

TIME PERFORMANCE ANALYSIS ON AFV EARTHWORK IN KEDUNGPELUK SIDOARJO USING THE EARNED VALUE METHOD

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Abstract

Construction project management has three main goals that must be achieved, namely cost, quality and time of work *Plengsengan Afv. Kedungpeluk Sidoarjo* which is planned to be completed within an estimated time of 120 calendar days and there are obstacles to contractor implementers who experience delays of 6.98% in this study researchers make efforts to find out Early Warning if there is poor performance in project completion so that management policies and changes in implementation methods can be made so that delays in project completion can be prevented. Earned Value Method is used in the management of *Afv Plengsengan work. Kedungpeluk Sidoarjo* which will integrate the concept of time value. Earned Value Method is calculated from various factors that show the progress and performance of the project such as Schedule Variance (SV), work productivity index (CPI), time productivity index (SPI), and project completion schedule forecast (ECD), The results of using Earned Value Method get the results The amount of time required (ETS) at the end of the 8th week review is 91 days. While the time to complete the project (EAS) is 140 days. With this, the rate of change in project completion time is 0.16% longer, Based on the results of the analysis obtained for construction service providers who carry out development work, must apply good and efficient implementation methods in all stages of work with consistent supervision so that there is no delay in the construction work of *Plengsengan Afv. Kedungpeluk Sidoarjo*.

Keywords: Cost, Time, Earned Value

1. INTRODUCTION

Drainage is one of the vital infrastructures for urban areas that functions to drain surface water to water bodies (rivers). A poorly designed drainage system will result in environmental damage, economic losses and a decrease in the quality of housing, including inundation, flooding, damage to existing facilities and infrastructure. This results in disruption of city functions, obstruction of human mobility and the emergence of various diseases.

Project is defined as a work activity that has a certain period of time, with the application of limited resources, to carry out a planned task. (Chmielarz, 2015) So that project management can be applied to all stages of the project, starting from the planning, design, procurement and implementation stages, so that to apply it will be more complicated and complex, because the resources available are different and varied and have intermediate goals, according to the stage. The goal of project management itself is to get proper control of a job to determine that its completion can be in accordance with the schedule within the limits of the budget and time set (Soeharto, 1999).

Control needs to be carried out on this job, because the project implementation is delayed. Time control is carried out so that delays in the final time of implementation can be prevented. In addition, the additional time due to these delays can be optimized.

Time is very important for project completion and can be determined when it ends. It can also be known whether or not it is efficient for the completion of the project (Pabalik et al., 2018). At the project planning stage, it is necessary to estimate the duration of the project implementation time. The completion time of a project varies, as a result the estimated completion time of a project cannot be ascertained. The level of accuracy of the project completion time is determined by the accuracy of the estimated duration of each job in the project. In addition to the time estimation approach, determining the relationship between jobs is also necessary for planning a job. To estimate the time and cost of a project, an approximate estimate is required. The implementation of a project generally experiences delays in work time, but there are also projects that experience acceleration from the original planned schedule.

In the implementation of construction projects, the main objectives of management are three things, namely cost, quality, and time (Kartikasari, 2014). A project is said to be successful in its management if the project can be completed with a predetermined level of quality or quality. Thus, it is very necessary to have a planning method that can help manage project implementation. Good and measurable project management is needed to ensure that the time for carrying out work is on schedule or can be faster so that the costs incurred are smaller than the budget so as to benefit and avoid delays in project completion which have an impact on losses. In the implementation of a project in the field, many projects experience delays in completion and even stop the implementation. This also has an impact on over head project costs which cause the project to experience losses. Whereas as a project contractor, cost profit is the goal. Therefore, it is necessary to control so that the deviations that occur can be overcome, so that the project can be completed as planned. The success of a project cannot be separated from the stages which include planning, implementation and supervision, so that the predetermined goals can be achieved. In an effort to complete a construction project, a good technique or management method is needed to improve efficiency, productivity and quality of work. In connection with this, it is necessary to carry out supervision and control measures in all sectors, especially time and cost control.

