



Risk Analysis of Implementation of Cost Estimation Activities for Construction Projects

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Abstract. Implementing construction projects requires several costs resulting from the budget planning process (cost estimation). Budget planning activities or cost estimation carried out by an estimator will always be accompanied by uncertainty that can cause the estimation results to be inconsistent with the implementation of the project. The purpose of the research is to find out the risks, assess the risks, and determine the dominant risks in the project cost estimation. The research uses a quantitative descriptive method with data collection through surveys and interviews. The research respondents were determined by the purposive sampling method. The research shows that there are 28 (twenty-eight risks) that may occur from 9 (nine) sources of risk, namely understanding tender documents (4 risks), survey process (3 risks), volume estimation (2 risks), identification of project resource needs (3 risks), preparation of implementation methods (1 risk), calculation of project costs (4 risks), preparation of schedules (3 risks) and project teams (5 risks). The acceptance of risks is in the unacceptable category of 8 (eight) risks and undesirable (undesirable) 20 (twenty) risks.

Keywords: Construction Project, Cost Estimation, Risk Analysis

1 Introduction

In the era of globalization, the development of the construction world is increasingly rapid and faced with several obstacles including time, cost, and quality (Setyawan et al., 2022). Construction projects are a process that is not repeated in other projects (Yuliana et al., 2023). One of the stages in the implementation of a construction project is cost estimation. Construction project cost estimation is a compilation and analysis of many factors that affect and contribute to construction costs and often do not involve factors of uncertainty and risk (Maddeppunggeng et al., 2018). Uncertainty or risk is something that cannot be eliminated in the implementation of a project (Ekung et al., 2021). Risk is the potential loss due to the occurrence of a certain event and is considered an obstacle/obstacle to the achievement of a goal (Ayu Yuliani, 2022). Risks are things that may occur naturally that threaten property or financial gains due to the dangers that occur (Peginusa et al., 2020). Uncertain events that could result in profits/opportunities or harm the project or risk (Sugiharto, 2020). If the risk occurs, it will have an impact on the overall project performance so that it can cause losses to the

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cost, time, and quality of work (Honesti & Ramadhan, 2021). Estimation theory states that the discrepancy between the budgeted cost and the final cost of the project is caused by uncertainty in the construction estimate (Ekung et al., 2021). In the cost estimation process, several factors make an estimate result that is unrealistic for the implementation of the project such as lack of experience of the estimator, unclear scope, complexity of the design, and size of the project. These constraints must be considered to minimize the risk arising in the project cost estimation process (Tresna Putri et al., 2016). Several studies take on risk, one of which is producing a risk statement that affects cost and time (Purba & Wulandari, 2021). The next study gave the results that the Planning and Professionalism Factors affect 35.21% on the risk of cost reduction, Environmental Factors and Estimated Magnitude by 21.47%, and Material Factors by 10.04% (Hafizhin, 2019). The next research also produced 4 cost variables and 2-time variables with high-risk categories that affect project performance (Iribaram & Huda, 2019).

Bali as a center of economic, tourism, and industrial activities has built many high-rise buildings although some are still in the construction stage. A construction project is said to be successful if the project cost can be reduced to a minimum so that maximum profits are obtained by the initial cost estimate (Putri et al., 2016). Because estimation is a reference in preparing a budget and is used as a control tool, it is necessary to analyze to apply the concept of risk management to minimize losses that can later be incurred. The novelty of this study is that the respondents selected came from 3 (three) contractor service companies that often work on projects with a value of more than 100 billion and the year of research implementation is 2024, whereas the previous research which was very blessed with the risk of cost estimation was carried out in 2016 so that a new analysis is needed.

2 Methodology

2.1 Research Design

The research method used is quantitative descriptive. The method of data collection is by survey, brainstorming, and interviews to obtain opinions from parties involved and have experience in the implementation of building construction projects. Risk analysis is a quantitative analysis starting from identifying risks through surveys, brainstorming, and interviews with parties experienced in research problems to subsequently conducting risk assessment analysis and determining risk acceptance.

2.2 Research Data

The types and sources of data needed are primary data and secondary data. Primary data was collected through surveys and brainstorming with respondents who were involved and had experience in the implementation of building construction projects to determine the risks that occurred and were supported by the identification of risks from previous research. The results of risk identification were made in the form of a checklist and compiled into a questionnaire to be distributed to selected respondents. The

determination of respondents was carried out by the purposive sampling method. The criteria for respondents are those who are already experienced in the field of building construction. The respondents taken were contractors consisting of PM (project manager), SM (site manager), and QS (Quantity Surveyor). The number of respondents was 30 respondents. The scale used is the Likert scale using a range of five assessment numbers to show the level of response of respondents to the risk items that have been identified (Yuliana & Rani, 2020). Secondary data is collected through websites on the internet to obtain references to previous research on cost risk management so that it can be used as a prop list data for brainstorming materials for the field.

