Controlling Construction's Time and Cost of Puskesmas with Earned Value Method

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ABSTRACT

On a project there are always some problems there are caused by cost and time. In the implementation of projects it is very rare that it can go exactly as planned. In avoiding losses in development work activities, cost and time control is used with a concept commonly called the Earned Value concept method. The purpose of writing this paper is to analyze the cost and time performance in completing the Lumbang Puskesmas Building project, Kabupaten Probolinggo using the Earned Value method. The performance results of project implementation based on the concept of earned value from ACWP are Rp. 4,624,935,401, BCWS and BCWP values are Rp. 4,624,935,404. based on the ACWP, BCWS and BCWP values, the value of Cost Variance (CV) is Rp 3.40 and Schedule Variance (SV) is equal to zero. The values of SPI and CPI are equal to 1. The estimated project completion time is 150 days which is the same as the project plan time. The estimated final cost of the project is Rp. 4,624,935,397 which shows that the costs incurred are smaller than the total budget plan (BAC) of Rp. 4,624,935,404. As a result of these calculations, the project did not experience delays or additional costs.

Keywords: BIM, Autodesk Revit, Autodesk Naviswork, Volume, RAB

1. INTRODUCTION

Project is defined as a series of temporary activities that take place for a limited period of time, with a certain allocation of resources and intended to carry out tasks whose objectives have been clearly outlined (Suharto, 1995). In planning construction projects generally involve several main aspects, namely in terms of time, cost and project scope. On a project there are always some problems caused to cost and time. In the implementation of projects it is very rare that it can go exactly as planned. What is often encountered is that projects experience delays in both time and work progress, but not all projects experience delays. In avoiding losses in development work activities, cost and time control is used with a concept commonly called the Earned Value concept method).

Therefore, a study is needed to analyze the cost and time control in the construction project of the Lumbang Health Center Building in Probolinggo Regency using the Earned Value method. The earned value method is used to measure the number of units of work that have been completed by a certain deadline and is assessed based on the amount of budget available for the work.

The purpose of writing this paper is to analyze the cost and time performance in completing the Lumbang Puskesmas Building project using the Earned Value method, analyze the implementation of the Lumbang Puskesmas Building construction project whether it has been carried out according to plan, find out the problems arising from cost and time performance during the project.

The object that will be used as the focal point of this research is the implementation of the Lumbang Puskesmas Building Construction project in Kabupaten Probolinggo which is reviewed from the evaluation of the completed project.

2. THEORY AND METHODS

2.1 Methodology

Location and time of research

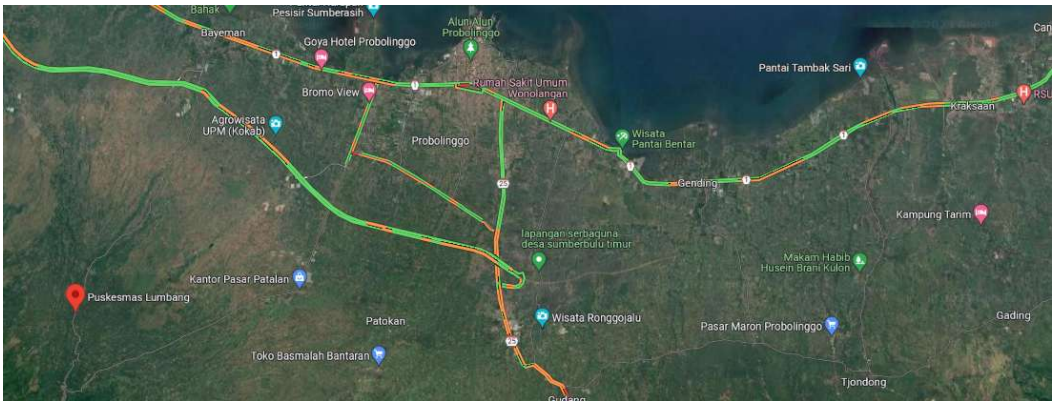

Figure 1. Research Location

1. Research Location
   The research location is the construction of the Lumbang Health Center Building owned by the Regional Government of Probolinggo Regency located on Jalan Raya Bromo No. 67, Waturiti, Lumbang District, Probolinggo Regency, East Java 67255
2. Research Time
   The data used is data from the beginning of reporting to the completion of the project.

