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Internal Factors Cause Change Order in High-rise Building Projects, Case Study: Hotel Projects in Malang

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ABSTRACT

Change is a common thing in construction. With change orders, changes can be made to change the scope of work or quality. This study consisted of 70 respondents from the owner, consultants, and contractors who handle high-rise building projects. From the respondent's response to the internal change order factors that affect time and cost performance by using the Relative Importance Index (RII) analysis, from the Owner side indicator produces the owner variable instructing additional work, from the consultant indicator it produces estimation error variables, from the contractor indicator it produces the delay variable previous construction by another contractor. Based on case studies, the number of additional time resulted in 22.91% of the contract planning time. Meanwhile, the number of additional costs resulted in 8,717% of the planning cost contract.

Keywords: Change Orders, RII, high-rise building projects, additional time, additional cost

1. INTRODUCTION

According to the Central Statistics Agency (BPS), in the first quarter of 2019, the contribution of construction to the Indonesian economy is quite large, 10.76 percent of Indonesia's Gross Domestic Product (GDP). This shows that construction in Indonesia is quite developing in 2019. According to the Ministry of Public Works and Public Housing, government projects have implemented the Project Design and Build (DB) method, because of the conventional Design Bid Build (DBB) method, the owner is at risk of requesting changes and claims from contractors have an impact on cost overruns, rework, additional work and completion of work that is often not on time [1]. According to [2], the average value of change orders in DB construction projects is 4.04% for school and campus building projects. According to [3], changes during project construction are inevitable in most construction projects, and change orders are issued to improve or modify the original design or scope of work. According to [4], design changes exist in construction projects and often lead to cost overruns or schedule delays. Change is almost always there in high-rise building construction projects. The problem facing construction in Indonesia is disputes between employers and contractors due to claims filed by contractors, especially in the public construction sector. Poor understanding of contracts, especially general terms of contracts, is the main cause of disputes [5]. The large number of parties involved in the project requires coordination between parties to avoid changes. Any changes that occur will impact changes in schedules and costs that have been previously planned.

Based on literature analysis, this study formulates the following problems:

- What internal factors cause change orders that affect the time performance

of high-rise building projects seen from the indicators?

- How much will it cost and increase the time for a high-rise building project?

The purpose of this study is to find out the internal factors that cause change orders seen from the owner, consultant, and owner indicators, and the amount of time and cost added due to change orders in high-rise building projects. The parties involved anticipate changes that can occur in the construction stage because the costs incurred due to changes at the construction stage are quite high.

2. LITERATURE REVIEW

Change orders are any changes that occur in a construction project after the details of the project design are completed and accepted by the owner [6]. In research [7], Change orders are usually changes in the scope of a construction project, can have a significant impact on costs, time, safety, labor productivity, and quality of work. In the study [6] Research on school building renovation projects, the results show that, on average, change orders increase project costs by 3.56% of the total contract costs for these projects and that three-quarters of project cost growth is due to change order. In addition, about 40% of these projects faced schedule overruns due to order changes. Additional client work and design modifications were the most important factors causing change orders, followed by the unavailability of construction instructions and procedures [7]. According to [8], the causes of change orders that affect time are divided into four categories, including:

- Causes of owners: (1) Financial Problems (2) Scope Change or Modification (3) Late Decision Making (4) Material Change (5) Insufficient Project Objectives (6) Specification Change (7) Inflexible Nature
- Causes of consultants: (1) Inadequate Drawings & Details (2) Specification Change (3) Conflicts in Contract Documents (4) Inadequate Design (5) Design Changes (6) Design Errors and Omissions (7) Poor Knowledge of Materials &Equipment's (8) Poor Coordination (9) Lack of Required Data (10) change in Technology (11) Inflexible Nature of Consultant (12) Value Engineering
- Causes of contractors: (1) Financial Problems (2) Lack of Strategic Planning (3) Equipment Shortage (4) Unfamiliarity with Local Conditions (5) Different Site Conditions (6) Unavailability of Skills (7) Lack of Communication (8) Poor Procurement Process (9) Complex Design (10) Complex Methods or Technology (11) Poor Workmanship (12) Lack of Involvement in Design (13) Fast Track Construction (14) Desired Profitability (15) Inflexible Nature of the Contractor

