uncertainties because they are related to cost, time, quality, policies and resources(Putra & Sulistio, 2020). Construction projects are unique because there is never the exact same set of activities, there are only similar projects. This means that no project is identical or exactly the same, each project will have a different character. (Imron et al., 2022) Construction projects also require organizations to bring together a variety of different resources, both different in character, quality, and purpose, so construction projects tend to be risky. Efforts to realize a construction project will involve three parties who have a dominant role, namely the project owner (owner) or principal (employer/client/bowher), consultants and implementers (contractors). The work of a large construction project will go through a series of stages that are quite complicated, starting with the design - making activities by the planning consultant, continuing with the implementation stage by the implementing contractor, and supervised by the supervisory consultant or construction management. Planning consultant is an individual or a business entity that has the ability in various disciplines in their respective fields that act both as advisors and or planners

(in this case the field of structure and construction), in accordance with the wishes and needs of the owner as well as being able to act as a supervisor in its implementation. People or entities that finance, plan and carry out project activities are called elements - elements of development executors. Each of these elements has duties, obligations, responsibilities and authority according to their respective positions. In carrying out activities to realize a project, each party according to its position interacts with each other according to the established working relationship. (Wulfram I, 2005). The project provider or assignor or service user is the person or entity that owns the project and provides work or orders to provide work to the service provider and who pays the cost of the work. Service users can be individuals / agencies / institutions / government and private agencies. Parties / entities called consultants can be divided into two, namely planning consultants and supervisory consultants.

Planning consultants can be separated into several types according to their specialization, namely consultants who handle architectural fields, civil fields, mechanical and electrical fields, and so on. These various types of fields generally become one unit and are called planning consultants, namely people / entities that make complete building plans in the fields of architecture, civil and other fields that are closely attached to form a building system. Planning consultants can be individuals / individuals with legal entities / legal entities engaged in the planning of building work. (Wulfram I, 2005). The task of the planning consultant is to make a complete plan consisting of drawing plans, work plans, and conditions - the terms of implementation of the work, structural calculations and cost budget plans. Planning consultants must also be active in providing suggestions and considerations to service users and contractors about the implementation of the work. Planning consultants are obliged to provide answers and explanations to contractors about things that are unclear in the drawing plans, work plans, and conditions. Planning consultants are also required to attend project management coordination meetings(Wulfram, 2005). In order for the project work to run according to the design plan, the services of a supervisory consultant are needed, namely a person or business entity appointed by the service user to assist in managing the implementation of development work, especially overseeing the course of work from the beginning to the end of the project work based on the contract documents. In addition to the planning consultant and supervisory consultant, there is an implementing contractor, which is a person or business entity that receives work and organizes the implementation of work according to a predetermined fee based on the plan drawings and regulations and conditions set. The contractor can be an individual company incorporated or a legal entity engaged in the implementation of buildings.

The project cycle begins with a problem or need which then raises ideas to solve the problem, one of which can be done by providing a facility or building. Starting from the idea, the stages of construction project planning appear, which in detail will consist of the stages: (1) Planning, (2) Feasibility study, (3) Exposure, (4) Design, (5) Procurement or auction, (6) Implementation / construction, (7) Maintenance and preparation for use. The earliest and most decisive stage of the project is the planning stage. In this planning stage, the outline of the project plan is determined including: recruitment of consultants (Construction Management, planners) to translate the owner's needs, making Term of Reference (TOR) / Terms of Reference (KAK), surveys (location, materials, equipment), project feasibility studies, design selection, implementation