The implementation of a project activity takes place faster than the planned schedule, not necessarily using the costs that have been allocated efficiently. If this happens, then at the end of the work the amount of implementation costs will exceed the budget planned at the beginning of the planning. As a result, the achievement of the work is not achieved as planned. Therefore, it is necessary to analyze the cost and time in an integrated manner, so that at the time of reporting the work can be accurately known achievement, and the total cost and time required in the completion of the project. Based on the results of the analysis, the necessary improvements can be made so that the work reaches the target. In general, there is no one project that in carrying out its activities can run smoothly from start to finish without experiencing changes from the initial plan, even more so for large and complex projects.

(Pancaningrum, 2017) Cost and Time Planning and Control is part of overall construction project management. In addition to quality assessment, the success of a project can also be assessed in terms of cost and time. The costs that have been incurred and the time used in completing a job must be measured continuously for deviations from the plan. (Sobari & Lutfi, 2018) The existence of significant cost and time deviations indicates poor project management. With the existence of project performance indicators

in terms of cost and time, it is possible to take preventive action so that project implementation goes according to plan (Tarore et al., 2012).

One of the project control methods is the Earned Value Concept method. Andrzej Czemplik (2014) The Earned Value concept is a control method used to control project costs and schedules in an integrated and efficient manner. This method shows project performance information for a reporting period and shows the estimated time and cost to complete all projects based on performance indicators at the time of reporting. The Earned Value concept is a development of the Variance Analysis concept (Gardjito, 2017). In Variance Analysis only some of the work results at the reporting time are shown compared to the budget or schedule.

The weakness of the Variance Analysis method is that it only analyzes cost and schedule variations separately so that it cannot reveal performance problems carried out on a project. Whereas with the Earned Value Concept method, the performance of the activities being carried out can be known and can increase the effectiveness in monitoring project activities. Over time, a refinement of the method was found, namely the Earned Schedule (ES) method. This method has better results in evaluating project time performance and predicting the final project time. The Earned Schedule (ES) method is an extension of the Earned Value Method (EVM) (Aditama, 2021). The Earned Schedule method uses time units to calculate project schedule control, not cost units like the EVM method.

Based on the above description, it can be generally concluded that the concept of "earned value method" as a construction project control instrument is needed to manage projects. Based on the cost and time performance, a project manager can identify the overall performance of the project and the work packages in it and then predict the cost and time performance of the project completion. The results of the project performance evaluation can be used as early warning if there are performance inefficiencies in project completion so that management policies and changes in implementation methods can be made so that cost overruns and delays in project completion can be prevented.

In the work of Plengsengan Afv. Kedungpeluk Sidoarjo which absorbs a budget of Rp 1,515,400,000.00 (One Billion Five Hundred Fifteen Million Four Hundred Thousand Rupiah) must be completed within an estimated time of 120 calendar days, with minimal time and implementation constraints such as difficulties in mobilizing materials to the job site, the contractor experienced a work delay of 6.98% being a problem that quite affects the ongoing activities of Plengsengan Afv. Kedungpeluk Sidoarjo, then the calculation of the Earned Value concept is used in the management of the work of Plengsengan Afv. Kedungpeluk Sidoarjo which will integrate the concept of time value (Kartikasari & Inayatullochmah, 2018).

The results of using the Earned Value method can be calculated various factors that indicate the progress and performance of project implementation such as time variance or Schedule Variance (SV), work productivity index (CPI), time productivity index (SPI), and project completion schedule forecast (ECD), which will certainly greatly assist the performance of contractors in managing their work performance (Balaka, 2014). The results of the project performance evaluation obtained can be used as an early warning if there is a lack of performance in the implementation of construction projects, the main objectives of management are three things, namely cost, quality and time. A project is said to be successful in its management if the project can be completed with a predetermined level of quality or quality. Thus, it is very necessary to have the right

planning and scheduling techniques or methods that can help manage project implementation effectively.

Based on the background description above, the purpose of this research is to obtain time performance with the Earned Value method with SV, SPI, CPI, and ECD indicators, as well as to obtain an estimate of the cost and time required to complete the Afv Plengsengan work. Kedungpeluk Sidoarjo.