3. MATERIALS & METHODS

This research is quantitative & qualitative research, using interview techniques and questionnaires. Interview respondents consisted of experts and experts in the field of high-rise building construction. What is meant by experts here are people who have a degree of expertise and are practitioners in the construction field who have 15-20 years of work experience. Meanwhile, the respondents to the questionnaire were from parties involved in construction activities, such as the owner, consultants, and contractors. The consultants consist of structural, architectural, mechanical-electrical, and supervisory consultants. In this study, there are two variables, namely the dependent variable (Y) and the independent variable (X). The dependent variable is the time and cost performance, while the independent variable is the internal factor causing the change order. The independent variable of internal factors causes change orders based on the author's results of the literature study. There are 18 variables with three indicators: owner, consultant, and contractor, which are in table 1.

Data collection was carried out through a method by using questions, where the researcher distributed questionnaires and structured interviews to respondents through several stages as follows: (1) The first stage clarifies the independent variables to experts. (2) The second stage is collecting data from respondents. (3) The third stage of data analysis. The method of analysis in this study uses the Statistical Package for the Social Sciences (SPSS) program version 25 and the Relative Importance Index (RII) method. SPSS is used to test the validity and reliability of the questionnaire results obtained from respondents to measure the level of confidence of the results of respondent data. RII is used as a ranking technique for each statement and to compare the responses received from the respondent.

The research instrument is in the form of a filling form regarding questions related to the research data needed and then distributed to the respondent for a response. The measurement scale uses Linkert, which consists of a scale of 1-5 with the information that it has Insignificant until extremely significant. As in table 2.

Table 1 . Internal factor independent variables cause change orders

Indicator	Change Order causes	References
Owner	Owner financial problems (X1)	[9], [10]
	Schedule changes by Owner (X2)	[11], [12]
	Owner instructs additional works (X3)	[13], [14]
	Owner needs during the design stage are unclear or not well defined (X4)	[7], [3]
	The scope of the project composed by the owner or owner's representative is unclear (X5)	[15], [9]
	Information provided by the owner is incomplete and inaccurate (X6)	[16]
Consultant	Substitution of materials or procedures (X7)	[14], [11]
	Ambiguity and errors in specifications and drawings (X8)	[17], [4]
	Poor coordination by the consultant engineer with the parties involved (X9)	[13], [8]
	Estimation Error (X10)	[13],
	Incomplete design during the design phase (X11)	[4], [11]
	Design changes by consultants (X12)	[8], [10]
Contractor	Desired profitability (X13)	[13], [11]
	Inadequate coordination among contractors (X14)	[18], [8]
	Improper handling of project progress by contractors (X15)	[18], [8]
	Ineffective quality control by contractors (X16)	[18], [8]
	Delay in previous construction by other contractors (X17)	[4], [12]
	The scope of work for contractors is not well defined (X18)	[11]

Table 2 Measurement scale

Scale	appraisal	Notes
1	0%	Insignificant
2	25%	Less significant
3	50%	Neutral
4	75%	Significant
5	100%	Extremely significant

4. RESULT & DISCUSSION

In the first stage, the authors conducted a structured interview about clarifying the experts' independent variables. Experts come from academics and practitioners. Expert validation results by experts on the independent variables of internal factors causing change orders based on literature studies resulted in 18 independent variables and three valid indicators, as in table 1.

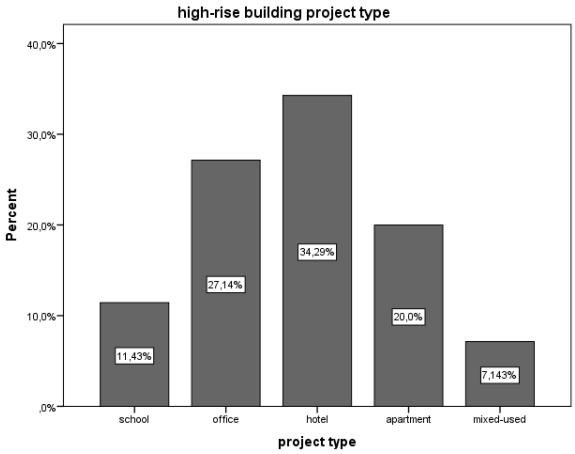

Figure 1 diagram high-rise building type

In the second stage, the authors collected data from respondents. Respondents who succeeded in returning the questionnaire were 70 respondents. Respondents came from company leaders, project managers, and site/office engineers

involved in the construction of high-rise buildings. Based on the results of the respondents, the project type resulted in 5 building categories. That is schools, offices, hotels, apartments, and mixed-use. The summary is in figure 1.

