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Impact of Plan Changes on Construction Duration: Case Study Road Reconstruction Project in West Lombok Regency, Indonesia

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Abstract
Construction activities are very dynamic activities, large resources and many parties involved. In construction activities are also faced with many problems, one of which is the existence of contract changes or Contract Change Order (CCO) that have an impact on the timing of construction project implementation. This study aims to determine the causal factors and the impact of changes caused by CCO on time, cost and quality at the time of implementation of construction projects on the Lembar - Sekotong - Pelangan Road Reconstruction package project (Lembar - Gili Mas Segment) 2 in West Lombok Regency. To find out the causal factors and the impact of the influence of CCO on the implementation time of construction projects, the respondents' data were analyzed by distributing questionnaires to the parties directly involved in the Lembar - Sekotong - Pelangan Road Reconstruction Package (Lembar Gili Mas Segment 2) Project in West Lombok Regency, Indonesia. Analysis of the results of the respondents' questionnaire answers using non-parametric statistical method Relative Importance Index (RII). From the results of the analysis, it is found that the causal factors and the impact of the influence of CCO are respectively from the construction indicators of design changes during the project and acceleration of work, time indicators of planning and design changes during the project and frequent delays in work, cost indicators of cost over runs (cost overruns) and damage to equipment used in the field, and from quality indicators of less than optimal planning results and quality of materials that are not suitable in the field.

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Introduction

In every construction project, there are usually changes known as Contract Change Order (CCO). It is rare for a construction project not to undergo changes until completion (Nunnally, 1993) [4]. Problems that are often experienced in construction work are changes, where the changes themselves can be in the form of volume differences, addition or subtraction of work, work delays, extension of work time for certain reasons. With these changes, it is inevitable that there will be a change in the work contract or CCO.

In Government projects, especially in the field of highway construction, the Unit Price Contract system is generally applied. This contract system is considered the easiest to implement and provides a balanced risk sharing of contract changes between Service Users and Service Providers. With the Unit Price Contract system, contract changes both related to implementation time, volume, design, and value (price) are very likely to occur.

The existence of CCO has a significant impact on the implementation of construction contracts, especially on Government projects in the field of road projects. These impacts include project budgets that become larger than the initial plan, extension of implementation time, and the emergence of new designs or work items that had not previously been planned. On the Lembar - Sekotong - Pelangan Road Reconstruction Package (Lembar - Gili Mas Segment 2) project in West Lombok Regency, Indonesia

(as a case study), when a CCO is being faced and resolved by the parties involved in a project, it is important to conduct research to analyze the right strategy in handling the CCO.
This research aims to identify effective approaches in the implementation of construction projects and overcome changes that occur in case study project. From this, it will be investigated what are the main causes of CCO, and its impact on construction implementation, cost, quality and time on the case study project.

Methodology

The methodology used includes literature studies to identify how much influence or impact a factor causing CCO has on the implementation, cost, quality and time of construction project implementation. The collected data were analyzed by Relative Importance Index (RII).

Literature Review

Keane *et al*. (2010) [2] categorized the causes of change orders into three categories based on the parties involved in the contract, namely change orders related to owners, contractors, and consultants:

1. Owner-related Change Orders can arise due to scope changes, owner financial problems, inadequate project objectives, substitution of materials or procedures, decision-making process bottlenecks, owner stubbornness, and specification changes by the owner.
2. Change Order related to consultants, consultants may request variations due to design changes by the consultant, errors or omissions in the design, problems in the contract documents, technological changes, value engineering, lack of coordination, design complexity, inadequate working drawing details, poor knowledge of available materials and equipment, lack of data required by the consultant, ambiguous design details, and specification changes by the consultant.
3. Change Order related to the contractor can occur due to lack of involvement in design, unavailability of equipment, lack of skills, financial difficulties of the contractor, desired profitability, differences in field conditions, poor workmanship, unfamiliarity with local conditions, fast track construction, poor procurement process, lack of communication, procurement delays, complex design and technology, and lack of strategic planning.

According to Keane *et al*, (2010) [2], the impact of change orders can be grouped into five categories: cost, quality, time, organization-related effects, and other effects.

