

The Potential Causes of Contractual Change Orders Sourced from The Construction Phase of The Building Project

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Abstract. The process of implementing construction projects often encounters changes. One of these changes is the change order. After recognizing its existence, the change is formalized by the issuance of a change order, which is a document that describes the scope of the change and its impact on project performance. If agreement is not reached between project participants on the changes, it becomes a claim or dispute that can negatively affect project implementation and reduce the chances of project success. Changes in construction projects are frequent and can occur from many different sources, for many different reasons, at any phase of the project and can have far-reaching impacts. This study aims to identify the factors that cause Contractual Change Order (CCO) to arise during the construction phase of building projects in Banda Aceh. This study uses a quantitative method with data collection techniques through distributing questionnaires to 36 contractor companies in Banda Aceh City. Data testing was done with validity and reliability tests, while the data analysis used was descriptive. From the research results, 16 CCO factors were identified during the construction project implementation phase. It was determined the two main causes of change orders from the contractors' view are bad weather conditions and soil conditions.

1 Introduction

Change orders have always been a necessary component of the building sector. Construction projects almost always contain changes of some kind, which are the consequence of several factors that are attributed to the various parties involved in the project's implementation. A change order, which is a document outlining the modification's scope and potential effects on cost and/or time, is issued once the change has been acknowledged and is formally regularized. If the parties involved in the project are unable to come to a consensus over the modification, it becomes a claim or dispute that could have a detrimental impact on the project's execution and reduce its chances of success.

Changes in construction projects are regular and are likely to occur from varied sources, by a range of causes, at any phase of a project and may have a wide-ranging impact [1]. Mubarak

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and Nurisra [2] identified the factors that cause change orders in building projects consist of planning, unforeseen conditions, design changes, and changes in scope and specifications. Oyewobi, et al. [3] found that there are 13 primary causes of variation orders in educational building projects: inadequate resources, inconsistent client behavior, improper contract coordination, inadequate work separation, multiple construction projects underway at the same time, complex drawing detail, inadequate understanding and interpretation of the customer's requirements, poor technology application, poor contractual procedure, omission during construction, contractor initiated changes. Senouci et al [4] identified 21 factors that cause change orders in Qatari construction projects. Uttam and Bhirud [5] in their view considered the main cause of change orders is modifications made by the owner to the design plan and schedule; however, the most common sources of variation in construction are procedural and error adjustments, design modifications, and changes made by customers and their consultants to the project scope and specifications. Martanti [6], on a government building project in Bogor, obtained 5 (five) dominant factors causing CCO which consisted of the project owner's request for optimization of building functions, discrepancies between drawings and field conditions, poor design/drawing, significant volume differences between drawings, field conditions and bill of quantities, and the clause on change orders was not clearly stated in the construction contract. Hansen [7] revealed six causes of CCOs from the Gelora Bung Karno (GBK) Aquatic Stadium project as a case study which are design/specification changes, scope changes, schedule changes, policy changes, site condition changes, and imported material problems. Ardine and Sulistio [8] of high-rise building construction projects in Jabodetabek obtained two factors that have a significant influence on the change order, namely construction factors and administrative factors. Iskandar et al. [9] identified the influencing factors of the contract change order work on high-rise residential projects including changes in the scope of work, changes in specifications, changes in design by consultants, changes in site conditions, natural disasters or floods.

Although, many studies related to change order in construction projects have been conducted in many countries, little or no research was found that illustrates or explains the causes of CCOs sourced from the construction phase. Over the entire building life cycle indicates that the construction phase, while not as significant as the use phase, is as important as other life-cycle stages [10]. Change orders need to be closely monitored, otherwise, conflicts may also emerge among all project participants [11].