4.1 Validity and Reliability Test

In the third stage, the authors analyzed the questionnaire data. In data analysis, the first time, testing the validity and reliability. Reliability test by calculating the value of the Cronbach alpha coefficient. The lower limit of acceptance is 0.6- 0.7 [19].

Table 3 . SPSS reliability test change orders to time
Case Processing Summary

		N	%
Cases	**Valid**	**70**	**100,0**
	Excludeda	**0**	**,0**
	Total	**70**	**100,0**

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,903	18

Table 4 . SPSS reliability test change orders to cost
Case Processing Summary

		N	%
Cases	**Valid**	**70**	**100,0**
	Excluded[a]	**0**	**,0**
	Total	**70**	**100,0**

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,918	18

Reliability testing was processed using the Statistical Package for Social Science (SPSS) software. The results of the reliability test on the factors causing change orders that have an impact on-time performance are 0.903, as in table 3. Therefore, 0.903> 0.70 so that the questionnaire instrument is valid. Reliability test results on the factors that cause change orders to the cost performance are 0.918, as in table 4.

The r-table value with a significance level used 5% obtained r-table Product Moment df = 70-2 = 0.239. The validity test results of the factors causing change orders on time and cost performance show valid variables because of the value of r-table > 0.239.

4.2 Analysis of RII

In the data analysis stage, the Relative Importance Index (RII) analysis is used, which aims to determine the level or ranking of the independent variables of time and cost performance and construction contract type variables. The following is the calculation of the formula [5].

RII=∑ W/ (A x N)

Where W=the weight given to the factors (range from 1 to 5) times frequency of the response (number of response), A=highest weight (5 in this study), and N=total number of respondents.

The independent variable ranking is calculated based on the indicators of the owner, consultants, contractors on-time performance, cost performance, and cumulative. The independent variable consists of 18 variables ranging from variables X1-X18 which are divided into three indicators. The owner indicator has six variables starting from X1-X6, the consultant indicator has six variables starting from X7-X12, and the contractor indicator starting from X13-X18.

Based on questionnaires from respondents, the results of RII calculations in table 5, on the independent variables that affect time performance, from the Owner indicator is the variable X2 schedule change by Owner with a value of 4.06, followed by the X1 variable owner's financial problems with a value of 4.01. From the consultant indicator, the variable that affects time performance is the variable X9, poor coordination by the consultant engineer with the parties involved with a value of 3.89, and the variable X12 for design changes by the consultant with a value of 3.77. From the contractor indicator, the variable that affects time performance is variable X17. The delay in previous construction by other contractors with a value of 4.16, followed by variable X15. Improper handling of project progress by contractors with a value of 4.09.

Table 5 RII Table of time and cost performance

Variable	Change order to time		Change order to cost		cumulative	
	RII	Rank	RII	Rank	RII	Rank
Owner indicator						
X1	4,01	2	3,94	4	3,98	2
X2	4,06	1	3,80	5	3,93	5
X3	3,94	4	4,04	1	3,99	1
X4	3,71	6	3,56	6	3,64	6
X5	3,91	5	4,00	2	3,96	4
X6	3,96	3	3,97	3	3,96	3
Consultant indicator						
X7	3,49	6	3,61	5	3,55	6
X8	3,73	3	3,54	6	3,64	5
X9	3,89	1	3,66	4	3,77	3
X10	3,60	5	4,23	1	3,91	1
X11	3,71	4	3,79	3	3,75	4
X12	3,77	2	3,83	2	3,80	2
Contractor indicator						
X13	3,53	6	3,80	5	3,66	6
X14	3,81	4	3,54	6	3,68	5
X15	4,09	2	3,90	2	3,99	2
X16	3,83	3	3,87	3	3,85	3
X17	4,16	1	4,00	1	4,08	1
X18	3,74	5	3,81	4	3,78	4

The results of RII calculations on the independent variables that affect cost performance, from the Owner indicator is the owner's X3 variable instructs additional work with a value of 4.04, followed by the X5 variable the scope of the project compiled by the owner or unclear owner's representative with a value of 4.00. From the consultant indicator, the variables that affect cost performance are variable X10, error in estimation with a value of 4.23, and variable X12 design-changes by the consultant with a value of 3.83. From the contractor indicator, the variable that affects cost performance is variable X17. The delay in previous construction by other contractors with a value of 4.00, followed by variable X15. Improper handling of project progress by contractors with a value of 3.90.

