

Cost and Time Performance Analysis Using the Earned Value Method in the MCC (Motor Control Center) Warehouse Room Construction Project at Pt. Omya Plant Paciran Lamongan

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ABSTRACT

Planned Value (PV) represents the expected expenses for tasks designated for a particular timeframe and outlined in the financial plan, also referred to as the Budgeted Cost of Work Scheduled (BCWS). This figure is calculated by taking the proportion of intended progress as per the timeline and multiplying it by the expenses earmarked for the project as detailed in the Bill of Quantities (RAB). PV or BCWS = (percentage of planned progress) x (Budget) PV or BCWS calculation for Week 1. PV or BCWS = (percentage of plan) x (total budget for the project) PV or BCWS = (0.07%) x (Rp. 2,270,000,000). PV or BCWS = Rp. 1,589,000. Earned Value (EV) or BCWP reflects the budgeted costs associated with work that has been finished, calculated by multiplying the percentage of actual progress by the budget. EV or BCWP = (percentage of actual progress) x (Budget) EV or BCWP calculation for Week 1. EV or BCWP = (percentage of actual progress) x (total budget for the project) EV or BCWP = (0.07%) x (Rp. 2,270,000,000) EV or BCWP = Rp. 1,589,000. According to the assessment conducted, the project duration was completed 7 days ahead of the projected timeline of 133 days. The assessment indicated that the final expenses were below the contracted amount of Rp. 2,189,355,000, resulting in cost efficiency

INTRODUCTION

Construction projects are complex activities involving various resources, such as labor, materials, equipment, as well as costs and time, which must be managed effectively. The success of a project is determined not only by the quality of the final result, but also by the ability to complete the work within the planned budget and time schedule. Therefore, cost and time control are crucial aspects of construction project management.

During project implementation, deviations often occur between plans and actual implementation. These deviations can take the form of work delays, cost overruns, or even both. This can be caused by various factors, such as inadequate planning, design changes, material procurement delays, and low labor productivity. If not properly managed, these deviations can negatively impact the overall success of the project.

One way to manage project timelines and expenses in a cohesive manner is through the Earned Value method. This technique enables project managers to assess the project's performance by comparing the planned outcomes with the actual results, taking into account both cost and time factors. It offers a clearer assessment of the project's status over a specific timeframe.

The Earned Value method brings together three key elements: Planned Value (PV), Earned Value (EV), and Actual Cost (AC). These three components allow for the calculation of various performance metrics, including Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), and Schedule Performance Index (SPI). These metrics are instrumental in determining whether a project is progressing as intended, is ahead of schedule, or is facing delays and budget overruns.

The use of the Earned Value method in construction projects is increasingly vital as the complexity of these projects grows. Industrial facility construction projects, such as Warehouse MCC (Motor Control Center) Rooms, require stringent oversight. These projects are associated with higher risks due to their connection to electrical systems and industrial processes that demand accuracy and timeliness.

The Warehouse MCC Room is an essential part of the electrical distribution network within an industrial setting. This room functions as the command hub for electric motors that are integral to various operations. Therefore, the construction of the Warehouse MCC Room should adhere to high-quality standards while also managing costs and timelines effectively, in order to ensure continuous operations for the company.

In practice, constructing Warehouse MCC Rooms frequently faces several challenges, such as alterations to technical specifications, limitations in resources, and on-site conditions that deviate from the original plan. These challenges can result in significant deviations from the predetermined budget and schedule. Consequently, it is essential to have a method that delivers precise and up-to-date information on project performance.

The Earned Value method provides an effective solution to these challenges by merging cost and time considerations into a single, comprehensive analysis. With this approach, project managers can perform frequent assessments of performance and implement necessary corrective measures to keep the project on course.

Furthermore, analysis using the Earned Value method can also be used to predict future project conditions, such as the final cost estimate (Estimate at Completion) and the estimated completion time. This information is crucial for decision-makers in determining project management strategies to minimize the risk of loss.

Based on this explanation, it can be deduced that controlling expenses and timelines is crucial for the success of construction projects, especially the construction of the MCC Warehouse Room. Consequently, this research was carried out to evaluate the cost and time efficiency of the project through the Earned Value analysis. This aims to provide an accurate understanding of the project's status and act as a foundation for better decision-making.

Variations in construction expenses are also affected by economic factors, which may involve rising costs of materials, equipment, wages, and labor. These fluctuations may stem from inflation, increased costs due to bank interest hikes, constrained financial resources, or delays in project execution. Additionally, productivity challenges, the readiness of essential facilities and infrastructure on-site, or specific incidents such as legal conflicts can also have an effect. On the other hand, delays in construction timelines are primarily related to the execution process, including setbacks in planning timelines, modifications during construction, feasibility of schedules, productivity challenges, regulations concerning planning safety and construction methods, environmental factors, and labor policies.