2. RESEARCH METHODS

In research conducted on the construction of Plengsengan Afv. Kedungpeluk Sidoarjo data collection as research material obtained from the executing contractor and also some from the supervisory consultant. The types of data collected are secondary data types and literature studies, including:

1. Project implementation schedule (Time Schedule)
 - a) S curve (Master schedule)
 - b) Actual project S curve
2. Cost Budget Plan (RAB)
3. Project Weekly Report
4. Actual Cost

Data analysis techniques performed on Earned Value are:

1. Project Performance Analysis

A. Cost and Schedule Analysis

- a) Planned Value (PV)
- b) Earned Value (EV)
- c) Actual Cost (AC)

B. Variance Analysis

Variance analysis is used to determine the extent to which the results are predicted from what is estimated.

- a) Cost Variance (CV)
- b) Schedule Variance (SV)

C. Performance Index Analysis

The performance index is used to determine the efficient use of resources

- a) Schedule Performance Index (SPI)
- b) Obtained from the division between EV and PV.
- c) Cost Performance Index (CPI)

2. Estimated Cost and Final Time of Work

- a) Estimate to Complete (ETC)
- b) Estimate at Complete (EAC)
- c) Time Estimate (TE)

3. Analysis of Project Progress or Delay Factors

To analyze the factors causing project progress or delay, it is done by:

- a) Interview with the implementing contractor (Site Engineer Manager, supervisor and logistics) and direct observation of daily project performance.

- b) Checking material delivery whether it is in accordance with the material arrival schedule.
- c) Checking weekly reports to find out the percentage of work that has been done for one week.
- d) Checking the daily report to find out the pattern of labor usage, tool usage, material usage, weather conditions and the use of field working hours.

Before analyzing in doing this research, it is necessary to prepare work steps in accordance with the flow chart that has been made, namely:

1. Determine the background.
2. Formulate the problem.
3. Collecting data (Time Schedule, RAB, weekly project progress report, actual cost) to calculate PV, EV, AC.
4. Perform performance analysis to calculate CV, SV, CPI and SPI.
5. Calculating the estimated project completion time Time Estimate (TE).
6. Analyzing project progress or delay factors.
7. Draw conclusions.

3. RESULTS AND DISCUSSION

3.1. PLANNED VALUE (PV) / BCWS CALCULATION

Planned Value (PV) is the budgeted cost of work scheduled for a certain period and specified in the budget, or also called Budgeted Cost of Work Scheduled (BCWS). Obtained by multiplying the percentage of planned progress contained in the time schedule by the project implementation cost listed in the RAB.

PV or BCWS = (% plan progress) x (Budget) Calculation of PV or BCWS in week 1

PV or BCWS = (% plan) x (Total project budget) PV or BCWS = (1.99%) x (Rp. 1,515,400,000)

PV or BCWS = Rp 15,002,460

For the calculation of the next week, it can be done in the same way as the calculation above, seen in table 1 below:

Table 1. PV or BCWS

Minggu	Kumulatif rencana	Anggaran	PV ATAU BCWS
1	0,99	1.515.400.000,00	15.002.460,00
2	2,76	1.515.400.000,00	41.825.040,00
3	4,77	1.515.400.000,00	72.284.580,00
4	8,54	1.515.400.000,00	129.415.160,00
5	9,46	1.515.400.000,00	143.356.840,00
6	21,33	1.515.400.000,00	323.234.820,00
7	38,88	1.515.400.000,00	589.187.520,00
8	43,87	1.515.400.000,00	664.805.980,00
9	27,21	1.515.400.000,00	412.340.340,00

10	52,98	1.515.400.000,00	802.858.920,00
11	78,22	1.515.400.000,00	1.185.345.880,00
12	85,98	1.515.400.000,00	1.302.940.920,00
13	93,11	1.515.400.000,00	1.410.988.940,00
14	99,23	1.515.400.000,00	1.503.731.420,00
15	100,00	1.515.400.000,00	1.515.400.000,00