methods and budgets. The planning stage is a stage of explanation, study, evaluation and program that includes technical, economic, environmental, and other matters. The results of the planning stage are: (1)Survey report, (2)Feasibility study (3)Program and budget, (4)TOR (Term of Reference), (5)Master plan. The planning stage is followed by the design stage which consists of: (1) Preliminary Design stage which includes: design criteria, cut, plan, situation drawing, site plan layout, budget estimation (globally). After the pre-design stage, it is continued with the development stage of the design (Development Design), which is the development stage of the pre-design that has been made and more detailed calculations include: calculations - detailed design calculations detailed drawings outline specifications cost estimates for construction in more detail. The last part of the planning stage is the preparation of the final design and construction document which includes: detailed drawings for all parts of the work, detailed technical specifications of materials, list of work items and volume of each work item (bill ofquantity), detailed construction cost estimates, as well as general administrative requirements and general regulations (tender documents). The successful implementation of a construction project starts from the planning stage. Good planning will produce a detailed engineering design (DED)/detailed plan drawing that is clear, easy to understand, complete, accommodates all the wishes of the work owner, and is in accordance with field conditions. Ideal planning has thought about detailed material selection, selection of estimated work implementation methods, selection of work equipment to be able to estimate the duration of time required to complete a construction project work from the initial stage to the handover of work. However, a construction project is a complicated activity, involving many resources, requiring the right project management organization in order to work together to realize an ideal construction project in terms of cost, quality and time. This makes construction project activities classified as high-risk activities(Hamdani et al., 2017). Risk and uncertainty can be a contributing factor to the failure of construction projects to achieve predetermined goals (Ibbs and Seth (2009). In general, risk is associated with the possibility (probability) of the occurrence of events beyond what is expected (Soeharto, 1995). Risk is the possibility of a situation/event in the process of business activities, which can have a negative impact on the achievement of predetermined business goals, there are seven risk events that often arise in construction projects(Labombang, 2011), one of which is the procurement of additional work (Change Order; CO) Asiyanto (2005). Change Order is the impact of the risk of high uncertainty, work added or removed from the original scope of contract work that changes the entire contract value or time of completion of the work (Jaydeep et al. 2015) revealed that in every construction project there are often changes that can be called CO. That rarely in a construction project does not change until the project is completed, but the number of CO processes in a project is not recommended because it is more detrimental to the project itself (Nunnaly, 1993). Factors causing CO can arise from various sources, namely project owners, consultants, contractors, subcontractors, natural factors, social factors, policies and others. Changes in work or CO to construction costs cause an overrun of between 10-15% of the contract value (Fleming et al., 1990). Service users have a large role in work changes because service users do not give sufficient time to planning consultants in conducting construction project design (Ndihokubwoyo and Haupt, 2009). Of the 54 projects studied, work changes or CO of construction projects

can cause productivity levels to decrease (Ibbs, 1997). CCOs have such a large impact that they have a cumulative and disruptive effect (O'Brien, 1991). If the effects of CCOs are not compensated for, it can reduce the performance of work execution. CCO can affect or impact the performance of project implementation in terms of cost, quality and time(Witjaksana, 2019). CCO will affect the project which has an impact on project costs, project completion time, and quality of results. Unplanned changes that occur in construction projects can cause additional work beyond what is expected, which will have an impact on additional costs and time (Chen and Hsu, 2007). Another study showed that 95% and 100% of road and rail projects, respectively, had a maximum cost overrun of 50%. The main causes of cost overruns were found to be scope changes, delays during construction, unreasonable estimates, project cost adjustments, and no practical use of earned value management systems. Research by Sulistio & Waty (2008) showed that the percentage of change orders occurred in 28.26% of projects in East Kalimantan on excavation and embankment works on pavement projects. Waty & Sulistio's research (2020) states that the effects of change orders from the calculation of change orders for road projects in Banten are: delaying the project completion date, cost overruns, generating claims and disputes, affecting performance and morale, and most contractors incur additional costs. (Putra et al., 2020). Based on the party that causes CCO,(Setyawan et al., 2020) the factors that affect CCO can be grouped into 4 parts, namely the work owner, the consultant (planner and supervisor), the implementing contractor and the outside party. Problems from the owner's side can consist of (1) Delay in approving drawings, contract designs and clarifications (Owner Performance), (2) Changes in the scope of work or additional work volume, (3) Changes in work that has been completed (rework), (4) Acceleration of work implementation, (5) Temporary work stoppage, and changes in specifications and designs/materials. Problems from the consultant's side can be in the form of (1)Discrepancies between drawings and field conditions, (2)Changes in volume due to planning calculation errors, (3)Defects in design and specifications due to errors and incompleteness of design or changes in design, (4)Differences between specifications, drawings and BOQ in planning, (5)Details of drawings and specifications are not clear. Problems from the side of the executing contractor can be in the form of (1)Late delivery of materials, (2)Delay in labor supply, (3)Subcon performance is not good, (4)Mistakes in work implementation, (5)Work Accidents, (6)Delay in work implementation (reschedule), (7)Changes in work methods. Problems from external parties consist of (1)Weather or natural events beyond prediction, (2)Changes in government policy, (3)Third party intervention, and (4)Monetary conditions. In this study, the researcher wants to focus on research to measure the value of change order ratio (COR)(Surahman et al., 2020), change order in addition (CORA) and change order in subtraction (CORS) on the case study project.