2.3 Data Analysis

Briefly, the research steps that must be carried out are: 1). Identifying risks. Risk identification is carried out by compiling a risk list related to cost estimates based on previous research. Next, brainstorming is carried out to find the suitability between the prompt list and the reality in the field and add a list of risks from brainstorming to the checklist. Furthermore, a questionnaire was prepared based on the results of risk identification and the range of the assessment scale, frequency, and consequences. The questionnaire that has been compiled will be distributed to 30 (thirty) respondents and tested for validity and reliability; 2). Analyze the assessment of the risks that occur.

Risk assessment is an action taken to qualitatively assess the potential risk of a condition. Risk assessment is carried out to determine whether major risks need to be managed or minor risks that do not require handling. Risk assessment on a project depends on the probability and impact of the risk (Matsura Labombang, 2021). The implementation of the analysis of the risk value is preceded by calculating the frequency mode value and the consequences of each respondent's choice statement. Each of the values of the mode is multiplied and determined by the amount of value; 3). Determining the scale of risk acceptance. Based on the risk value that has been obtained, then the risk acceptance of each identified risk item is determined. The scale used is according to Table 1.

Table 1. Risk Acceptance Scale

Risk Acceptance	Scale
Unacceptable	$x > 12$
Undesirable	$5 \leq x \leq 12$
Acceptable	$2 < x < 5$
Negligible (negligible)	$x \leq 2$

The value of "x" is the value of the multiplication between the value of the risk frequency mode and the value of the risk consequence mode.

3 Result and Discussion

3.1 Risk Identification

Risk identification is carried out using interviews and brainstorming with parties involved and having experience related to the cost estimation process. The first step in risk identification is to compile a risk list based on the results of previous research that discusses cost estimation risk management (prompt list). The list of risks that have been compiled is then taken to the contractor (project manager, site manager, and estimator of the Bali International Hospital Centre project, Sumitra Hotel and Resort project, and Icon Mall Sanur project) and conduct interviews and brainstorming to find out the identification of risks that occur in the cost estimation process. In this brainstorming, risks that are not other than the list of risks that have been prepared are also identified. The results of risk identification are according to Table 2.

Table 2. Risk identification results

No.	Source of risk	Risk identification
1	Understanding Tender Documents	Errors in interpreting the provisions in the technical and administrative specifications in the tender documents Data discrepancy between technical specifications and plan drawings Not attending the job explanation meeting with the owner Incomplete contract documents, specifications, and drawings from the owner
2	Survey Process	Lack of information about the project location Absence of information about existing utility data at the project site Lack of information about resource unit pricing
3	Estimated Volume	Volume discrepancy listed on the Bill of Quantity (BQ) Lack of thoroughness in volume calculation
4	Identify Project Resource Needs	Wrong calculation of productivity and equipment requirements for project implementation Wrong calculation of productivity and manpower requirements for project implementation Wrong calculation of material requirements for project implementation
5	Preparation of Implementation Methods	Errors in planning implementation methods
6	Preparation of Work Unit Price Analysis (AHSP)	Work item coefficient calculation error Errors in determining the unit price of work Errors in the calculation of bid prices
7	Project Cost Calculation	Wrong calculation of the total cost of the project

		A mistake in the calculation of the payment system by the owner Wrong calculation of bank interest
8	Preparation of Schedule	Mistakes in calculating taxes, insurance, overheads, and profits The preparation of work schedules is not appropriate Improper resource use schedule
9	Project Team and Estimator	Error in specifying the duration of a work item Less experienced estimators Lack of estimator's understanding of the project scope Lack of understanding of estimators of project implementation methods Lack of coordination between the estimator and the project team Too many projects are being handled at the same time.

Based on Table 2, it is known that risk identification amounted to 28 (twenty-eight) which came from 9 (nine) risk sources. The source of the risk is a stage in the cost estimation process and the team involved in it. The distribution of sources and the identification of cost estimate risks are shown in the following Figure 1.

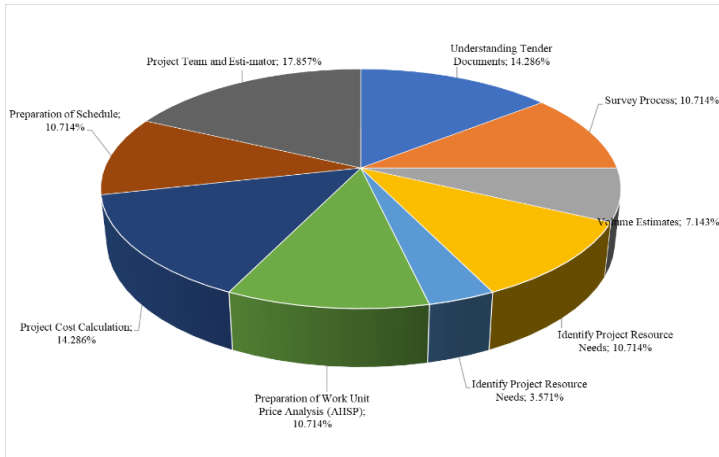


Figure 1. Risk identification spread

Figure 1 shows the distribution of risk sources with the percentage of each risk identification where the risk source with the largest proportion is the project team and the estimator with a value of 17.857% of the total risk. This is because the cost estimation process is carried out by an expert called an estimator and the estimator must have sufficient experience with the project to produce estimated results that are by the project implementation budget. This success must certainly be supported by the project team involved in it.

