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Analysis of Factors Causing Contract Change Orders (CCO) in the Construction Project of the City Furniture Center Building in Surakarta

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***Abstract* - Contract Change Order (CCO) is an activity to change the work contract of a project. CCO has become a unique part of a project because the CCO that occurs will be different for each project. The emergence of CCO in the implementation of construction projects will have an impact on project owners and contractors who carry out construction. Therefore, this paper is made with the aim of analyzing the risk factors that cause CCO in construction projects, especially in the Surakarta City Furniture Center Building construction project, which during its implementation found obstacles that forced CCO on the project. This paper was conducted using the Likert scale method approach; Relative Importance Index (RII), and severity index (SI) in order to find the main risk factors for CCO in the project, for data collection in this research was carried out by distributing questionnaires. At the end of the analysis, 3 main factors causing CCO were found, which included differences in the size of work items and building structures required in the field with the plan drawings, the existence of several construction operations that could not be carried out, and from the project owner's request to change the building design. After the discovery of these three main factors, it is hoped that the next development project will be able to avoid the existing risk factors and later be able to improve the quality of work and the final results of existing work.**

Keywords: Contract Change Order, risk factors, Likert scale, Relative Importance Indeks, severity indeks.

I. INTRODUCTION

A project is a series of interconnected activities with a specific start and end point and deliverables. Projects are usually cross-functional, requiring different skills from different professions and organizations. Every project is unique, no two projects can be exactly the same, in both there will definitely be a difference.

A construction project is a series of interconnected activities to achieve a specific goal (building/construction) within specified time, cost and quality constraints. Construction projects always require resources such as people, materials, machines, methods, money, information, and time. Construction projects are large, complex, unique, dynamic, and risky work, as well as uncertainty. During the implementation of construction work there will be changes in the work that occurs, both major changes and minor changes [12]. These changes can occur at the beginning, middle or end of the project implementation.

Changes in work that occur in construction projects will cause a change in the existing work contract, often referred to as a Contract Change Order (CCO). In short, a Contract Change Order (CCO) can be defined as a modification of the original project contract [7]. CCO in a construction project is an activity that changes the scope of work, implementation time, and also the cost of implementing a project. These three scopes cannot be separated when a CCO occurs [5]. A construction project rarely runs without a CCO. This is usually caused by various causes originating from various parties involved in project implementation [1].

Every construction project has a cause of CCO, and the cause will never be the same from one project to another [2]. Some of the factors that cause CCO itself come from changes in building design made by consultants for the main source, and changes in materials used in construction are the second factor for CCO [1]. In addition, the existence of CCO is caused by a decrease in the quality of work during the construction project as the main source, and the occurrence of a dispute between the owner and the contractor is the second cause of CCO in a construction project [4]. Apart from what has been mentioned, there are actually many more causes of CCO.

The emergence of CCOs in the implementation of construction projects will have an impact on both the project owner and the contractor carrying out the construction. Significant and extensive changes in the work will affect the quality of the project. Such as the implementation of construction work that deviates or does not comply with the contract value and the value of the documents previously agreed between the owner and the contractor. To avoid disputes that can result in delays and completion of work, an agreement between the various parties involved is required [6].

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The emergence of CCOs can also put a strain on the relationship between owners, planners, contractors, subcontractors and other parties involved in the construction process. Not only is your workflow disrupted, but working relationships are strained while trying to quickly get response estimates, working drawings, and many other things needed to get the workflow back on schedule [11].

If unmanaged, change orders in CCOs can balloon. Changing the amount of work through the contract change mechanism can increase the project cost by about 10-15%. Government of Indonesia projects limit the amount of additional costs due to CCO to 10% of the price specified in the initial contract based on Presidential Regulation No. 54 of 2010 [3]. A CCO in its implementation must pay attention to the availability of existing budgets and limit the amount of additional costs incurred.

With the impacts caused by the existence of this CCO, making CCO is often avoided by parties involved in a construction project. One of the ways that can be done is to prevent the factors that cause CCO in a project, therefore of course in-depth research is needed regarding the factors that cause a CCO.

The Surakarta City Furniture SME Center Building construction project itself is one of the government projects located at JL. A.Yani Gilingan Surakarta City. It is a project that is divided into three work sessions in which the first session is carried out in 2022.

During the construction period, this project did not escape the obstacles that occurred. The constraints that occur are sourced from various parties involved in the implementation of the project, and due to the existence of several obstacles this makes the construction project of the Surakarta City Furniture IKM Center Building a CCO.

There are some differences that exist in the type, handling method, and volume of work between what happens in the work contract and what is in the field conditions, to overcome this, a CCO is carried out. This made changes to several aspects of the Sentra IKM project, the changes that occurred certainly had a significant impact on the workmanship and the final results of this project.