The research object chosen to identify the value of the change order ratio (COR), is six real data in the form of project contract addendums carried out in the period 2017 - 2022 analyzed from archival data sources of supervisory consulting service provider companies from Surabaya. The six project data showed a significant influence of contract change orders(Khalim et al., 2021), both in terms of the causes of change orders, as well as the impact of change orders caused, namely delays to the contract time and additional project contract value(Ningsih et al., 2015). Of the six project addendum documents studied, five of them required additional budget and one project was completed with a

balance budget. Of the six projects studied, four of them required additional time to complete the work, and two other projects could be completed on time. This shows that change orders have a significant impact on project completion, especially in terms of time and cost. The amount of change order cost margin can be measured using several calculation analyses, namely COR, CORA, CORS, and CORS. (Edwin & Waty, 2020). Change Order of Ratio (COR) is an index used to measure the total variant cost of projects that experience change orders. This COR value is the value of changes that occur in projects that experience change orders. Change Order ratio in Addition (CORA) is an index used to measure the ratio of the total added budget on projects that experience change orders. Change Order Ratio in Substraction (CORS) is an index used to measure the ratio of the total less achieved on the project that is done change order.

From the background of the above problems , the objectives of this research are measuring the value of change order ratio (COR) on six case study projects, measuring the value of change order in addition (CORA) on six case study projects, and measuring the value of change order in subtraction (CORS) on six case study projects.

2. RESEARCH METHODS

The research object is six building work packages in Bangkalan, Surabaya and Malang whose implementation is supervised by the supervisory consultant PT Dira Bina Nusa Group in the 2017-2022 period.

Table 1. Case Study Project Data

No	Nama Paket Pekerjaan	Identifikasi Nama
1	Pembangunan Gedung Lab School Internasional Unesa	Proyek 1
2	Pembangunan Gedung Dekanat FE Tahap II (G-6) Unesa	Proyek 2
3	Pengadaan & Pemasangan Paving & Pembuatan Drainase Pada Jur. Kebidanan Politeknik Kesehatan Kemenkes Surabaya	Proyek 3
4	Pembangunan Kantin kampus Belakang Lab Soshum	Proyek 4
5	Rehab Berat Gedung Pelayanan B RSJ Lawang	Proyek 5
6	Pembangunan Rusun Pon Pes Muhammadiyah Boarding School	Proyek 6

Source: Recapitulation / Researcher's Process, 2023

The location of the research activities is the construction of buildings whose supervision is carried out by PT Dira Bina Nusa Group consultants in Surabaya City, Bangkalan, Trenggalek and Malang whose construction implementation in the 2017-2022 period.

Data collection is a process of collecting research data to be processed and formulated, processed so that it can provide answers to hypotheses.

The data collection method that will be used is descriptive method, namely by describing contract change orders that occur in construction projects which include the causes and impacts caused by the application of contract change orders(Dharmayanti,

2021). The data collected consists of primary data sourced from PT Dira Bina Nusa Group, in the form of work supervision documents that experience change orders.

Secondary data is data obtained from literature studies, such as books, references, journals, and other research related to this research topic. Secondary data collected in this study include:

a. Literature related to the parties involved in project activities consisting of work owners, planning consultants, supervisory consultants, and implementing contractors.
b. Literature related to contract change orders(Iskandar et al., 2022).
c. Contract change order addendum document(Murtopo et al., 2022).
d. Monthly Report on Physical Work Progress.
e. Cost Budget Plan of projects that use contract change orders.
f. Attachments to contract documents consisting of Detail Engineering Design (DED) drawings, Cost Budget Plan (RAB), Work Plan and Conditions (RKS)

Data collection in this study focused on secondary data in the form of detailed engineering design drawings, cost budget plans, and technical specifications obtained from planning consultants. Secondary data in the form of contract change orders are obtained from contractors. Secondary data in the form of minutes of change meetings are obtained from supervisory consultants.

The analysis used in this research is a quantitative analysis in the form of numbers to use analysis, and the data obtained is numerical based on the variables that are cause-and-effect.

The analysis of the causes of contract change orders is by using descriptive methods which explain the contract change orders that occur in construction projects which include the causes and impacts caused by the application of contract change orders(Harviyanti & Pasa, 2022), as well as the role of stake holders in controlling contract change orders(Martanti, 2019). The variables of factors causing change orders along with their indicators used in this study are as follows. There are several calculation analyses that can be used to measure change orders that occur, namely COR, CORA, CORS, FCO and PCO. (Edwin & Waty, 2020) :

Change Order Ratio (COR)

This index measures the total variance cost of projects that have change orders.

COR = (sum of additions and subtractions for change order projects divided by original contract price) x 100%

Change Order Ratio in Addition (CORA)

CORA = (sum of the value added from projects that experienced change orders divided by the original contract price) x 100%

Change Order Ratio in Subtraction (CORS)

CORS = (sum of the value of work less than the project for which the change order was made divided by the original contract price) x100%

Three indicators to calculate the change order cost margin, namely COR, CORA, and CORS. FCO is to measure the frequency of change orders while PCO is to measure and calculate the cause of change orders(Edward & Waty, 2020).