3.2 Risk Assessment and Risk Acceptance

Risk assessment is carried out to determine the level of risk acceptance that occurs. The risk assessment was carried out by multiplying the value of the frequency mode and the value of the consequence mode based on the results of the respondents' answers. The results of the risk assessment can be seen in Table 3. Risk acceptance is divided into 2 (two) categories, namely dominant risk and minor risk. Dominant risks consist of unacceptable and undesirable risks that must receive further treatment in the form of determination of mitigation and risk ownership. Meanwhile, minor risks consist of acceptable and negligible risks that can be ignored. The results of risk acceptance can be seen in Table 4.

Table 3. Risk assessment

Risk number	Source of risk	Risk identification	Frequency mode values	Consequently mode values	Risk assessment	Risk acceptance
1	Understanding Tender Documents	Errors in interpreting the provisions in the technical and administrative specifications in the tender documents	3	3	9	Undesirable
		Data discrepancy between technical specifications and plan drawings	3	3	9	Undesirable
		Not attending the job explanation meeting with the owner	2	3	6	Undesirable
		Incomplete contract documents, specifications, and drawings from the owner	2	4	8	Undesirable
2	Survey Process	Lack of information about the project location	2	3	6	Undesirable
		Absence of information about existing utility data at the project site	2	3	6	Undesirable
		Lack of information about resource unit pricing	3	4	12	Undesirable
3	Estimated Volume	Volume discrepancy listed on the Bill of Quantity (BQ)	3	4	12	Undesirable
		Lack of thoroughness in volume calculation	3	5	15	Unacceptable
4	Identify Project Resource Needs	Wrong calculation of productivity and equipment requirements for project implementation	3	4	12	Undesirable
		Wrong calculation of productivity and manpower requirements for project implementation	3	4	12	Undesirable
		Wrong calculation of material requirements for project implementation	3	5	15	Unacceptable
5	Preparation of Implementa	Errors in planning implementation methods	3	4	12	Undesirable

	tion					
	Methods					
	Preparation of Work	Work item coefficient calculation error	3	4	12	Undesirable
	Unit Price	Errors in determining the unit price of work	3	5	15	Unacceptable
	Analysis (AHSP)	Errors in the calculation of bid prices	3	5	15	Unacceptable
6	Project Cost	Wrong calculation of the total cost of the project	3	5	15	Unacceptable
	Calculation	A mistake in the calculation of the payment system by the owner	3	3	9	Undesirable
		Wrong calculation of bank interest	3	3	9	Undesirable
		Mistakes in calculating taxes, insurance, overheads, and profits	2	3	6	Undesirable
7	Preparation of Schedule	The preparation of work schedules is not appropriate	3	4	12	Undesirable
		Improper resource use schedule	3	3	9	Undesirable
		Error in specifying the duration of a work item	3	4	12	Undesirable
8	Project Team and Estimator	Less experienced estimators	3	5	15	Unacceptable
		Lack of estimator's understanding of the project scope	3	5	15	Unacceptable
		Lack of understanding of estimators of project implementation methods	3	5	15	Unacceptable
		Lack of coordination between the estimator and the project team	3	4	12	Undesirable
		Too many projects are being handled at the same time	3	3	9	Undesirable

The results of the risk assessment show varying values ranging from 6 – 15. In addition, it can also be seen that the frequency mode value is more in the "3" category, namely "rare" because it refers to the experience of the respondents in handling the cost estimation process where they think that they only sometimes or even rarely experience problems in the cost estimation process. As for the value of the consequence mode, there are more in the categories "2", "3" and "4" or "moderate", "large" and "very large" because although the frequency of risk events is rare or sometimes occurs, the impact on the project cost overrun is large enough that it can still cause losses to the implementation of the project later.

Based on the results of the risk assessment above, 2 categories of risk event acceptance rates were obtained, namely unacceptable and undesirable. Risks with unacceptable categories amounted to 8 risks or 28.57% and undesirable categories amounted to 20 risks or 71.43%. The results of risk acceptance are more centered on unacceptable and undesirable because the consequences for cost overruns are in a moderate to very large range so that it affects the final value of risk even though the frequency of occurrence only ranges from rare to occasional. Risks that include major risks are risks with unacceptable and undesirable acceptance, so mitigation measures and allocation of ownership of these risks must be determined.

4 Conclusion

The risk of cost estimation that may occur is as many as 28 (twenty-eight risks) which are sourced from 9 (nine) sources of risk, namely understanding ten-der documents (4 risks), survey process (3 risks), volume estimation (2 risks), identification of project resource needs (3 risks), preparation of implementation methods (1 risk), calculation of project costs (4 risks), preparation of schedules (3 risks) and project teams (5 risks). The risks identified include dominant risks with 2 (two) categories of risk event acceptance levels, namely unacceptable 8 risks and undesirable categories 20 risks.

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