Therefore, to eliminate or reduce the unwanted circumstances that could lead to these defects, it becomes essential to examine and analyze the causes of contractual change orders to understand their effects on project delivery. Thus, this study aims to identify the causes of CCO at the construction phase in building projects. To achieve the objectives of this study, a review of existing relevant literature was carried out on potential causes of CCO in building projects with a special emphasis on the construction phase. Construction companies with previous experience constructing buildings in Banda Aceh city were surveyed to collect data. The information presented in this article will help governments and the agencies in charge of managing public works in managing CCOs in construction projects.

2 Literature Review

The following three subsections provide and explain the findings derived from the literature review of the contract change order.

2.1 Construction project phases

A construction project is a sequence of actions to accomplish a goal (building or construction) within a specific time, money, and quality constraints. Projects involving construction include multiple phases [12]. Project construction stages are the phases that a construction project goes through, starting from the initial concept and ending with the delivery of the final result. Although there are other ways to split up the phases of a project's construction, seven phases constitute a popular method:

1. *Initiation*: the client, project owner, and supervisor establish the project's goals, objectives, scope, and viability. They also develop a project initiation document and analyze the location.
2. *Feasibility study*: this phase aims to convince the owner that the proposed construction project is feasible.
3. *Briefing*: the owner provides a description of the project's functions and allowable budget so that the consultant can correctly interpret the owner's requirements and estimate the appropriate costs.
4. *Design*: the schematic design, design development, and construction documentation are produced by the architects, engineers, and designers in this phase. They also secure the project's required approvals and permits.
5. *Procurement*: aims to select the contractor who will be executing the construction on site.
6. *Construction*: the actual construction is completed in this phase. Apart from overseeing the site operations and communicating with stakeholders, the project manager also monitors progress and resolves conflicts. Suppliers and contractors deliver their goods and services in accordance with the terms of the agreement.
7. *Maintenance and start-up*: the project manager ensures that all specifications and requirements are met by the project. They also test and inspect the equipment and systems, train staff members and users, and hand over the project to the owner or customer.

A crucial part of any building project is the construction phase. This phase involves carrying out the actual building work, and it is crucial to guarantee that the project is completed on time, within budget, and quality of work. The fundamental component that guarantees a project's success is the appropriate implementation of the successive phases of construction planning. Different decisions should be made during various phases based on presumptions, imperfect facts, and the experiences of construction professionals.

2.2 Contractual change order

The word "changes" in any construction project refers to a set of instructions that permit additions, modifications, and deletions from contracts as a way to describe the size, scope, and type of work that has to be done. A written order signed by the owner and given to the contractor, a change order is described as an addition to or decrease in work that can be made about the initial scope of work of a contract [13]. A modification or addition to the original plans, specifications, or other contract requirements is referred to as a change. An employer's directive approving a modification is known as a change order. Due to the complexity of construction projects, it is nearly impossible to complete a building project without making modifications to the plans or the construction process itself. For this reason, change is a crucial component of construction project management.

In projects managed by the Indonesian government, Peraturan Presiden No. 16 Tahun 2018 on government procurement of goods/services [14], regulates variation orders, more often known as Contract Change Orders (CCO), in clause 54, which state that if there are

differences between site conditions at the time of implementation and the drawings and/or technical specifications specified in the contract document, owner and service providers can make changes to the contract, which include to increase or decrease the volume stated in the contract, adding and/or reducing the type of activity, changing technical specifications following field conditions, and/ or changing the implementation schedule. Furthermore, in the case of contract changes that increase in contract value, the addition to the final contract value shall not exceed 10% of the price stated in the initial contract.

A change order on a construction project is an event that results in modifications to either the scope of work, execution time, or cost [15]. This is most likely unavoidable on most projects due to the uniqueness of each project and the limited time and cost in the planning process. These changes may occur at the early stage, mid-stage, late stage of the project, or at more than one stage of the project. CCO during construction implementation comes from the parties involved in the project, namely the owner, consultant, and contractor, as well as other factors related to project implementation. On the other hand, CCO does not always have a negative impact on construction projects, CCO can also have a positive impact such as accelerating work time, improving work quality, and cost savings due to using more effective work methods [16].