3. ANALYSIS AND DISCUSSION

3.1. COR, CORA, and CORS Analysis and Calculation

Change Order Ratio (COR) calculation is calculation done by comparing the change order value to the initial contract value . This index measures the total variant cost of the project where the change order occurs. Based on the analysis of calculations with COR shows that on average there is a change order value of 26% on the six project objects studied. The results of the CORA calculation analysis also show an average figure of 16% for change orders caused by additional work. The results of the CORS calculation analysis show an average of 10% for change orders caused by less work. The following presents the results of the analysis of COR, CORA and CORS calculations on the six research object projects:

Table 2. Results of COR, CORA, CORS Calculation Analysis of Case Study Project

No	Nama	Kontrak (Rp.)	Addendum (Rp)	Tambah (Rp.)	Kurang (Rp)	Jumlah Tambah+Kurang	COR (%)	CORA (%)	CORS (%)
1	Proyek 1	14.177.840.000,00	15.237.276.000,00	3.238.641.215,41	2.400.310.997,49	5.638.952.212,90	0,40	0,23	0,17
2	Proyek 2	6.761.600.000,00	7.379.200.000,00	2.213.946.000,00	1.596.346.000,00	3.810.292.000,00	0,56	0,33	0,24
3	Proyek 3	1.029.185.559,90	1.063.376.676,05	45.658.882,97	13.806.029,19	59.464.912,17	0,06	0,04	0,01
4	Proyek 4	1.944.514.000,00	1.944.514.000,00	122.762.982,41	109.871.686,98	232.634.669,39	0,12	0,06	0,06
5	Proyek 5	3.841.210.000,00	4.224.434.000,00	752.714.000,00	369.471.000,00	1.122.185.000,00	0,29	0,20	0,10
6	Proyek 6	2.933.447.200,00	3.185.715.805,97	332.399.795,21	80.131.189,24	412.530.984,44	0,14	0,11	0,03
						RATA -RATA	0,26	0,16	0,10

Source: Recapitulation / Researcher's Process, 2023

Based on the analysis of the calculation of the change order ratio (COR), it can be seen that the largest change order event occurred in project two, with a total change value of 56%, followed by project one change order of 40%, followed by project five at 29%. In fourth place there is project six with a COR value of 14%, in fifth place project 4 at 12%, and finally the project that experienced the least change order events was project three with a value of 6%.

Table 3. Results of Total Change Rating Analysis of Case Study Projects

No	Nama	Kontrak (Rp.)	Addendum (Rp)	Tambah (Rp.)	Kurang (Rp)	Jumlah Tambah+Kurang	COR (%)
1	Proyek 2	6.761.600.000,00	7.379.200.000,00	2.213.946.000,00	1.596.346.000,00	3.810.292.000,00	0,56
2	Proyek 1	14.177.840.000,00	15.237.276.000,00	3.238.641.215,41	2.400.310.997,49	5.638.952.212,90	0,40
3	Proyek 5	3.841.210.000,00	4.224.434.000,00	752.714.000,00	369.471.000,00	1.122.185.000,00	0,29
4	Proyek 6	2.933.447.200,00	3.185.715.805,97	332.399.795,21	80.131.189,24	412.530.984,44	0,14
5	Proyek 4	1.944.514.000,00	1.944.514.000,00	122.762.982,41	109.871.686,98	232.634.669,39	0,12
6	Proyek 3	1.029.185.559,90	1.063.376.676,05	45.658.882,97	13.806.029,19	59.464.912,17	0,06

Source: Recapitulation / Researcher's Process, 2023

The research findings recorded five dominant work items that contributed to change orders in each case study of the building works studied. In project case study one, the masonry and concrete work items practically dominated the occurrence of change orders

with a percentage change of 539%. This was due to the difference in the volume of the bill of quantities and plan drawings received by the executing contractor during the auction with the implementation in the field, resulting in volume shortages as a result of adjusting the drawings to the real conditions in the field.

In project case study 2, the ACP roof and facade cover work item became the largest contributor to the change order with a figure of 212.90%. This was due to the unavailability of roof covering material without trusses according to contract specifications at the time of implementation, so that a redesign process had to be carried out to change the roof covering from using roofing material without trusses to a roof covering design using trusses. The next change is related to the procedure for calculating the volume of concrete which causes a change in the back up volume of concrete which causes a reduction in the ACP work of the building facade, this can be considered to reduce the achievement of architectural building quality. Because the appearance of the building that should be beautified with ACP becomes a plain look of paint finishing.