Moreover, issues impacting the quality of work results are mainly driven by the competency and skills of the workforce. For instance, this includes the establishment of planning standards and specifications, financial management as support, and procedures for supplying materials, equipment, and oversight.

In addition, there are other significant challenges affecting scheduling, time, and quality, specifically the high costs associated with economic analysis and workforce training initiatives. These three elements are interconnected. This indicates that to enhance performance as outlined in the contract, it is generally necessary to improve quality, which often leads to surpassing the budget. Conversely, to cut costs, it usually requires compromising quality and timelines.

Planning is a process aimed at establishing a foundation for goals and objectives, which includes organizing all necessary resources to achieve them. It provides a framework for implementation regarding the distribution of resources for conducting activities. In a broader sense, planning is essential for setting the groundwork for project objectives, which include scheduling, budget and quality. (Imam Soeharto, 1997).

The definition above emphasizes that planning is a process, meaning that planning undergoes specific stages. These stages are called processes. Preparing a complete plan includes at least:

1. Schedule

A schedule is a breakdown of the project plan into a systematic sequence of activities to achieve the objectives. A frequently used approach to schedule development is the creation of a network, which graphically depicts the relationship between the sequence of project tasks.

2. Forecast

A forecast is a systematic effort to predict future conditions using available data. The purpose of a forecast is to provide information to be used as a basis for planning and control.

3. Target

A target is a specific objective toward which all activities are directed and directed. There are three project objectives: schedule, budget, and quality.

4. Policies and Procedures

Policies and procedures play a crucial role in the implementation of a major project. They are communication tools that are expected to regulate, coordinate, and unify the direction of the various activities being carried out. Policies can be interpreted as guidelines for decision-making. While policies provide guidance on what needs to be done and what can be done, procedures explain how to do it. Procedures can be used to:

- a. Reduce errors caused by lack of communication.
- b. Reduce overlap and repetition.
- c. Reduce decision-making tasks, as procedures themselves constitute decisions about how work is to be performed.

A budget represents a plan for the use of funds to carry out work within a specific timeframe. In project implementation, a well-prepared budget, linked to the planned work schedule, serves as a baseline or benchmark for control activities. Budgets can become inconsistent with reality. If the budget variance is too large, its use as a planning and control tool becomes ineffective. Therefore, the budget needs to be adjusted if necessary for control and planning purposes. Adjustments here aim to align the budget with the final situation. This ensures the budget's stringency and realistic nature are maintained.

6. Alternatives

Several alternatives are always available to achieve goals and objectives. Therefore, selecting the most appropriate alternative for a proposed activity requires careful consideration, and careful assessment is necessary to ensure the chosen alternative does not cause future harm.

The objective of the implementation phase is to deliver the building required by the project owner and designed by the Planning Consultant within the agreed cost and timeframes, and to the required quality. Activities undertaken at this stage include planning, coordinating, and controlling all field operations. Project planning and control generally include:

1. Planning and controlling the implementation schedule
2. Planning and controlling the field organization
3. Planning and controlling the workforce
4. Planning and controlling equipment and materials

Coordination of all field operations includes:

1. Coordinating all construction activities, both temporary and permanent, as well as all installed facilities and equipment.
2. Coordinating subcontractors
3. Provision of general supplies.

The implementation of building construction work differs from road construction, dam construction, port construction, etc. In construction work, there are targets that contractors must achieve, as follows:

1. Completion with the same quality as specified in the plan.
2. Completion within a timeframe equal to or less than the planned time.
3. Completion with a cost at least equal to the planned cost.
4. Completion without causing environmental impacts (social, physical, and administrative).
5. Lab inspection/testing.
6. First handover.
7. Maintenance period.
8. Second handover.

Control is carried out concurrently with project implementation. Project control is carried out to ensure the project remains on track within the time, cost, and performance limits set forth in the plan. There are several differences between planning and control: Planning focuses on establishing direction and objectives, allocating resources, anticipating problems, and motivating participants to achieve objectives. Control, on the other hand, focuses on guiding work toward objectives, utilizing resources effectively, making improvements/corrections, and rewarding achievement.

There are three steps in the project control process:

1. Determining performance standards, such as technical specifications, budgeted costs, schedules, or resource requirements.
2. Comparing actual performance with standard performance.
3. Taking corrective action to address the causes of differences between actual and standard performance.