Source: Processed by Researchers, 2023

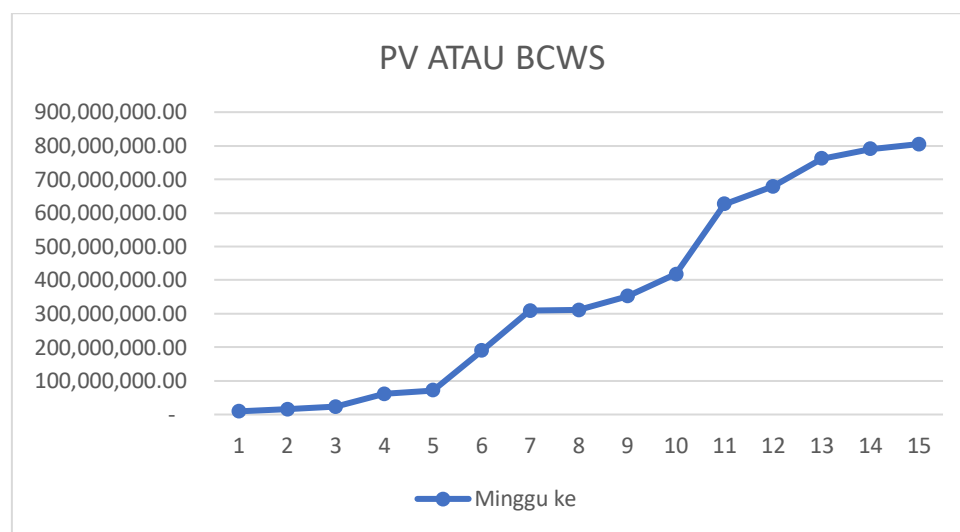


Figure 1. Grafik Planned Value (PV) / Budgeted Cost of Work Schedule BCWS

Source: Processed by Researchers, 2023

Description:

Graph and table Planned Value (PV) / Budgeted Cost of Work Schedule (BCWS) can be seen cost expenditure each week according to the contract.

3.2. EARNED VALUE (EV) or BCWP Calculation

Earned Value (EV) or BCWP is the budgeted cost for work that has been completed, obtained by multiplying the percentage of progress that has been carried out with the budget.

EV or BCWP = (% actual progress) x (Budget) Calculation of EV or BCWP in week 1

EV or BCWP = (% actual progress) x (Total project budget) EV or BCWP = (1.23%) x (Rp. 1,515,400,000)

EV or BCWP = Rp. 9,900,568.89

For the calculation of the next week can be seen in table 4.2 below:

Tabel 2. EV or BCWP

Minggu	Kumulatif Aktual	Anggaran	EV atau BCWP
1	1,23	1.515.400.000,00	18.639.420,00
2	2,09	1.515.400.000,00	31.671.860,00

3	3,56	1.515.400.000,00	53.948.240,00
4	8,89	1.515.400.000,00	134.719.060,00
5	12,98	1.515.400.000,00	196.698.920,00
6	19,77	1.515.400.000,00	299.594.580,00
7	30,05	1.515.400.000,00	455.377.700,00