2.2 Flow Chart

Figure 2 shows a research flow chart using the Earned Value method. The first stage in this research is to identify the problems that occur and conduct literature studies. Furthermore, data collection was carried out in the form of primary data and secondary data needed in this study. From this data, the next stage in conducting this research is the analysis or processing of the data with the earned value method assisted by two application tools, namely Microsoft Project and Microsoft Excel. The final stage is to draw conclusions and suggestions. The chart of the study is as follow:

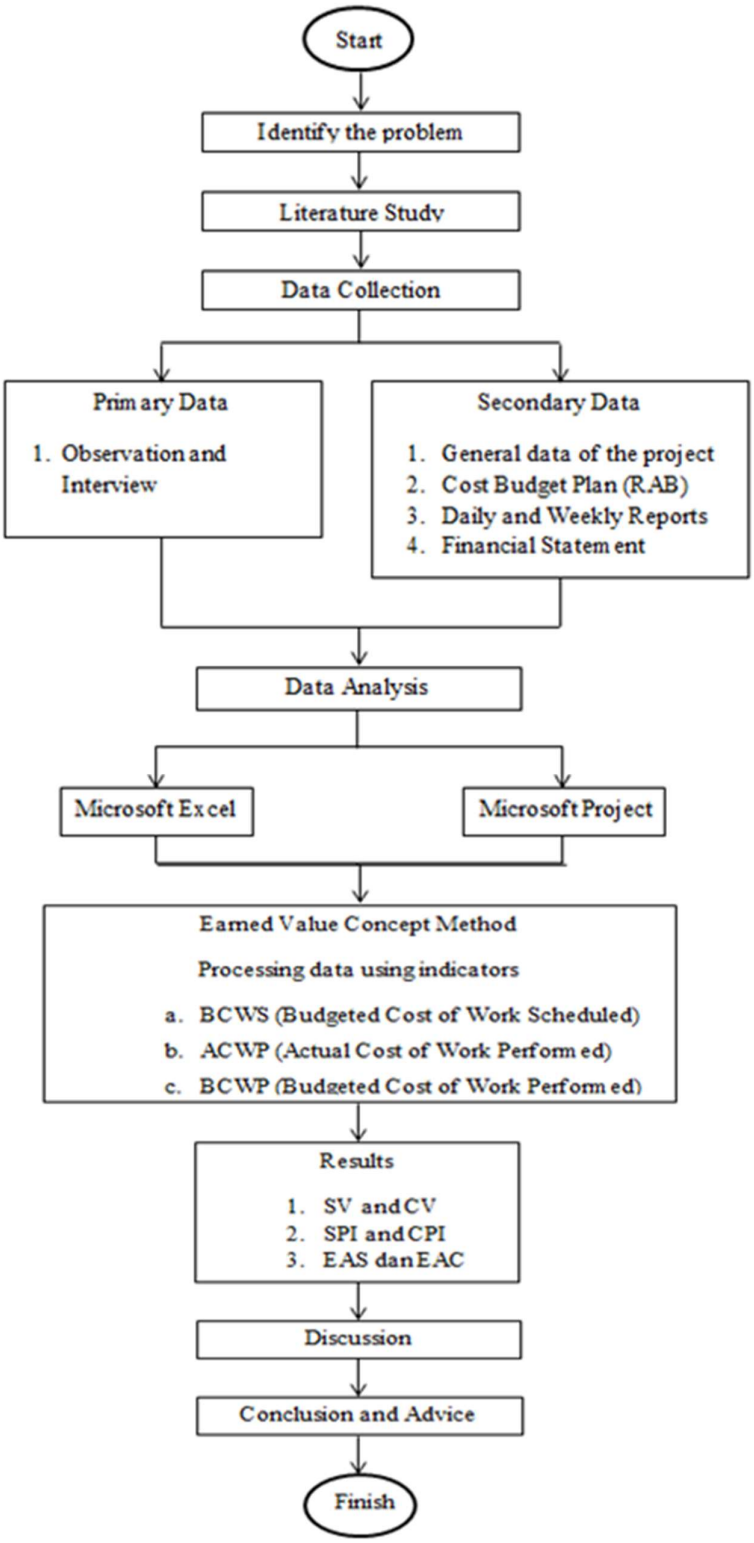

Figure 2. Research Flow

2.3 Data Collection Method

In this study, the types of data used were primary data and secondary data. The primary data itself is obtained by making direct observations at the project location studied. Another case with secondary data where the data is obtained indirectly through the supervisor of the research project implementer. The data needed in this study are as follows:

1. Primary Data
   In this data, observation data and interviews with related parties or those concerned are needed to identify the causes of delays that occur in the project under study.
2. Secondary Data
   Included in this data are general data from the project, Cost Budget Plan (RAB), weekly daily reports.