2.3 Causes of CCO in the construction phase

Modifications have become the norm in building projects nowadays. This circumstance has prompted scholars to carefully examine change orders in an attempt to ascertain their sources and minimize their negative impacts. Many studies have identified causes of change orders in the building project. The focus of this study is to identify the cause of CCO during the construction phase in Indonesia. Mubarak and Nurisra [2] indicated sources of CCO related to the construction phase are a lack of information on project location, changes in scope due to the disclosure of new conditions that are different from the results of previous studies, changes in the scope of work at the request of the owner, changes in market conditions, specification changes, unforeseen circumstances, and force majeure. Senouci, et al [4] identified a total of 21 factors that cause change orders in Qatari residential and commercial projects. Out of these 27 factors, 6 factors originate from the construction phase which are changes of plans or scope by the owner, delays in the project, changes in the quantities of work, local governments, differing site conditions, and safety considerations. Oyewobi, et al [3] identified 13 main factors as causes of change orders on educational building projects in Nigeria, and factors that source from the construction phase are lack of attention to site condition, increase in construction cost, inconsistent government policy, high cost of material, change in plan and scope by the client, and change in the specification by the client. Furthermore, Martanti [6] identified owner's request, cost overrun, delays, and differing site conditions as factors causing CCO in building projects in the Bogor government building. Ardine and Sulistio [8] identified the causes of CCO of high-rise building construction projects in Jabodetabek are the difference between design drawings and field conditions, changes in scope of work, changes in specifications, temporary suspension of work, the underground conditions different from the investigation results, groundwater seepage during excavation, changes in project site conditions and safety considerations. Specification changes, scope changes, site condition changes, policy changes, soil conditions, and forces majeures are the change order causes at the Gelora Bung Karno Aquatic Stadium project in Jakarta [7]. Based on those literature reviews a total of 16 factors that cause CCO from the construction phase in building projects [Table 1].

Table 1. Causes of CCO from the construction phase

No.	Cause of CCO	References
1	Soil condition	[7, 8]
2	Differing site condition	[6, 8, 9]
3	Site inaccessibility	[2, 3, 4]
4	Changes in scope due to the disclosure of new conditions	[2, 4, 7, 8, 9]
5	Temporary suspension of work	[4, 7, 8]
6	Changes in the scope of work at the request of the owner	[2, 3, 4, 6, 8,]
7	Employer’s policies,	[7, 8]
8	Postponement of work due to owner's request	[8]
9	Government regulation/policy	[3, 4, 7, 8]
10	Market changes	[2, 3, 8]
11	Change of specification	[2, 3]
12	Force majeure	[2, 7, 8]
13	Bad weather	[2, 7, 8]
14	Natural disasters	[2, 7, 8, 9]
15	Price changes	[2, 3, 6]
16	Occupational safety considerations	[4, 8]

3 Research methodology

The main research objective of this paper is to identify the potential cause of CCO in building projects during the construction phase. To achieve this aim of the research, a quantitative questionnaire and descriptive statistical analysis method were used, through surveying 35 contractors in Banda Aceh City were chosen randomly. The selected contractors are those who have been involved in building projects in Banda Aceh.

Furthermore, the variables used for the research questionnaire were derived from the relevant literature review and these were amended to suit the purpose of this study to ensure the reliability and validity of the variables used. The respondent was asked to indicate their response on factors as causes of CCO from the construction phase as identified through previous studies. The questionnaire in this study is divided into two parts, namely part 1 is in the form of questions related to the characteristics of respondents and companies, while part 2 is in the form of questions related to CCO factors. The aim of the questionnaires in part 2 was to obtain for ranking the cause of CCO. Five-point Likert scale was used to assess the likelihood of CCO occurrence. The overall ranking of CCO causal factors was obtained by the mean rank score. The mean score analysis was conducted using the following equation [17]:

$$MS = \frac{\sum_{i=1}^5 W_i X_i}{\sum_{i=1}^5 X_i} \tag{1}$$

Where: W= Weight assigned to i_{th} response; $W_i= 5, 4, 3, 2,$ and 1 for $i= 1, 2, 3, 4$ and 5 respectively; i =Response category index= $1, 2, 3, 4$ and 5 for never, seldom, sometimes, often and very often respectively; X_i = Frequency of the i_{th} response; Ms = Mean rank score.