This research is intended to identify the main factors causing a CCO in building construction projects, especially in the construction project of the Surakarta City Furniture SME Center Building so that in the implementation of the next development project, these factors can be avoided.

II. METHOD

The steps in this research are shown in the research flow chart.

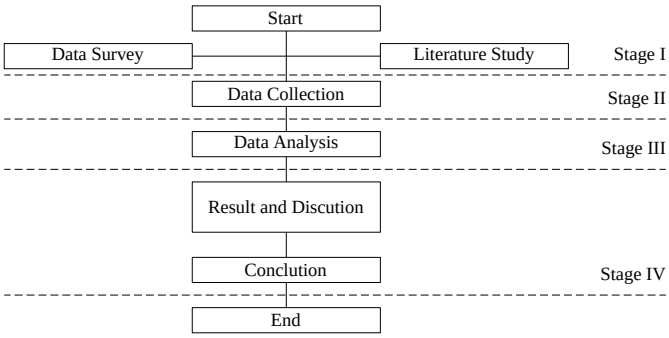

Figure 1: Research Flow Chart

2.1 Data Survey and Literature Study

The first step in this research is a data survey of the factors causing CCO through direct observation at the project site and interviews with parties involved in project implementation.

The literature study was carried out by looking for references or sources both from the internet, journals, final assignments, and from technical books that support the analysis in this research. Literature studies are taken from various sources, including magazines, books, documents, the internet, and libraries. Literature study is a series of activities on how to collect library materials, how to read and record, and how to manage writing materials [8].

2.2 Data Collection

The data collection method used in this research is a questionnaire questionnaire. The research object itself is the parties involved in the implementation and decision making on the project. The research objects are representatives of the project owner, the Implementing Contractor Team on the project, namely personnel from PT Reka Esti Utama, and the management consultant team, namely personnel from CV Sokogi Reksacipta.

There are 5 main variables used as independent variables in this study, namely plan drawing indicators, contract document indicators, project owner indicators, construction implementation indicators, and external indicators which can be seen in Table 1.

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Table 1: Indicators and Risk Factors Questionnarie

Indicator	Code	Risk Factors	Reference
Detail Engineering Design	A.1	Discrepancies in location/position between plan drawings and existing conditions in the field	[9]
	A.2	There is a difference in size between the plan drawing and the size in the field	Interview
	A.3	Design complexity not followed by detailed plan drawings	Interview
	A.4	Material specifications are not easily obtained or discontinuous	Interview
	A.5	No Building Information Modeling (BIM) implementation	[9]
Contract Documents	B.1	Lack of clarity of contract documents in relation to add-less work	[9]
	B.2	Specification requirements of materials used	Interview
	B.3	Complexity of work method	[9]
	B.4	Requirements for the demanded experts	[9]
	B.5	Problematic tendering process	[9]
Project Owner	C.1	Request for contract changes by the project owner for optimization of building designation	Interview
	C.2	Lack of coordination and communication between project owners and contractors	Interview
	C.3	Lack of coordination and communication between the project owner and the consultant	[9]
	C.4	Delay of the project owner in authorizing changes to the contract	[9]
	C.5	Request for contract changes based on budgetary issues	[9]
Contractor	D.1	Changes to the contract due to work plans that cannot be applied in the field	Interview
	D.2	Low coordination between contractor and consultant	[9]
	D.3	Implementation methods are not implemented as scheduled	[9]
	D.4	Specifications that are too binding on certain manufacturers	[9]
	D.5	Contractor's inability to understand the plan	[9]
External Factors	E.1	Changes to government regulations	[9]
	E.2	An unfavorable climate	Interview
	E.3	Lack of neighborhood support	[9]
	E.4	Occurrence of natural disasters	[9]
	E.5	Uncertainty of payment according to the term	[9]

This questionnaire was distributed to 10 respondents who were divided into 3 position groups, for a description of each position group can be seen in Figure 2.

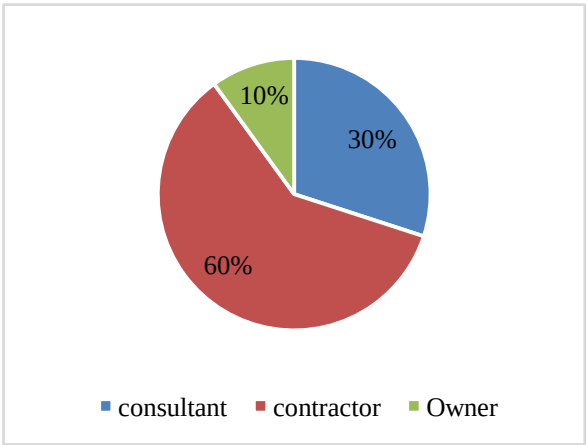

Figure 2: Number of respondents by job title

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2.3 Data Analysis

The scale used in the preparation of the questionnaire in this study is the Likert Scale. Likert scale is a scale used to measure attitudes and opinions. In this study, the Likert scale was used to complete a questionnaire that required respondents to indicate their agreement with a series of risk factors that had been provided [10]. The effect of this statement will be grouped into 5 scale levels which consist of Strongly Disagree, to Strongly Agree. The Likert scale values used can be seen in Table 2.