For control purposes, timely and accurate information regarding ongoing work is required. To provide timely and accurate information, companies need a good information system. Here are some project-related information systems:

1. Project Cost Accounting System (PCAS)

A PCAS is a structure and methodology, either manual or computerized, that enables project planning and cost control.

2. Project Management Information System

This system, which can be manual or computerized, is intended to provide timely, accurate, and appropriate information for management decision-making. In general, a project management information system aims to:

- a. Provide information necessary for planning, control, and document summaries.
- b. Separate data from other computer information systems into a project database.
- c. Integrate work, labor costs, and schedule information to produce planning, control, and summary reports for project managers and stakeholders.

- d. Assist in overall project implementation by: creating schedules and work networks, allocating resources using leveling techniques, creating budgets that include variable, fixed, and overhead costs, conducting cost control and performance analysis, and presenting easily readable reports and graphs.

The project control process consists of several activities carried out systematically and sequentially. Control is a systematic effort to determine standards in accordance with planning objectives, design information systems, compare standards with implementation, and then take necessary corrective actions so that resources are used effectively and efficiently to achieve objectives. (Ir. Iman Soeharto, 1999)

The project control process can be broken down into the following steps:

1. Determining objectives.

The project objective is to produce a product within specified quality, schedule, and cost limits. Objectives are the cornerstone of control activities.

2. Defining the scope of work.

To clarify objectives, the project scope is further defined, including the size, boundaries, and type of work required to complete the overall project scope.

3. Determining standards and benchmark criteria.

To achieve objectives effectively and efficiently, it is necessary to develop standards, criteria, and specifications that serve as benchmarks for comparing and analyzing work results. The standards, criteria, and benchmarks selected and determined must be quantitative, and the measurement and calculation methods must provide an indication of target achievement.

4. Monitoring and reporting

At specific intervals, inspections, measurements, and data collection are conducted on the results of project implementation.

5. Taking corrective action

If the analysis indicates significant deviations, corrective action is necessary.

Therefore, control is the process of measuring, evaluating, and correcting project performance. For construction projects, there are three elements that are constantly controlled and measured: progress compared to the contract agreement, financing against the budget plan, and the quality of work results against technical specifications. Therefore, the basic control process in every construction activity generally consists of:

1. Establishing work standards
2. Measuring performance against standards
3. Correcting deviations from standards if they occur.
4. Time control

Time control in the field aims to ensure that the implementation time is in accordance with the established time plan. The implementation time plan must be prepared before the project begins. This is so that the existing time plan can be used as a benchmark against which work progress can be measured.

THEORETICAL REVIEW

A previous study, entitled "Cost and Schedule Control Using Earned Value (Building X Gresik Rehabilitation Project)," found that the final week's

results were above plan. The final week's results showed a SV of Rp185,792,583.94 and a CV of Rp348,089,626.99. The SPI was 1.06 and the CPI was 1.12. The study estimated the project's completion time at 89 days and the final cost at Rp4,254,837,523.80, resulting in a project profit of Rp368,781,573.68. (Agatha & Dani, 2018)

Meanwhile, the study, entitled "Cost and Time Review of the South City Square Lot 2 Project Using the Earned Value Method," also revealed a project completion time of Rp185,792,583.94. The results of the study showed that the project experienced work delays until the 26th week because the SPI value was less than 1 and the SV was negative, in terms of costs, it showed that management had been carried out well because the estimated difference between the planned cost and the actual cost was Rp 2,526,376,097. (Sobari & Lutfi, 2018)

METHODOLOGY

The approach taken for project control is the Integrated Cost and Schedule Control Method, often referred to as Earned Value. This technique analyzes the changes in Schedule Variance and Cost Variance throughout the duration of the project (Ir. Iman Soeharto, 1999).

The Earned Value approach serves as a management tool in projects that merges both cost and schedule. It showcases three aspects: the degree of project completion (percent complete), which is based on the expected costs (budgeted cost), the actual expenses incurred (Actual Cost), and the value obtained from these expenses (Earned Value). With these three elements, the Earned Value method can correlate financial performance with time by assessing both cost and time variances (Fleming and Koppelman, 1994).

By evaluating this cost and time data, a project manager can ascertain the overall status of the project and its components, allowing for predictions regarding the project's financial performance and timeline for completion. This analysis of project performance can provide early indicators of inefficiencies in meeting project deadlines, enabling adjustments in management strategies and methods to avoid budget excesses and delays.