4 Result and discussion

The following three subsections provide and explain the findings derived from the previously mentioned analysis.

4.1 Respondents' profile

Respondents' profiles describe the situations of personnel and company. Profiles for 36 respondents involved are shown in Table 2. The table shows that 100 percent of the respondents are professionals, whereas 83 percent of respondents have more than 5 years of experience in the construction project. Contractor qualifications are dominated 89 percent by medium-sized companies and a small number of large-scale companies. This suggests that the respondents' responses could be verified because they have relevant expertise in the subject area.

Table 2. Respondent's profile

No	Respondent's Profile	Quantity	Percentage (%)
1.	<i>Professional designation</i>		
	Director	9	25.00
	Engineer	19	52.78
	Project Manager	8	22.22
2.	<i>Year of experiences</i>		
	0 – 5 years	6	16.67
	> 5 – 10 years	11	30.56
	> 10 – 15 years	11	30.56
	Above 15 years	8	22.22
3.	<i>Company qualification</i>		
	Medium	32	88.89
	Big	4	11.11

4.2 Result of validity and reliability test

The questionnaire instrument testing was carried out with validity and reliability tests [17]. The validity of the questionnaire was determined by calculating the correlation between the data in each statement and the total score, using the Pearson Product Moment correlation formula. After doing the validity test the researchers conducted a reliability test. Reliability refers to an understanding that an instrument is reliable enough to be used as a data collection tool. Reliability analysis was conducted by calculating Cronbach's Alpha value. All 16 variables in the test showed that $R_{count} \geq R_{table}$, with a 5% significant threshold of R_{table} 0.329, indicating that the instrument is deemed legitimate. Table 3 shows the test results for reliability that all of the examined variables have Cronbach's Alpha value larger than 0.6.

Table 3. Result of validity and reliability test

No.	Test	Value	Benchmark	Result
1.	Validity	$R_{count} = 0.329 - 0.847$	$R_{table} \geq 0.329$	Valid
2.	Reliability	$\alpha = 0.757$	$\alpha > 0.6$	Reliable

The questionnaire data collection in this study is therefore fully valid, allowing it to proceed on to the next analysis phase, according to the validity and reliability test on the CCO variables at the project construction phase.

4.3 Cause of CCO factors

Causes of CCO factors were analyzed and ranked according to respondents' responses based on mean score value. There are 16 factors that initiate change orders in construction projects as observed from the literature review of previous researchers in this area. Table 4 and Fig.

I summarize the findings of this study. The factors were ranked and based on the overall ranking, Table 4 shows that the mean score obtained is in the range of 2.194 to 3.944. Based on the interpretation of the mean score, it shows that the potential occurrence of the CCO factor is from very rare to frequent. Frequent factors are bad weather (3.944) and soil conditions (3.528). Infrequent factors are differing in site conditions (3.139), site inaccessibility (2.611), changes in scope due to new conditions (2.694), temporary suspension of work (2.722), changes in the scope of work due to owner's request (2.833), employer's policy (3.139), market changes (2.528), changes in specifications (2.861), and natural disasters (2.667). Postponement of work due to owner's request (2.444), government regulation/policy (2.194), and force majeure (2.472) are very rare factors that cause CCO in the construction phase.