In project case study 3, the work item of installing the main building power cable from the main panel is the biggest contributor with a figure of 120%. This is because the layout of the power cable placement path from the main building to the main panel is not the same because it is blocked by the existing ground water tank and the existing septic tank, so changes must be made to the cable track path. This caused the length of the main power cable to increase. The planning design drawings are less accurate, so they do not detect existing ground water tanks and existing septic tanks that are still functional.

In project case study 4, the floor elevation work item was the largest contributor to the change order at 150%(Ardine & Sulistio, 2020). This is due to the request for additional elevation height of the planned canteen floor against the paving road on the east side as well as the request for design changes from the work owner.

In project case study 5, the work item of procurement and installation of lamps is the biggest contributor to the change order of 100%. This is possible because the lamp work item has not been listed in the bill of quantities received by the implementing contractor at the time of the auction. This is also the case with building demolition materials whose volume has increased a lot compared to the bill of quantities. Meanwhile, in the dirty water installation work, there were additional work items that were not well identified in the planning process. In the frame work there are also many mismatches between the plan drawings, bill of quantities and the existing conditions in the field, this is a serious problem considering that the work carried out is rehabilitation including the replacement of wooden frames with aluminum.

In project case study 6, the external drainage work item around the building was the largest contributor to the change order with a figure of 65.80%. This is possible because the landscaping DED drawing does not match the factual conditions of the field so adjustments need to be made. The complete work items contributing to the change order ratio in the six case study projects are presented in table 4 as follows:

Table 4. Case Study Project Total Change Rating Analysis Results

No	Nama		Jenis Pekerjaan	Persentase Perubahan	Keterangan
1	Proyek 1	1	Pasangan & beton praktis	539,00	Volume kurang, penyesuaian gambar dengan BoQ
		2	Peralatan Fire Alarm	283,10	Penggantian peralatan utama, terkait dengan sistem
		3	Penutup atap	275,90	Penggantian material penutup atap
		4	Beton GWT dan rumah pompa	221,80	Volume kurang, penyesuaian gambar dengan BoQ
		5	Kusen, pintu dan jendela	148,60	Penggantian tipe kusen, pintu, jendela
2	Proyek 2	1	Penutup atap & fasade ACP	212,90	Volume kurang, perubahan tampilan fasade finishing ACP
		2	Papan nama/identitas bangunan	120,09	Volume kurang, perubahan tampilan desain
		3	Dinding partisi	94,00	Perubahan desain, menyesuaikan gambar dan HSPK setempat
		4	Kusen dan aksesoris	78,00	Perubahan desain, menyesuaikan gambar dan HSPK setempat
		5	Finishing lantai & dinding	77,00	Volume kurang, perubahan tampilan desain
3	Proyek 3	1	Pasang Kabel dari panel induk NYY 4x10 mm	120,00	Volume kurang, pemasangan mengikuti kondisi lapangan
		2	Pasang finishing batu alam	116,60	Volume kurang, gambar tidak sesuai dengan BoQ
		3	Coating batu alam	105,00	Volume kurang, gambar tidak sesuai dengan BoQ
		4	Galian Tanah Cadas/Rabat/Aspal	7,16	Volume kurang, gambar tidak sesuai kondisi lapangan
		5	Pengangkutan Bekas Galian Keluar Lokasi	7,16	Volume kurang, gambar tidak sesuai kondisi lapangan
4	Proyek 4	1	Urugan peninggian lantai	150,00	Volume kurang, gambar tidak sesuai kondisi lapangan
		2	Finishing lantai	125,20	Volume kurang, gambar tidak sesuai kondisi lapangan
		3	Pondasi	100,00	Volume kurang, gambar tidak sesuai kondisi lapangan
		4	Rabatan lantai kerja	100,00	Volume kurang, gambar tidak sesuai kondisi lapangan
		5	Atap	100,00	Item pekerjaan dobel, salah satu harus dihapus
5	Proyek 5	1	Lampu	100,00	Item belum ada di BoQ
		2	Sanitair	100,00	Volume kurang, gambar beda dengan BoQ
		3	Bongkaran bangunan eksisting	100,00	Volume kurang, gambar tidak sesuai kondisi lapangan
		4	Instalasi air kotor	83,00	Volume kurang, perubahan layout gambar karena kondisi lapangan
		5	Kusen	80,00	Gambar denah kusen, detail kusen, kondisi lapangan berbeda
6	Proyek 6	1	Drainase luar di sekeliling bangunan	65,80	Gambar tidak sesuai layout
		2	Lansekap	57,04	Volume kurang
		3	Ground tank dan rumah pompa	47,39	Volume kurang
		4	Pekerjaan struktur dan rumah pompa	37,17	Volume kurang
		5	Pekerjaan utilitas di luar bangunan	33,94	Volume kurang