1. **Cost-Related Effects:** Delayed payments can lead to increased project costs due to interest charged. The change order processing process involves procedures, documentation, and reviews that must be completed before they can be implemented, which in turn can increase overhead costs. In addition, additional payments to contractors are often a potential effect of change orders in construction projects. Change orders are often perceived as additional work for the contractor, which can add to the overall project cost.
2. **Quality-Related Effects:** Change orders during the project can affect the quality of the final result. If change orders occur frequently, this can reduce the quality of work as constant changes can disrupt the consistency and stability of the project. In addition, Change Orders can affect the project completion time and may cause an acceleration of the construction process. This acceleration often has a negative impact on quality, as the reduction in time available for work can reduce attention to detail and quality standards.
3. **Time-Related Effects:** Change Orders that occur during construction, or even afterward, often lead to rework and delays in project completion. Change Orders can affect the progress of the project, which in turn can impact payments to subcontractors, as the main contractor usually cannot pay subcontractors until they receive payment from the project owner. Delays in completion schedules are a common problem in construction projects. In addition, logistical delays can occur as Change Orders often require new materials and equipment, which can add to the time needed to complete the project.
4. **Organization-Related Effects:** Disputes over Change Orders and claims are often unavoidable, and Change Order clauses are often a major source of disputes in projects. Construction changes are a major cause of disputes in construction projects, which can affect the professional relationship between the parties involved, leading to further disputes and delays. These claims and disputes can adversely affect a company's reputation and increase the likelihood of professional conflicts.
   In addition, variations in the project may affect safety conditions. Change Orders may require additional methods and precautions which, if not properly managed, could lead to poor safety conditions. Acceleration of work due to Change Orders can worsen safety conditions, and delays in completion, failure to meet quality standards, and increased risk of work accidents can damage the firm's reputation, worsen professional relationships, and cause disputes among professionals.
5. **Other Effects:** Change Orders can affect project progress without directly causing delays. The negative time-related effects of a Change Order can be offset by accelerating the completion of the work. By implementing effective acceleration strategies, contractors can mitigate the adverse time impact of Change Orders, ensuring that the project remains on track despite the changes.

Results and Discussion

From the literature study it is discovered that data collected is analyzed by using Relative Importance Index (RII) analysis of impact factors of CCO to construction project time duration (Infantri, 2024) [1] In terms of construction indicators (Table 1), variables X1 and X13 are the design changes during the project and the acceleration of work have two top impacts on the existence of CCO (Infantri 2024) [1]; this is because changes during the project implementation period often occur due to the wishes of the project owner that arise during the construction phase. This can be caused by various factors, such as changes in the scope of work, changes in specifications, changes in material types, changes in architectural planning, changes in work methods, and the need to accelerate the implementation of work. (Sapulette, 2009) [5].
In terms of time indicators (Table 2), variables X20 and X17, which are changes in planning and design during the project and frequent delays in work, respectively, have a significant impact because this occurs due to sudden design changes that make scheduling change (Infantri, 2024) [1]. Design changes will always affect the scope of the project, so scope planning needs to be updated and completed to avoid errors in implementation. Changes to the initial design will have a major impact on the material procurement plan for all

construction activities. If the preliminary design has already entered the implementation stage, these changes can have a significant impact on the project implementation time and potentially cause delays in the construction project (Mochtar and Shesia, 2023) [3].

In terms of cost indicators (Table 3), variables X22 and X25, namely the occurrence of cost over runs and damage to equipment used in the project, have a very influential impact on the continuity of the implementation of construction projects (Infantri, 2024) [1]. This occurs because of informal changes submitted directly in the field without official records, which occur due to errors in implementation or design errors that result in a job that cannot be done in the field due to existing changes. Therefore, contractors should submit changes in writing. These changes must be based on strong administration as support, so that there are no disputes between actors in a construction project (Wirawan, 2019). It is proposed by the contractor to the owner to change the scope of work, implementation time, costs or other matters that are different from those specified in the contract documents. These provisions usually give the owner unilateral freedom to change the scope of work and require the contractor to follow these changes (Widhiawati, 2016) [6].