The cumulative RII calculation of the independent variables that affect time performance and cost performance, from the Owner indicator is the X3 variable the owner instructs additional work with a value of 3.99, followed by the X1 variable of the owner's financial problems with a value of 3.98. From the consultant's indicator, the independent variables that affect on-time performance and cost performance are the X10 variable with a value of 3.91 and the X12 variable design-changes by the consultant with a value of 3.80. From the contractor indicator, the variable that affects time performance and cost performance is the variable X17 delays in previous construction by other contractors with a value of 4.08, followed by the variable X15 improper handling of project progress by contractors with a value of 3.99.

4.3 Case Studies

The study was conducted on a hotel project in Malang with a building area of 24,000 M2, 16 floors with a function as a hotel, and the ballroom. The construction contract agreed by the owner and contractor on this project includes structural, architectural, and plumbing works. The study was conducted by analyzing the RFI issued by construction management consultants based on requests for information from contractors, site instructions, S-curve analysis, and work calculation data from contractors.

Time performance analysis by analyzing the S-curve issued by the contractor. The S curve analysis informs that the field's work should have reached 93% of the work plan. However, the progress of implementation in the construction area only got 70.09%. This indicates that the work progress is delayed by 22.91%. See table 6.

Table 6 Additional work time

Work plan	Actual in the field	Lateness
93%	70.09%	22.91%

Table 7 Additional work cost

List of work	Percentage of additional costs
Addition of space under the drop off Floor	0,268%
Changes in the ground water tank structure	0,319%
Sewage treatment plant changes	0,322%
Addition of a separator lift	0,153%
Addition of ladder columns	0,098%
Reinforcement of connecting bridge floors	0,020%
Changes in façade material	0,809%
Addition of meeting room	2,922%
Change of lifts	0,130%
Added gym room	0,037%
Swimming pool floor and wall finishing	0,059%
Garbage change work	0,016%
Additional work for steel structures	0,545%
Additional MEP foundations and structures	0,046%
Roof floor work	0,164%
Disable ramp structure work	0,063%
Work to add ceiling to meeting room	0,111%
Steel reinforcement work on the roof	0,490%
Pit lift work of drop off area	0,132%
Plumbing work	0,017%
changes in public area ceiling	0,494%
Changes of the kitchen area	0,182%
Change of restaurant room	0,172%
Perimeter fence work	0,305%
Roof insulation spray work	0,590%
Aluminum composite panel change works	0,253%
Total	8,717%

Analysis of cost performance by analyzing RFI data, site instructions and contractor calculations, work progress has increased costs, which are caused by internal factors, among others: changes in the scope of work by the owner, changes in design by consultants, changes in the material by the owner, contractors, and consultants; and additional work from the owner. The number of additional costs reached 8.717% of the contract value. The work items that experienced the biggest change orders were the addition of meeting rooms 2,922%, followed by changes in façade material 0,809% of the total contract value. The work items that experienced a slight change in order were the addition of Garbage change work 0,016% of the total contract value. The following are the additional work costs resulting from the change orders, summarized in table 7.

5. CONCLUSION

Change orders often occur in implementing high-rise building projects on cost and time performance, which cause additional time and cost. Based on the analysis, the internal factors that cause change orders to cost and time performance based on indicators are as follows:

- Owner party indicator: owner instructs additional works
- Consultant Indicators: Estimation Errors.
- Contractor indicators: Delays in previous construction by other contractors

Based on the results of a case study on a hotel project, the amount of time added due to change orders resulted in 22.91% of the planning time contract. Meanwhile, the amount of additional costs resulted in 8,717% of the planning cost contract.

To reduce the occurrence of change orders, coordination between the parties involved in the construction project must be carried out from the planning stage to the implementation stage. Here are the things you can do:

- Use design and build methods on projects.
- Calculating estimates using the Building Information Modeling (BIM) method starting at the planning stage.
- Commitment to progress and planning time must be paid attention to and obeyed.

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