Source: Recapitulation / Researcher's Process, 2023

Description of the causes of work changes that led to contract change orders on the six projects of the research study object(Sari et al., 2020):

a. Job Owner

The owner of the work may submit a change order in consideration of changes in budget conditions, related to the development plan of the area where the building is located in the future, improving the quality of the work, and the final result of the work that is different from the expectations of the owner of the work at the time of planning.

b. Planning Consultant

The planning consultant can give consideration to approve or reject the proposed changes with technical considerations. One of the causes of design changes in terms of planning factors is that the planned material is no longer available (discontinue), there are conditions that were not expected at the time of planning, such as the construction of the

foundation of the former old building, the condition of the building plan site that has changed and is not the same as the conditions at the time of planning, the soil structure is different from the planner's assumptions, and there are changes in government policy rules.

c. Supervisory Consultant

The supervision consultant can provide a chronological identification report and documentation of factors causing the change order(Edwin & Waty, 2020), as well as help collect field data to assist the planner in determining technical justification and alternative solutions related to the proposed changes submitted with technical or administrative (contract) considerations.

d. Implementation Contractor

The implementing contractor can propose a change order if there is a design plan that is different from the field conditions, a volume that is different from the field conditions, a volume that is different from the design plan, discontinue material specifications / difficult to find in the market, design plans and design details that do not support each other so that it is necessary to make drawings of proposed changes and changes in implementation methods due to field conditions.

The findings of the research on the six case study projects noted that change orders affected cost and time and ultimately reduced implementation performance. Of the six case study projects, five of them experienced additional costs of varying magnitude, ranging from the lowest 103.32% to the highest 109.98%. Likewise, in terms of time, change orders that occurred in the six case study projects caused the need for additional time for four case study projects. This additional time was used for recalculation, method adjustment, and the change order administration process that required the approval of the parties(Kosasi et al., 2019).

Table 5. Results of Change Order Analysis and Its Effects on Six Case Study Projects

No	Nama	Kontrak	Addendum	Tambahan Anggaran		Keterangan	Tambahan Waktu
		(Rp.)	(Rp)	(Rp)	(%)		
1	Proyek 1	14.177.840.000,00	15.237.276.000,00	1.059.436.000,00	107,47	Tambah anggaran	Tambah Waktu
2	Proyek 2	6.761.600.000,00	7.379.200.000,00	617.600.000,00	109,13	Tambah anggaran	Tidak Ada
3	Proyek 3	1.029.185.559,90	1.063.376.676,05	34.191.116,14	103,32	Tambah anggaran	Tidak Ada
4	Proyek 4	1.944.514.000,00	1.944.514.000,00	-	100,00	Balance Budget	Tambah Waktu
5	Proyek 5	3.841.210.000,00	4.224.434.000,00	383.224.000,00	109,98	Tambah anggaran	Tambah Waktu
6	Proyek 6	2.933.447.200,00	3.185.715.805,97	252.268.605,97	108,60	Tambah anggaran	Tambah Waktu

Source: Recapitulation / Researcher's Process, 2023

Based on the analysis and recapitulation of contract change order documents on the six projects used as research objects, the following facts can be found(Lela et al., 2022):

1. There are change orders or additions and deletions in the six projects under study.
2. There were additional costs in five projects and one balance budget in six projects used as research objects.
3. There was an increase in time in four projects and two case study projects still completed the work according to the contract time.

4. Change orders that occurred in the six projects of the research study object were dominantly caused by the volume of work listed on the BoQ was less or did not match the detailed design drawings, the volume was less due to the volume of BoQ and drawings that did not match the field conditions so that the drawings and volume of work had to be adjusted, work items not yet listed in the BoQ, incomplete design plan drawings that required interpretation and detailing, a request for design changes from the owner, a request for material changes from the owner, the layout of the design plan did not match the field conditions.
5. Change orders in the six case study projects were initiated by the work owner and the implementing contractor. (Mangampa et al., n.d.)The proposed change order submitted by the work owner was due to Changes in Detail Engineering Design due to changes in the owner's wishes in the middle of the work implementation and Adjustments to the available budget.
6. The proposed change order submitted by the implementing contractor is due to Differences in Detail Engineering Design drawings with factual field conditions, Differences in volume calculations between Detail Engineering Design drawings and Bill of Quantity bid by the implementing contractor at the time of the auction, There are discontinuous materials or difficult to find in the market, Proposed improvements in the quality of steel door work results, Differences in volume calculation procedures in concrete work that cause change orders(Waty & Sulistio, 2021).