2.4 Data Analysis Method

Data The data that has been obtained from the previous process is processed by being used related to the purpose of writing this final project. This data will be analyzed and adjusted to the concept of earned value method as theoretical and reality when in the field. The stages in this study are as follows:

Stage 1

Before conducting this final project research, a literature study is needed that aims to deepen knowledge related to the research topic of the earned value method. Then determine the formulation of the problem contained in the previous chapter 1.

Stage 2

Perform ACWP, BCWP, BCWS calculations using the earned value method. ACWP itself is obtained based on project financial data produced every day. BCWP is calculated based on the actual weight of all work against the contract value, just as the BCWS value is calculated based on the weight of work against the planned cost budget on the project. This analysis is carried out cumulatively and weekly. After the three indicators are generated, then the calculation of variance analysis is carried out in accordance with the formula equation that has been established in the second chapter earlier.

Stage 3

Perform CV, CPI, SV, and SPI calculations. The CV value is calculated based on the difference between BCWP and ACWP while the value of SV itself is calculated based on the difference between BCWP and BCWS. Furthermore, calculations are made from CPI and SPI where CPI itself is calculated based on the results of the comparison between the value of BCWP to ACWP while for SPI itself the result of the comparison between the value of BCWP to the value of BCWS. If the greater the difference from the number 1, the greater the deviation from the basic planning. This analysis is carried out cumulatively and weekly then presented in the form of a graph that illustrates the relationship between time, cost and weekly and cumulative performance indexes.

Stage 4

Calculate estimated costs (EAC) and time (EAS) using the equations written in chapter 2 earlier. Analysis of cost forecasts and schedules is intended to provide early warning of things that will happen in the future if at the time of reporting there is no change. Based on the results of the previous analysis obtained, it can be determined the value of cost and time forecasts by calculating deviations and performance indices first. From the results of

the analysis of cost and time forecasts, it can be known when the project is completed with the amount of cost needed to complete the project.

Stage 5

Conduct discussions and conclusions. The discussion explains the calculations that have been done regarding the earned value method. At the conclusion stage, the data that have been analyzed and discussed previously in chapter 4 are made a conclusion related to the research objectives in chapter 1.

3. RESULTS AND DISCUSSION

Research Results

Calculation of ACWP, BCWP, BCWS job indicators.

Microsoft Excel

Table 1. Recapitulation of Calculation Results

Mg to	BAC	ACWP	BCWP	BCWS
1	Rp 4.624.935.400	Rp 15.556.117	Rp 15.556.117	Rp 43.226.160
2		Rp 183.304.125	Rp 183.304.125	Rp 151.265.874
3		Rp 309.933.577	Rp 309.933.578	Rp 268.170.547
4		Rp 436.120.406	Rp 436.120.406	Rp 436.925.146
5		Rp 663.283.596	Rp 663.283.596	Rp 640.894.798
6		Rp 932.007.720	Rp 932.007.720	Rp 898.451.951
7		Rp 1.302.268.199	Rp 1.302.268.200	Rp 1.208.460.478
8		Rp 1.555.770.113	Rp 1.555.770.114	Rp 1.530.493.394
9		Rp 1.902.654.084	Rp 1.902.654.085	Rp 1.866.177.257
10		Rp 2.162.163.813	Rp 2.162.163.815	Rp 2.150.139.214
11		Rp 2.425.210.838	Rp 2.425.210.840	Rp 2.413.130.055
12		Rp 2.712.584.743	Rp 2.712.584.745	Rp 2.661.770.049
13		Rp 3.001.769.624	Rp 3.001.769.626	Rp 2.922.120.959
14		Rp 3.190.621.453	Rp 3.190.621.456	Rp 3.162.752.780
15		Rp 3.295.928.001	Rp 3.295.928.003	Rp 3.432.755.544
16		Rp 3.398.590.174	Rp 3.398.590.176	Rp 3.688.050.886
17		Rp 3.501.156.745	Rp 3.501.156.748	Rp 3.902.091.843
18		Rp 3.538.727.497	Rp 3.538.727.499	Rp 4.092.239.023
19		Rp 4.041.322.702	Rp 4.041.322.705	Rp 4.272.691.016
20		Rp 4.274.477.000	Rp 4.274.477.003	Rp 4.443.992.937
21		Rp 4.410.322.156	Rp 4.410.322.159	Rp 4.592.201.069
22		Rp 4.528.555.368	Rp 4.528.555.371	Rp 4.624.935.404
23		Rp 4.624.935.401	Rp 4.624.935.404	Rp 4.624.935.404