Table 2: Likert Scale Values

Scale	Value
Strongly Disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly Agree	5

The results of the assessment of each indicator will be processed using the Relative Importance Index (RII) approach to determine the most important variables affecting the existence of CCO. The determination of the RII value is as follows.

$$RII = \frac{\sum W}{AxN}$$

With:
W = Total Likert scale values for each variable/indicator
A = The largest value of the Likert scale
N = Number of respondents for each category variable

To determine the order of the most relevant variables or indicators in the emergence of CCO, the severity index (SI) approach is used. The equation for determining SI on a Likert scale with a maximum value of 5 is as follows.

$$SI = \frac{\sum_{i=1}^{5} a_i n_i}{5 \sum_{i=1}^{5} n_i}$$

With:
ai = Acquisition of value from respondent i on a scale of 1-5
ni = Frequency of respondent i

The SI value ranges from 0 to 100 where a value of 0 states that the factor/statement is not relevant while a value of 100 states that the factor/statement is considered very relevant. SI value categories in terms of their relevance can be seen in Table 3.

Table 3: Scale Category Severity Index

SI Value (%)	Relevance
80 < SI ≤ 100	Very High
60 < SI ≤ 80	High
40 < SI ≤ 60	Medium
20 < SI ≤ 40	Low
0 < SI ≤ 20	Very Low

III. RESULTS AND DISCUSSIONS

The results of the assessment of each indicator from the respondents can be seen in Figure 3.1 with statement A is related to Detail Engineering Design (DED), statement B is related to contract documents, statement C is related to project owners, statement D is related to construction implementation, and statement E is related to external factors.

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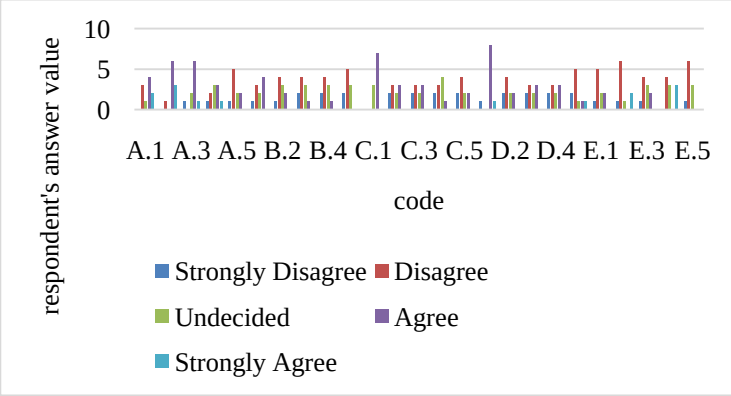

Figure 3: Recap of answer result

The Relative Importance Index (RII) method is used to determine the influence of a factor or variable that causes CCO. The RII value is given by Equation (1). The RII value ranges from 0 to 1. The RII results are then sorted from the highest RII value to the lowest RII value. The higher the RII value, the greater the impact on CCO. Table 4 shows the level of RII value for each indicator.

Table 4: Relative Importance Index (RII) Results

Code	Risk Factors	RII
A.2	There is a difference in size between the plan drawing and the size in the field	0,82
D.1	Changes to the contract due to work plans that cannot be applied in the field	0,76
C.1	Request for contract changes by the project owner for optimization of building designation	0,74
A.3	Design complexity not followed by detailed plan drawings	0,72
A.1	Discrepancies in location/position between plan drawings and existing conditions in the field	0,70
E.4	Occurrence of natural disasters	0,64
A.4	Material specifications are not easily obtained or discontinuous	0,62
B.1	Lack of clarity of contract documents in relation to add-less work	0,58
B.2	Specification requirements of materials used	0,52
C.2	Lack of coordination and communication between project owners and contractors	0,52
C.3	Lack of coordination and communication between the project owner and the consultant	0,52
D.3	Implementation methods are not implemented as scheduled	0,52
D.4	Specifications that are too binding on certain manufacturers	0,52
E.2	An unfavorable climate	0,52
E.3	Lack of neighborhood support	0,52
A.5	No Building Information Modeling (BIM) implementation	0,50
E.1	Changes to government regulations	0,50
C.4	Delay of the project owner in authorizing changes to the contract	0,48
C.5	Request for contract changes based on budgetary issues	0,48
D.2	Low coordination between contractor and consultant	0,48
D.5	Contractor's inability to understand the plan	0,48
B.3	Complexity of work method	0,46
B.4	Requirements for the demanded experts	0,46
E.5	Uncertainty of payment according to the term	0,44
B.5	Problematic tendering process	0,42

The Severity Index (SI) method is used to identify the factors that are most relevant to CCO. SI values range from 0 to 100. The lower the SI value, the lower the relevance to CCO. The magnitude of the SI value as well as the SI scale of each risk factor itself is shown in Table 5.