4. CONCLUSION

The conclusions of the change order research on the six study object projects that experienced contract change orders are as follows:

1. The average Change Order Ratio (COR) index in the six projects of the research study object is 26%. This means that the 6 projects studied experienced a proportion of changes amounting to 26% of the original contract value.
2. The average Change Order Ratio in Addition (CORA) index in the six projects studied was 16%. This means that of the 6 projects of the study object experiencing a change order, 16% is due to additional work from the original contract value.
3. The average Change Order Ratio in Subtraction (CORS) index in the six projects is 10%. This means that of the 6 projects that experienced change orders, 10% were caused by work less than the original contract value(Widhiawati et al., 2016).

5. ADVICE

From the above conclusions, suggestions can be given which may be useful in the future, namely:

1. Before carrying out the construction implementation process, the work owner must choose a planning consultant who is professional, reputable, experienced in the field of work similar to the work to be done, has certified experts, has good financial performance, considering that the design planning stage is the initial stage that

determines the success or failure of the next stage, namely the implementation of building construction.

2. The job owner should require the planning consultant to carry out a sequential process of planning activities starting from the planning contract, submission of the method of carrying out the planning work, reviewing the planning site, discussing the planning terms of reference, checking the suitability of the land ownership letter, measuring the land, checking the suitability of the land with the city plan (SKRK), soil investigation, identification of internal studies (building function plan, building philosophy, type of activity, duration of activity, type of space, space demands, space relationships), identification of external studies (shape and size of the site, condition of buildings around the site, land boundary rules, buildable area, land accessibility, views out and into the site, site contours, site surface conditions, utilities around the site, noise analysis, sunlight orientation analysis, and site surface drainage).
3. The work owner should require the planning consultant to conduct exposure and consultation at the stage of understanding the terms of reference, identification of internal studies, identification of external studies, design philosophy, determination of design concepts, preparation of pre-design designs, preparation of design designs, volume calculations, determination of technical specifications of materials, assumption of implementation methods, and calculation of cost budget plans.
4. The owner of the work should include an obligation to the planning consultant to oversee the implementation of the construction phase of the implementation with a mechanism for periodic supervision of the planning consultant and withholding payment of the planning consultant's services by 15% (in accordance with the regulation of the Minister of Public Works No. 22/PRT/M/2018 concerning Procedures for the Construction of State Buildings, page 23.
5. Before the planning document is tendered, an evaluation assessment should be carried out, related to the suitability of the detailed engineering design to the applicable normative provisions and design design regulations, checking the list of work items and the quantity of each work item and its back up volume, the suitability of the procedure for calculating the volume of work to the Indonesian National Standards and the Minister of Public Works Regulations governing the procedure for calculating the Budget Plan, the procedure for determining the price list reference used (if using a price survey as a price reference reference), source of reference for wage and material price lists (if using the local Work Unit Price Analysis as a price reference), a list of bid price support letters sourced from vendors or material suppliers, a list of vendor or supplier names and contact persons who can be contacted for clarification, material technical specifications related to market availability and continuity of supply, and an examination of the feasibility of the implementation method assumed by the planner.
6. It is recommended that the time gap between planning and the time of implementation of the work is as minimal as possible / not too long, so that planning assumptions and conditions in the field at the time of planning, material prices and availability have not changed.

REFERENCES

ardine, A. A., & Sulistio, H. (2020). Penyebab Change Order Pada Proyek Konstruksi Gedung Bertingkat. *Jmts: Jurnal Mitra Teknik Sipil*, 511–522.

Dharmayanti. (2021). Analisis Faktor Penyebab Contract Change Order Dan Pengaruhnya Terhadap Kinerja Pelaksanaan Proyek Konstruksi Di Lingkungan Pemerintah Kabupaten Badung. *Spektran*, *9*(2), 141.

Edward, P., & Waty, M. (2020). Penyebab Change Order Pada Proyek Perkerasan Jalan. *Jmts: Jurnal Mitra Teknik Sipil*, 207–214.

Edwin, D., & Waty, M. (2020). Analisis Korelasi Biaya Change Order Terhadap Bobot Pekerjaan Pada Dua Proyek Jalan Aspal Provinsi Banten. *Jmts: Jurnal Mitra Teknik Sipil*, 175–182.

Hamdani, H., Isya, M., & Abd Rani, H. (2017). Analisis Risiko Penawaran Underestimate Cost Terhadap Kualitas Proyek Konstruksi Jalan Di Provinsi Aceh. *Jurnal Teknik Sipil*, *1*(2), 511–520.

Harviyanti, E., & Pasa, Y. A. (2022). Analisa Faktor Yang Berpengaruh Terhadap Terjadinya Cco (Contract Change Order) Pada Proyek Pembangunan Laboratorium Fisika Sma 1 Sekatak. *Jurnal Sains Benuanta*, *1*(2), 1–8.