In terms of quality indicators (Table 4), variables X30 and X31, namely the results of suboptimal planning and the quality of materials that do not match the field, have a significant impact on the implementation of work in the scope of construction projects (Infantri, 2024) [1]. This occurs due to the influence of external factors that are difficult to predict as a cause of Change Order (Widhiawati, 2016) [6]. Previously the contract addendum and CCO changed the contents of the contract which caused the work to be less than optimal completion. The unavailability of materials or materials needed according to specifications due to truly scarce market conditions results in delays in the completion of construction work.

Finally, In terms of all the above findings, from an expert point of view in his existing book according to (Widhiawati, 2016) [6] CCO is a written agreement signed by the owner, contractor, and planner to change or modify the work listed in the contract documents. These changes can include adjustments to the cost and time of the work.

Table 1: Construction Indicators Relative Imprtance Index (Infantri, 2024) [1]

NO	Impact Factors of CCO to Construction Project Time Duration	Rank
A. Construction Indicators		
X1	Design Changes	1
X13	Work Acceleration	2

Table 2: Time Indicators Relative Imprtance Index (Infantri, 2024)

NO	Impact Factors of CCO to Construction Project Time Duration	Rank
B. Time Indicators		
X20	Work delays	1
X17	Changes of Planning and design during project implementation	2

Table 3: Time Indicators Relative Imprtance Index (Infantri, 2024)

NO	Impact Factors of CCO to Construction Project Time Duration	Rank
C. Cost Indicators		
X22	Cost overruns during construction	1
X25	Construction equipment downtime	2

Table 4: Time Indicators Relative Imprtance Index (Infantri, 2024)

NO	Impact Factors of CCO to Construction Project Time Duration	Rank
D. Quality Indicators		
X30	Sub-optimal Planning	1
X31	Material quality is not according to the specifications	2

Conclusion

From the results of analyzing the respondent's data and analyzing the answers to the questionnaire, the factors causing the occurrence of CCO and the impact of the effect of CCO on time, cost and quality on the implementation of the case study of Lembar-Sekotong-Pelangan Road Reconstruction Project in West Lombok Regency, Indonesia are as follows:

1. In the construction indicators, there are two most dominant causal factors and the impact of the influence of CCO, namely design changes during the project and acceleration of work, in planning roads and bridges requires understanding and accuracy in reading the intentions desired by the owner. Frequent communication and consultation so that there are no differences in intent between the owner and the planner, aims to minimize design changes.
2. In the time indicators, there are two most dominant factors that cause CCO that are quite influential, namely changes in planning and design during the project and frequent delays in work, schedules that often change and delays in materials coming to the site which cause delays in several work items.
3. In the cost indicators, there are two most dominant causal factors and the impact of the influence of CCO which is quite influential, namely the occurrence of cost over runs and damage to the equipment used in the project, the increase in material prices that are not in accordance with the approved contract and the addition of labor to catch up with delays and lack of maintenance of heavy equipment and the age of old equipment makes the equipment not work optimally in the field.
4. In the quality indicators, there are two most dominant causal factors and the impact of the influence of CCO that are quite influential, namely suboptimal planning and the quality of materials that do not match the field, the existence of contract addendums and CCO that change the contents of the contract which causes suboptimal work completion and the unavailability of the required materials according to specifications because market conditions are really scarce or limited.

From the results of analyzing the answers to the respondent's questionnaire, the suggestion in overcoming the impact of the influence that occurs due to the CCO at the time of implementation of the case study construction project the Lembar-Sekotong-Pelangan Road Reconstruction in West Lombok Regency, Indonesia is as follows:

1. In the time indicators, there are two suggestions, namely trying to accelerate the critical path if there is a delay and holding a work meeting so that there is no miscommunication between all parties, so that delays can be prevented or minimized.
2. In the cost indicators, there is one suggestion, namely holding a regular monitoring process to control the development of changes so as to minimize the occurrence of cost over runs (cost overruns) during work implementation.

3. In terms of quality indicators, there are two suggestions, namely ensuring that the materials used comply with technical specifications and monitoring and supervising the work carefully.

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