Microsoft Project

Table 2. Recapitulation of Calculation Results

Mg ke	BAC	ACWP	BCWP	BCWS
1	Rp 4.624.935.400	Rp 1.064.211.106	Rp 1.064.211.106	Rp 1.064.211.106
2		Rp 3.150.749.840	Rp 3.150.749.840	Rp 3.150.749.840
3		Rp 3.828.007.566	Rp 3.828.007.566	Rp 3.828.007.566
4		Rp 4.105.370.819	Rp 4.105.370.819	Rp 4.105.370.819
5		Rp 4.208.585.313	Rp 4.208.585.313	Rp 4.208.585.313
6		Rp 4.267.570.480	Rp 4.267.570.480	Rp 4.267.570.480
7		Rp 4.320.318.389	Rp 4.320.318.389	Rp 4.320.318.389
8		Rp 4.382.981.304	Rp 4.382.981.304	Rp 4.382.981.304
9		Rp 4.427.680.724	Rp 4.427.659.066	Rp 4.427.659.066
10		Rp 4.444.927.585	Rp 4.444.903.329	Rp 4.444.903.329
11		Rp 4.461.209.535	Rp 4.461.182.680	Rp 4.461.182.680
12		Rp 4.475.158.341	Rp 4.475.128.887	Rp 4.475.128.887
13		Rp 4.484.675.722	Rp 4.484.643.669	Rp 4.484.643.669
14		Rp 4.502.914.838	Rp 4.502.880.186	Rp 4.502.880.186
15		Rp 4.535.955.616	Rp 4.535.918.366	Rp 4.535.918.366
16		Rp 4.554.166.611	Rp 4.554.126.762	Rp 4.554.126.762
17		Rp 4.562.743.831	Rp 4.562.701.383	Rp 4.562.701.383
18		Rp 4.572.011.940	Rp 4.571.966.893	Rp 4.571.966.893
19		Rp 4.592.056.807	Rp 4.592.009.161	Rp 4.592.009.161
20		Rp 4.605.735.849	Rp 4.605.685.604	Rp 4.605.685.604
21		Rp 4.605.822.911	Rp 4.605.770.068	Rp 4.605.770.068
22		Rp 4.605.909.974	Rp 4.605.854.531	Rp 4.605.854.531
23		Rp 4.605.938.994	Rp 4.605.938.994	Rp 4.605.938.994

The result of calculating ACWP, BCWS and BCWP using the help of two applications, namely Microsoft Excel and Project, is that there is a difference of IDR 18,996,000 in each value of the three indicators. The difference is caused because when the calculation on MS Excel is to calculate manually using equations that already exist in scattered theory, while when using MS Project the calculation is done simultaneously with the system provided in the application. So that this causes a difference in the calculation value of the two applications.

Elaboration

1. Cost Variance (CV) dan Schedule Variance (SV)

   Cost variance (CV) shows the result of actual cost value against plan cost and schedule variance (SV) against plan time. It can be seen in the CV value on the graph that there is no movement or equal to 0 which means that in week 1 to the final week of the project there is no additional cost. Another case with the SV value where there is a significant up and down movement in weeks 15-22 and is negative which means that work in that week is experiencing delays. The cause of this work delay is because funds from contractors to suppliers are stopped, causing disruption to the project work process from planning.

