Preliminary cost in industrial building at Sumatra, Kalimantan, and Papua

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Abstract. Preliminary cost is a support cost that needs to be done so that the construction project can run well, but costs tend to experience an increase from the planned cost that has been determined to the final cost. Preliminary cost affects profits or losses of a construction project, therefore this study is essential so it can be known the reference for preliminary cost and cause of cost overruns, which items that give a high contribution to the preliminary cost, and the relationship between preliminary cost and profit at company XYZ. At Sumatra, Kalimantan, and Papua, the actual preliminaries cost occurs by 215%, 114%, and 188% from the planned cost, thus the cost overruns happened. The cause of this cost overruns can occur because of lack of skill of the estimator for estimating and planning about cost, duration, equipment and tools, missed implementation of method statement, lack of information about the project, incomplete design, and unacquired land. The component of the preliminary cost is vary based on its location. This analysis is necessary because it can show which items are influential and contribute a large proportion to the overall preliminary so that more attention is given to those items. The preliminary cost has a contradict relationship to profit, if the preliminary cost is increased, the profit will be decreased.

1. Introduction
Preliminary cost is the cost of administering a project and providing general plant, site staff, facilities site-based services and other items not included in the rates for measured works [1]. The cost of preliminaries is very influential on the project time, the shorter the project duration the cost of preliminaries (staff, accommodation, heavy equipment) will be smaller and can get 12 to 20 percent of the tender value [2]. Estimated preliminary costs in construction are an important part of the budget preparation process [3]. Preliminary cost affects profits or losses of a construction project [4], thus an accurate estimate cost is crucial. When it comes to the final cost, costs tend to raise from the predetermined cost [5]. Many studies that have addressed this issue, Morris and Hough [6] found more than 4,000 government projects experienced cost overruns and occurred by 40 to 200 percent. Pickrell [7] found that seven out of eight rail transit projects experienced overruns of 17 to 150 percent. MacDonald [8], found that the final costs of 50 road projects increased 24 to 26 percent from the specified costs, even Flyvbjerg and Budzier [9], found that one in six projects experienced cost overruns of up to 200 percent, and one in three projects failed.

Company XYZ assumed to have similar issues regarding cost overrun. Company XYZ is a private contractor and based in Jakarta, Indonesia. Most of its projects are industrial building and the projects are located outside Java island. The existing data about cost is not well documented and has never been analyzed. Therefore this study is essential so it can be known the reference for preliminary cost and cause of cost overruns, which items that give a high contribution to the preliminary cost, and the relationship between preliminary cost and profit at company XYZ.
2. Method
The study is restricted to a sample of 13 projects, for which data (preliminary cost) could be found from projects that have been completed by company XYZ. The sample was chosen from larger population projects. The sample was extracted from 17 projects to 13 projects because these samples reflect a complete data history of the cost. The technique used for selecting the data is using the confidence interval. The actual purpose of the confidence interval is for estimating, but according to Zar [10], the confidence interval can be used to determine whether the data is an outlier or not. Swarupa [11] said that if the data is far from the average, there is a probability that the data is an outlier. An outlier also can be known if the data is outside the lower and upper limit in confidence interval [12]. The lower and upper limit of the confidence interval is selected from the actual cost because it represents the real cost of the projects. Figure 1 illustrates the percentage of the preliminary cost to contract value at Sumatra, and there were 6 projects before the selection data is made. The red dash-line shows the lower and upper limit of the actual cost with the confidence level of 95%. If there is data outside the lower or upper limit, that data can be not taken into further analysis because it can interfere with the analysis. At Sumatra, there is a single project that has a higher preliminary cost than the upper limit, so that project is not being used for further analysis. This technique also applied to Kalimantan and Papua.