Table 4. Mean score causes of CCO

Code	Causes of CCO	Mean Score	Standard Deviation	Rank
A	Soil condition	3.528	0.956	2
B	Differing site condition	3.139	0.785	6
C	Site inaccessibility	2.611	1.094	12
D	Changes in scope due to the disclosure of new conditions	2.694	1.045	10
E	Temporary suspension of work	2.722	1.158	9
F	Changes in the scope of work at the request of the owner	2.833	0.692	8
G	Employer's policies	3.139	0.717	5
H	Postponement of work due to owner's request	2.444	1.025	15
I	Government regulation/policy	2.194	0.775	16
J	Market changes	2.528	1.054	13
K	Change of specification	2.861	0.856	7
L	Force majeure	2.472	1.028	14
M	Bad weather	3.944	0.845	1
N	Natural disasters	2.667	1.025	11
O	Price changes	3.361	0.710	3
P	Occupational safety considerations	3.278	0.826	4

As illustrated in Fig. 1 the overall CCO factor is based on their mean score values. It revealed that the two top-ranked factors that cause contract change order are bad weather and soil condition.

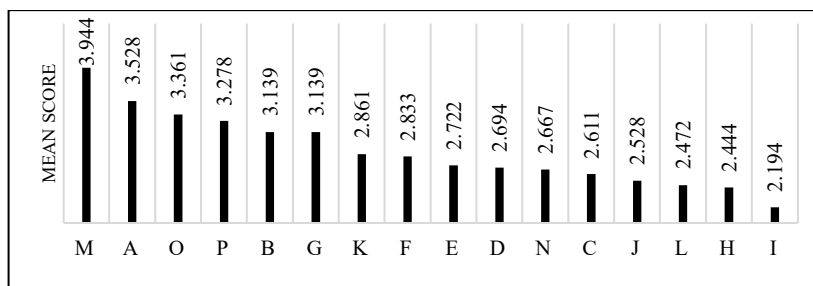


Fig. 1. Causes of CCO Ranking

Global climate change that triggers extreme weather events also affects weather conditions in the city of Banda Aceh. Weather conditions can be said to be unpredictable, where from

hot weather there can be heavy rain and strong winds. Such severe weather can have negative impacts on society and the environment, such as flooding, landslides, infrastructure damage, logistic disruption, and disruption of activities. Since bad weather can have a variety of effects on construction operations, it can lead to contract change orders in building projects. A few consequences of inclement weather include decreased visibility for both workers and equipment materials or equipment damage from strong winds and rain, foundation or job site instability from erosion and flooding, etc. These consequences mean that bad weather has the potential to delay the construction schedule and endanger the workers and the building's safety. Therefore, the contractor or the owner may request a change in the scope of work, the cost of the project, or the timeline of the project.

The second highest rank of CCO factor is soil condition. According to [7], poor soil condition leads to groundwater seepage during excavation and an increase in soil condition investigations. The lack of a soil investigation process causes inaccurate data that requires re-investigation during the work. Soil conditions are one of the factors that can cause cost overrun in building projects, especially when they are not properly investigated or accounted for in the design and planning phases [18, 19]. In a building project, poor soil conditions may result in a contract change order. Poor soil can have a variety of effects on construction projects. For example, it can have a low bearing capacity, requiring more fill, excavation, or foundation work to sustain the structure. Another scenario is that the soil can be unstable or prone to erosion, necessitating additional protection, drainage, or stabilization techniques. Unexpected obstructions like rocks or utilities may be present in the soil, necessitating additional expenses for removal, relocation, or alteration. These circumstances may lead to the project requiring more labour, supplies, machinery, time, or risk, which could raise costs and lead to disagreements or delays. Thus, before beginning a project, it is crucial to carry out a comprehensive soil investigation and analysis.

Conclusion

This paper investigated the cause of the construction phase of the building project in Banda Aceh City. Sixteen causes of CCOs were identified in the literature review. Through structured questionnaires with 36 respondents, 16 common and significant factors were identified. The result showed that the potential occurrence of the CCO factor are from very rare to frequent, which consists of the following 2 frequent factors, 9 infrequent factors, 3 very rare factors, and 3 factor hardly ever happens. From the ranking of factors causing CCO during the construction phase, the two highest factors are bad weather and soil conditions. The results of this study are expected to contribute to the knowledge of improved contract management practices related to CCO events.

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