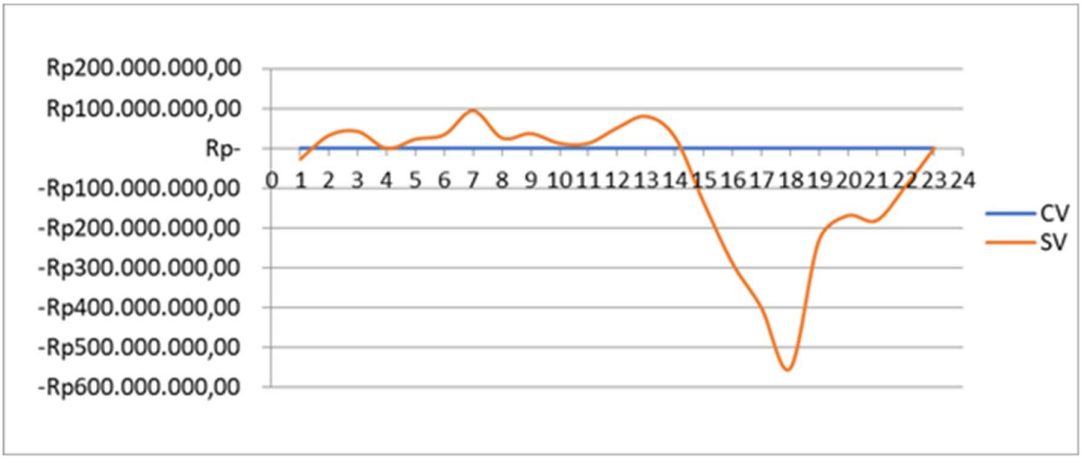

Figure 3. CV and SV charts

2. *Cost Performance Index (CPI) dan Schedule Performance Index (SPI)*

The cost performance inderks (CPI) value is indicated by the weight of the value obtained on each cost incurred while the schedule performance index (SPI) shows the weighted value obtained against the planned time. The movement of the cost variance index (CPI) and schedule variance index (SPI) values against the normal limit is 1. It can be seen that in week 1, 15 to week 22 the value of SPI decreased by <1 which caused the work completion time in the first week to be longer than the work plan. But in the 2nd, 5th to 7th weeks it rises above 1 which indicates faster execution than planned.

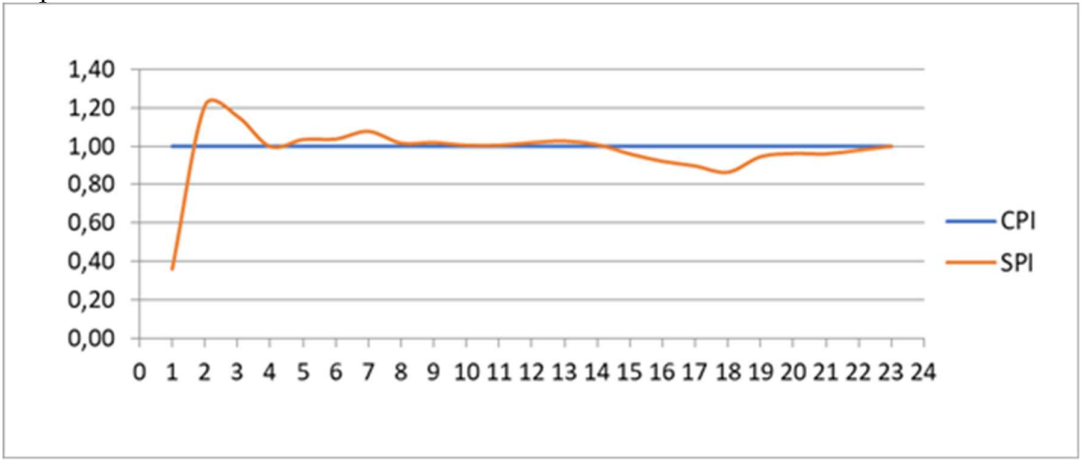

Figure 4. CPI and SPI charts

3. *Estimated Final Cost and Project Completion Time*

The data used in the calculation of estimated costs and end times use the last week of the upgrade, which is the 23rd week. Based on the data above, the estimated value of cost and time is determined as follows :

a. ETS
   Plan time = 150 days
   Time has elapsed 134 days
   Time remaining = 16 days
   ETS = (remaining time) / SPI
b. EAS

EAS = End time + ETS
EAS = 134 days + 16 = 150 days

c. Estimated costs for remaining work
ETC = (BAC – BCWP)/CPI
ETC = Rp -4

d. Estimated cost at project completion
EAC = ETC + ACWP
EAC = Rp 4.624.935.397

Based on previous calculations, it can be known that the cost required in completing the project is smaller than the budget should be.

4. CONCLUSION

Based on the results of data analysis and discussion, the following conclusions can be drawn :

1. The results of project implementation performance based on the concept of earned value can be as follows :
   a. The value of ACWP is Rp. 4,624,935,401, the value of BCWS and BCWP is Rp. 4,624,935,404.
   b. The value of Cost Variance (CV) is Rp 3.40 indicating that the costs incurred are smaller than the budget should be. While Schedule Variance (SV) is equal to zero which means the work is running on schedule.
   c. The value of SPI and CPI is equal to 1 which means that the execution time runs according to schedule and the costs incurred are in accordance with the existing contract value.
   d. The estimated project completion time is 150 days which is the same as the project plan time. The estimated final cost of the project is Rp. 4,624,935,397 which shows that the costs incurred are smaller than the total budget plan (BAC) of Rp. 4,624,935,404.
2. Based on the results of the analysis using earned value, the implementation of the lumbang puskesmas building construction project is carried out according to schedule and costs incurred in accordance with the existing contract value.
3. Results of project implementation performance based on cost and time arising various problems during the project. As for some problems that arise, there is a temporary suspension of funds from contractors to suppliers because these funds are widely used for other purposes, causing some weight of work to be late in several weeks. However, during the following week, the contractor maximized the lagging work performance again, thus preventing delays in planning time.

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