Imron, M. A., Tjendani, H. T., & Witjaksana, B. (2022). Analysis Of Factors Causing Variation Order In Construction Projects Of Pt. Tatamulia Nusantara Indah Surabaya Branch Office 2018-2022 Period. *Devotion Journal Of Community Service*, *3*(14), 2695–2706.

Iskandar, Y., Susetyo, B., & Suroso, A. (2022). Pengaruh Contract Change Order (Cco) Terhadap Kinerja Biaya Pada Proyek Hunian Bertingkat Tinggi. *Konstruksia*, *13*(2), 55–80.

Khalim, M. A., Adi, H. P., & Rochim, A. (2021). Analisis Contract Change Order Pada Pelaksanaan Proyek Apartemen Alton Semarang. *Wahana Teknik Sipil: Jurnal Pengembangan Teknik Sipil*, *26*(2), 222–234.

Kosasi, M. H., Andi, A., & Arijanto, L. (2019). Analisa Aspek-Aspek Dalam Prosedur Change Order Pada Proyek Konstruksi. *Dimensi Utama Teknik Sipil*, *6*(1), 9–16.

Labombang, M. (2011). Manajemen Risiko Dalam Proyek Konstruksi. *Smartek*, *9*(1).

Lela, J. C., Manoppo, F. J., & Supit, C. J. (2022). Analisis Penyebab Dan Pengaruh Contract Change Order Terhadap Kinerja Kontraktor Pada Proyek Konstruksi Di Kabupaten Minahasa Selatan. *Jurnal Ilmiah Media Engineering*, *12*(1).

Mangampa, M. I. S., Latupeirissa, J. E., & Tiyouw, H. C. P. (N.D.). *Analisis Contract Change Order Terhadap Waktu Pada Proyek Pembangunan Stasiun Kereta Api Makassar-Pare Pare*.

Martanti, A. Y. Y. (2019). Analisis Faktor Penyebab Contract Change Order Dan Pengaruhnya Terhadap Kinerja Kontraktor Pada Proyek Konstruksi Pemerintah. *Rekayasa Sipil*, *7*(1), 32–42.

Murtopo, A., Nugroho, A., & Budihardjo, M. A. (2022). Kajian Contract Change Order (Cco) Pada Proyek Pembangunan Laboratorium Terpadu Universitas Tidar. *Reviews In Civil Engineering*, *6*(2), 46–52.

Ningsih, N., Syahrudin, S., & Wardhani, N. (2015). *Identifikasi Dan Analisis Penyebab Dan Akibat Contract Change Order Terhadap Biaya Dan Waktu Pada Proyek*

Konstruksi. Tanjungpura University.
Putra, H. E., & Sulistio, H. (2020). Pengaruh Change Order Terhadap Biaya, Mutu, Dan Waktu Pada Proyek Konstruksi Gedung Bertingkat. *Jmts: Jurnal Mitra Teknik Sipil*, 1349–1362.
Sari, H., Anwar, C., & Rizal, F. (2020). Evaluasi Contract Change Order Pada Proyek Peningkatan Jalan Blang Mee–Kuala Keureuto Barat Kabupaten Aceh Utara. *Jurnal Sipil Sains Terapan*, *3*(02).
Setyawan, P. A., Wardani, A. A. A. C., & Putra, C. (2020). Evaluasi Faktor Penyebab Terjadinya Contract Change Order (Cco) Pada Proyek The Hava Villa. *Widya Teknik*, *13*(01), 9–18.
Surahman, E., Satrio, A., & Sofyan, H. (2020). Kajian Teori Dalam Penelitian. *Jktp: Jurnal Kajian Teknologi Pendidikan*, *3*(1), 49–58.
Waty, M., & Sulistio, H. (2021). Change Order Dan Risiko Change Order Pada Proyek Jalan Di Jawa Barat. *Paduraksa: Jurnal Teknik Sipil Universitas Warmadewa*, *10*(1), 124–141.
Widhiawati, I. A. R., Wiranata, A. A., & Wirawan, I. P. Y. (2016). Faktor-Faktor Penyebab Change Order Pada Proyek Konstruksi Gedung. *Jurnal Ilmiah Teknik Sipil*, *20*(1), 1–7.
Witjaksana, B. (2019). Activity Based Management Change Order Model-Based Economic Value Added Through The Effectiveness And Efficiency To Improve The Financial Performance Of Building Construction Projects In Surabaya City. *Archives Of Business Research*, *7*(2).
Wulfram, I. E. (2005). Manajemen Proyek Konstruksi Edisi-Revisi. *Penerbit Andi, Yogyakarta*.

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/).