These data were analyzed to find the ratio of preliminary cost, and investigate the cause of deviation from planned cost through actual cost. The first step is to categorize the planned and actual preliminaries cost based on the location of the projects and to classify the preliminaries cost to its sub-component such as preparation cost, employee cost, tools and equipment cost, financial cost, and transportation cost. This classification can be different from another contractor. Then compare the planned cost to actual cost to identify the deviation of the preliminaries cost. To identify the cause of this deviation, several project managers and cost control manager who was knowledgeable about the projects were being inquired. Besides analyzing the preliminary cost, it’s components also need to be analyzed. The component of the preliminary cost is vary based on its location. The first thing to do is find the percentage of each component that has a high influence on preliminary cost with the Pareto principle. The Pareto principle (also known as the 80-20 rule) states that many phenomena occur that 80% of the consequences that occur result from 20% of the causes [13]. This Pareto analysis will be used to find out what components of preliminary that give a high contribution to the overall cost of preliminary. Then, to analyze the relationship between preliminary cost and profit, the data about it must be collected, then divine the correlation coefficient to know how strong the relationship, then find out which component of cost that contributes to the profit.

3. Result and discussion
3.1 Preliminary cost
After these data were analyzed, the result is shown in table 1. The percentage presented in the table and figure is percentage preliminary cost to the contract value.
From figure 2, it can be known that at Sumatra, Kalimantan, and Papua, the most influential to less influential planned preliminaries cost are equipment and tools cost, employee cost, and preparation cost. From figure 3, it can be known that at Sumatra, and Kalimantan, the most influential to less influential actual preliminaries cost are employee cost, equipment and tools cost, and preparation cost. Meanwhile at Papua, the most influential to less influential actual preliminaries cost are equipment and tools cost, employee cost, and preparation cost. The differences between planned and actual preliminaries cost are because there are some factors that the estimator did not consider at that time such as acceleration of the project, differences work method between planned and actual, the site condition that differs from the tender documents, natural disaster, etc.

| Location          | Preliminary cost | Deviation (%) |
|-------------------|------------------|---------------|
|                   | Planned (%)      | Actual (%)    |               |
| Sumatra (5 Projects) | 6.53 %         | 13.98 %       | 7.45 %        |
| Kalimantan (4 Projects) | 8.85 %       | 10.05 %       | 1.20 %        |
| Papua (4 Projects)    | 9.13 %         | 17.14 %       | 8.01 %        |

In this study, the actual preliminary cost is always greater than the planned cost. The comparison between planned and actual preliminaries cost based on location is shown in figure 1, and figure 2.
At Sumatra, Kalimantan, and Papua, the actual preliminaries cost occurs by 215%, 114%, and 188% from the planned cost, thus the cost overruns happened. Interview between several project managers and cost control manager who was knowledgeable about the projects are conducted afterward. The interview results about the cause of this deviation are lack of skills of estimating and planning about cost, duration, needs of equipment and tools for the project and miss implementation of method statements that have been made. The contractor also did not make a contingency allowance for unexpected things that can interfere with the project such as natural disasters. The owner’s project point of view is due to lack of information about the project, incomplete design, unacquired land, and incomplete submission of documentation. These projects completed in 2004 to 2018, thus the estimation method and planning skills should have improved over time [5], and these issues occur in every project, the contractor should pay attention about this cost overrun as it can impact the profitability of the contractor. Westney [14] argued that this is because of the factors responsible for overruns are those that we do not estimate and for which we do not plan.