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Table 5: Severity Index (SI) Result

Code	Risk Factors	SI	Relevance
A.1	Discrepancies in location/position between plan drawings and existing conditions in the field	70	High
A.2	There is a difference in size between the plan drawing and the size in the field	82	Very High
A.3	Design complexity not followed by detailed plan drawings	72	High
A.4	Material specifications are not easily obtained or discontinuous	62	High
A.5	No Building Information Modeling (BIM) implementation	50	Medium
B.1	Lack of clarity of contract documents in relation to add-less work	58	Medium
B.2	Specification requirements of materials used	52	Medium
B.3	Complexity of work method	46	Medium
B.4	Requirements for the demanded experts	46	Medium
B.5	Problematic tendering process	42	Medium
C.1	Request for contract changes by the project owner for optimization of building designation	74	High
C.2	Lack of coordination and communication between project owners and contractors	52	Medium
C.3	Lack of coordination and communication between the project owner and the consultant	52	Medium
C.4	Delay of the project owner in authorizing changes to the contract	48	Medium
C.5	Request for contract changes based on budgetary issues	48	Medium
D.1	Changes to the contract due to work plans that cannot be applied in the field	76	High
D.2	Low coordination between contractor and consultant	48	Medium
D.3	Implementation methods are not implemented as scheduled	52	Medium
D.4	Specifications that are too binding on certain manufacturers	52	Medium
D.5	Contractor's inability to understand the plan	48	Medium
E.1	Changes to government regulations	50	Medium
E.2	An unfavorable climate	52	Medium
E.3	Lack of neighborhood support	52	Medium
E.4	Occurrence of natural disasters	64	High
E.5	Uncertainty of payment according to the term	44	Medium

It can be seen in Table 5 above that most of the risk factors in each indicator mostly have medium and high relevance to the causes of CCO, then it can also be seen in Table 5, the problematic job auction process and the uncertainty of payment according to the term are the risk factors that have the least relevance to the occurrence of CCO. This shows that in the process of auctioning work there are no significant obstacles (no problems occur) and payment of work achievements according to the term runs smoothly.

Based on the results of the analysis that has been done, it can be taken 3 risk factors that have the most influence on the occurrence of CCO in the construction project of the Surakarta Furniture SME Center Building.

The first comes from the Detail Engineering Design (DED) indicator where the difference in size between the plan drawing and the size in the field is the cause. It can be seen in Table 4 and Table 5 that this factor has the highest RII value and SI value, making this factor the main influence and relevance to the occurrence of CCO on the project. During the process, it is often found that there is a difference in the size of a work item, as well as the structure needed in the field with the plan drawings in the DED. This causes some structures and work items to be redesigned so that their implementation can be carried out precisely following the conditions needed in the field.

Next comes from the Construction Implementation indicator where contract changes due to work plans that cannot be applied in the field are the cause. This factor is the factor that has the largest RII value and SI value in the Construction Implementation indicator compared to the other four factors. This factor is still continuous with the previous factor where in the process there are several construction implementations that cannot be carried out due to conditions in the field that are not possible, one of which is pit-lift work where the implementation must be adjusted to the approved

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elevator product so that there are size adjustments and additional pit-lift foundations and walls.

The last is from the Project Owner indicator where the request for contract changes by the project owner for optimization of building designation is the biggest factor in the indicator compared to other factors in the same indicator. In its implementation, the project owner who had gone through discussions and discussions with the parties involved in the project finally decided to make changes to the building design, precisely in the front building / showroom where the building reduced the building grid on the right and left sides of the building which initially had a length of 68 meters to 52 meters, this was shown because in the initial plan the building design could block the existing road circulation.

IV. CONCLUSION

Based on the results of the study, several conclusions were obtained, including:

a) Indicators that influence the existence of CCO in the construction project of the Surakarta City Furniture IKM Center Building include those related to the Detail Engineering Design (DED) which does not match the conditions in the field. Implementation of construction that is not the same as the initial work plan, as well as requests from the project owner to make changes to the contract for optimization of building designation.
b) Based on the analysis of the questionnaire results, 3 main factors were obtained, namely, the difference in the size of work items and structures required in the field with the plan drawings, the existence of several construction implementations that could not be carried out, and from the project owner's request to change the building design.
c) The 3 indicators and risk factors that have been analyzed should be considered during the implementation of the second and third stages of the project.

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