Source: Processed by Researchers, 2023

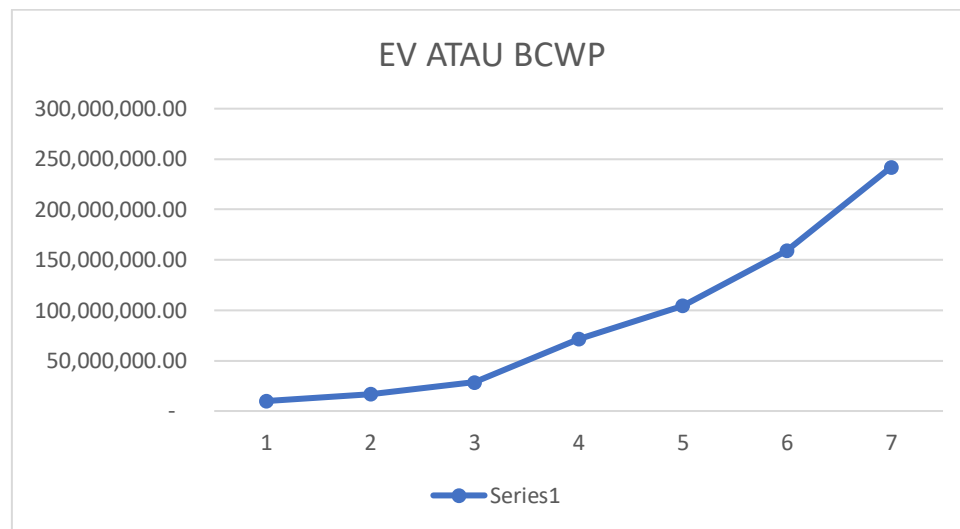


Figure 2. Earned Value / BCWP Chart

Description:

Graph and table Earned Value (EV) / Budgeted Cost of Work Performed (BCWP) can be seen there is a delay in the 7th week can not be seen.

3.3. CALCULATION OF ACTUAL COST (AC)

Actual Cost (AC) or also called Actual Cost of Work Performed (ACWP) is the actual cost used (Real Cost)(Witjaksana & Reresi, 2012).

Tabel 3. ACWP

Minggu	ACWP
1	12.780.000,00
2	45.762.000,00
3	78.445.600,00
4	127.963.000,00
5	145.763.900,00
6	234.988.400,00
7	286.549.000,00

Source: Processed by Researchers, 2023

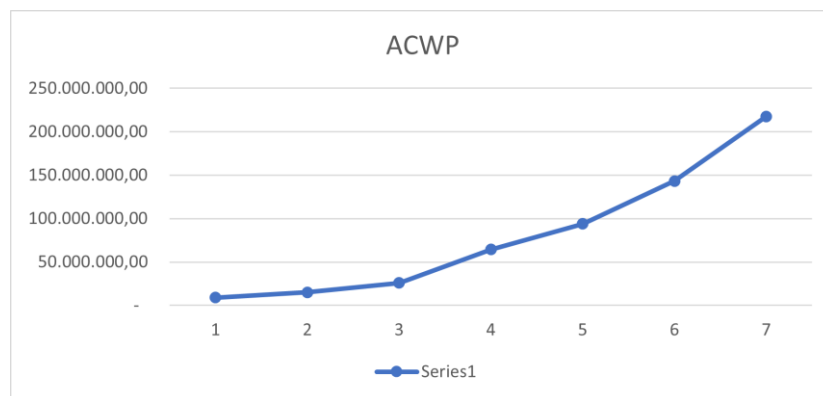


Figure 3. Graph of Actual Cost of Work Performed (ACWP)

Description:

From the graph and table Actual Cost of Work Performed (ACWP) can be seen the actual tactical expenditure.

From the three data above, the comparison data between Planned Value (PV), Earned Value (EV), Actual Cost (AC) is obtained as shown in the following table:

Table 4. Comparison of Planned Value (PV), Earned Value (EV), Actual Cost (AC)

Minggu	PV ATAU BCWS	EV atau BCWP	ACWP
1	15.002.460,00	18.639.420,00	12.780.000,00
2	41.825.040,00	31.671.860,00	45.762.000,00
3	72.284.580,00	53.948.240,00	78.445.600,00
4	129.415.160,00	134.719.060,00	127.963.000,00
5	143.356.840,00	196.698.920,00	145.763.900,00
6	323.234.820,00	299.594.580,00	234.988.400,00
7	589.187.520,00	455.377.700,00	286.549.000,00