3.2 The component item of preliminary cost

The purpose of this analysis is to determine the main component item of the preliminary cost that has a high influence on actual cost. The high influence means that the component item contributes up to 50% of the total actual cost of preliminary. The first thing to do before the Pareto analysis is to find the percentage of each component of preliminary cost that has a high influence on the actual cost. The second is using the Pareto principle to determine component items which make up to 50% of the total cost of preliminary. The greater the percentage means the greater the component items in contributing to the total actual cost of preliminary.

| Location | Component of preliminary cost | Component of preliminary cost (%) |
|----------|-------------------------------|-----------------------------------|
| Sumatra  | Worker residence              |                                   |
|          | Employee staff                |                                   |
|          | Honorary staff                |                                   |
|          | Transportation for staff      | 52.72                             |
|          | Transportation for honorary staff |                               |
|          | Tower Crane                   |                                   |
| Kalimantan | Honorary staff                | 64.48                             |
|          | Diesel fuel                   |                                   |
| Papua    | Coordination and security     |                                   |
|          | Employee staff                |                                   |
|          | Excavator                     | 56.27                             |
|          | Maintenance tools and equipments |                               |
|          | Diesel fuel                   |                                   |

This analysis is necessary because it can show which items are influential and contribute a large proportion to the overall preliminary so that more attention is given to estimating and controlling because only with a few items could get more than 50% of the total cost of preliminary.
3.3 Preliminary cost and profit

Further, we also want to know the relationship between preliminary cost and profit at company XYZ and shown in figure 4. There are several projects that suffer losses. To know how strong the correlation between preliminary cost and profit, it was performed correlation analysis. The outcome of the analysis is the coefficient correlation is -0.609, and the R square is 37%. This result strengthens the previous statement that the preliminary cost and profit have a contradict relationship. From the figure can be known that as a preliminary cost increase, the profit of the project will be decreased and if the preliminary cost decrease, the profit will increase.

![Figure 4. Comparison planned preliminaries cost based on location.](image)

The R square means that 37% of profit influences by preliminary cost, therefore, the other 63% is influenced by another variable. The component of cost at company XYZ are preliminary cost, material cost, and labor cost. Because of the previous result that other variables have a higher influence on preliminary cost, we analyze the three of this component of cost. It is decided to choose one project for each location that has the highest profit. The result is shown in figure 5.

![Figure 5. Comparison planned preliminaries cost based on location.](image)

From figure 5, it is concluded that the main items which contribute to profit are material and labor. Generally in a tender, when the estimate of cost is precise enough and the quotation of material and labor vendor are relatively reputable, the material and labor costs are more or less equivalent. The difference from each contractor is the work method which they planned is the most effective and efficient. The difference occurred in company XYZ might be caused due to the project location which is outside of Java island where there is limited access. These projects project inside Java island and projects outside Java island are incomparable as company XYZ currently did not have a project inside the Java island.
4. Conclusion
Based on the analysis, it was found that:
1. In this research, preliminary cost deviations at company XYZ always occur. The actual cost is always greater than the planned cost. The deviation from planned cost to actual cost are 7.45% (Sumatra), 1.20% (Kalimantan), and 8.01% (Papua).
2. The cause of this deviation can occur because lack of skill of the estimator for estimate and plan about cost, duration, equipment and tools, miss implementation of method statement at the project and did not consider unexpected events such as a natural disaster. This deviation can also occur because of weak information about overall projects, including design, and the land that has not been acquired.
3. At Sumatra, the component items that contribute 52.72% of the total actual cost are worker residence, employee staff, honorary staff, transportation for staff, transportation for honorary staff, and tower crane. At Kalimantan, the component items that contribute 64.48% of the total actual cost are honorary staff, and diesel fuel. At Papua the component items that contribute 56.27% of total actual cost coordination and security, employee staff, excavator, maintenance tools and equipment, and diesel fuel.
4. The preliminary cost has a contradict relationship to profit, if the preliminary cost is increased, the profit will be decreased. The component cost that contributes to profit besides preliminary cost is material and labor costs.

Based on the conclusion, the cause of deviation should have given better attention. Data about the past project should be well documented to be used as a database for reference to similar upcoming projects. With a sample of only 13 projects, the intention is not to provide a clear picture of cost overruns, yet to rather understand the causes of overrun at company XYZ. Further studies about cost at company XYZ are crucial since the sample is relatively small and does not representative enough about all projects at company XYZ.

5. References

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