Source: Processed by Researchers, 2023

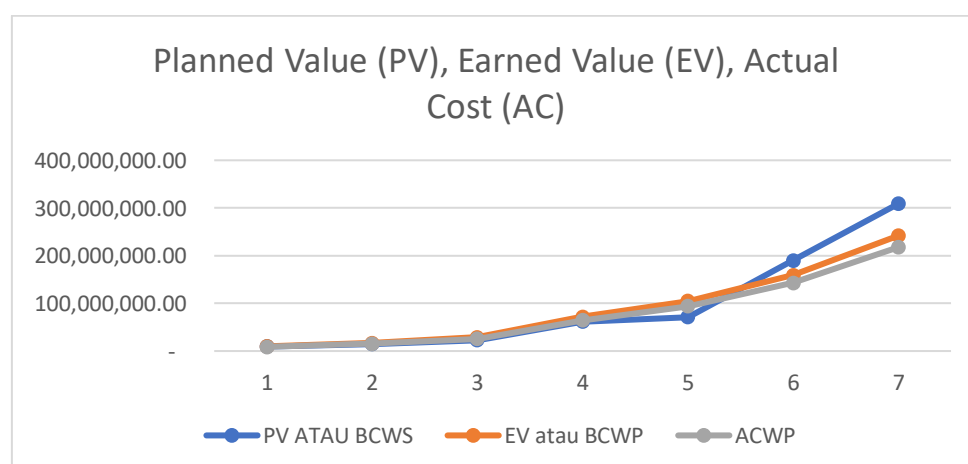


Figure 4. Comparison Chart Planned Value (PV), Earned Value (EV), Actual Cost (AC)

1. In week 6 to week 7 the project experienced work delays, this is indicated by the EV or BCWP value which is smaller than the PV or BCWS value.
2. For actual costs or ACWP in week 6 to week 7, the cost expenditure is greater with the ACWP graph marked higher than EV / BCWP.

3.4. CALCULATION OF PROJECT PERFORMANCE, COST ESTIMATION AND COMPLETION TIME PROJECT

1) Time Variant Calculation

In the 6th week review, the SV value in week 6 is obtained from the subtraction of Earned Value / BCWP and Planed Value / BCWS in week 6.

$$SV = EV - PV$$

$$SV = \text{Rp } 299,594,580.00 - \text{Rp } 323,234,820.00 = -\text{Rp } 23,640,240.00$$

A negative value indicates that the project implementation time is running late from the initial planning.

This SV and CV value indicates that the project is delayed or running faster than planned and the costs incurred are greater than or less than the planned budget,

2) Calculation of Performance Index

a) Calculation of Time Performance Index (SPI)

At week 6 review, the SPI value at week 6 is obtained from the comparison between Earned Value and Planed Value at week 6.

$$SPI = EV / PV$$

$$SPI = -\text{Rp } 23,640,240.00 / \text{Rp } 323,234,820.00 = -0.07$$

An SPI value of less than 1 indicates that the performance of the work time is not as expected or is delayed from what has been planned.

3) Calculation of Estimated Project Time

a) Calculation of Final Estimate of Project Time

Cost or schedule forecasts are very useful because they provide an early warning of things that will happen in the future, if the trends that exist at the time of reporting do not change.

At the end of the review i.e. week 7, the estimated remaining work time, Estimate Temporary Schedule (ETS) is as follows:

$$ETS = (\text{remaining time}) / SPI$$

$$ETS = (120 - 49) / 0.78$$

$$ETS = 71 / 0.78 = 91$$

While the estimated completion time of all work, Estimate All Schedule (EAS)

$$EAS = \text{finish time} + ETS$$

$$EAS = 49 + 91$$

$$EAS = 140 \text{ days}$$

From the above calculations, it is obtained that the processing time is 20 days longer than the planned schedule of 120 days, this can be anticipated by increasing the number of workers so that the work can be completed according to schedule.

4. CONCLUSIONS and SUGGESTIONS

The analysis of the Plengsengan Afv project in Kedungpeluk, Sidoarjo reveals key findings. At the end of week 7 review, the Estimate Temporary Schedule (ETS) indicates a required time of 91 days, while the overall completion time for the Estimate All Schedule (EAS) project is projected to be 140 days. Additionally, a 0.16% increase in project completion time is observed with the addition of 20 days. To mitigate future time delays, the study suggests that construction service providers involved in development projects implement efficient methods with consistent supervision. Furthermore, for more accurate results in future research, the utilization of the Critical Path Method (CPM) or the Ms. Project Program for data analysis is recommended (Rakasyiwi et al., 2022).

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