As projects become more intricate, issues such as delays and budget overruns tend to arise. Often, the management approach segregates the cost tracking system from the scheduling system for construction projects. The cost tracking system can produce performance updates and financial forecasts, whereas the scheduling system can provide reports on project timeline status. Although both systems offer valuable project management information, they can present differing insights regarding project conditions. Therefore, a system that effectively combines time and cost data is essential. In this context, the Earned Value approach can function as a comprehensive performance assessment tool, integrating both financial and temporal factors.

The Variance Analysis technique is a tool for managing the expenses and timeline of a building project. This approach involves recognizing differences by comparing the actual spending with the budgeted amount. Variance analysis is performed by gathering data on the current state of the project at the time of reporting, which includes calculating the number of work units finished, and then contrasting this with the planned figures or examining usage records of

resources. This technique reveals the discrepancies between the costs of execution and the budget, as well as the actual time against the projected schedule (Ir. Iman Soeharto, 1999).

Another way to demonstrate variance is by using a graph. An "S" chart will illustrate the progress of the volume of work completed throughout the project cycle. When compared with a similar chart prepared based on the baseline plan, any deviations will be immediately apparent. "S" charts are used in the following situations:

1. In analyzing overall project progress.
2. Similar to the above, but for individual work units or elements.
3. In engineering and purchasing activities, to analyze the percentage (%) of work completion, such as man-hours for preparing designs, producing drawings, and preparing purchase requests, versus time.
4. In construction activities, to analyze labor usage or man-hours and to analyze the percentage (%) of completion and other tasks measured (expressed) in units versus time.

"S" charts are very useful for use in monthly reports and reports to project management, as they can clearly show project progress in an easy-to-understand format.

Performance standards are needed to control the use of existing resources in a project. This ensures that project resources are utilized effectively and efficiently in project implementation. (Kaming & Rahardjo, 2010)

Performance reporting must meet five components:

1. Forecasts, which provide a standard for comparing actual results with estimates.
2. What actually happened.
3. Estimates, which are based on predicting future events.
4. Variances, which indicate the extent to which estimated results differ from expectations.
5. Reasoning, which explains the state of the project.

If a report reveals a deviation, management will investigate and understand the underlying reasons. Therefore, control is necessary to ensure work is on budget and on schedule.

The use of the Earned Value concept in project performance assessment is explained in Figure 2.2. Some terms related to this assessment are Cost Variance, Schedule Variance, Cost Performance Index, Schedule Performance Index, Estimate at Completion, and Variance at Completion.

1. Cost Variance (CV)

Cost variance is the difference between the value obtained after completing work packages and the actual costs incurred during project implementation. A positive cost variance indicates that the value of the work packages obtained is greater than the costs incurred to complete them. Conversely, a negative value indicates that the value of the completed work packages is lower than the costs incurred (Ir. Iman Soeharto, 1999).

$$CV = EV - AC$$

Where, CV = Cost Variance, the difference between Earned Value and Actual Cost.

EV = Earned Value, the budgeted cost for the work performed.

AC = Actual Cost, the cost incurred for the work performed.

2. *Schedule Variance (SV)*

Schedule variance is used to calculate the deviation between Planned Value (PV) and Earned Value (EV). A positive value indicates that more project work packages were implemented than planned. Conversely, a negative value indicates poor project performance because fewer work packages were implemented than planned (Ir. Iman Soeharto, 1999).

$$SV = EV - PV$$

Where, SV = Schedule Variance, the difference between Earned Value and Planned Value.

EV = Earned Value, the budgeted cost for work that has been implemented.

PV = Planned Value, the budgeted cost for work scheduled for a specific period.

3. *Cost Performance Index (CPI)*

The cost efficiency factor can be demonstrated by comparing the value of the work physically completed (Earned Value (EV) with the costs incurred in the same period (Actual Cost (AC)).

$$CPI = EV / AC$$

Where, CPI = Cost Performance Index, the cost efficiency factor

EV = Earned Value, the budgeted cost for
P Work performed.

AC = Actual Cost, the cost incurred for
P Work performed.

The Cost Performance Index (CPI) value indicates the weight of the value earned (relative to the overall project value) against the costs incurred. A Cost Performance Index (CPI) of less than 1 indicates poor cost performance, as the costs incurred (Actual Cost (AC)) are greater than the value obtained (EV), or in other words, waste occurs (Ir. Iman Soeharto, 1999).

4. *Schedule Performance Index (SPI)*

The performance efficiency factor in completing work can be demonstrated by comparing the Earned Value (EV) of the physically completed work with the planned expenditures based on the Planned Value (PV) of the work plan.

$$SPI = EV / PV \text{ (2.4)}$$

Where,

SPI = Schedule Performance Index, the performance efficiency factor in completing work.

EV = Earned Value, the budgeted cost for work completed.

PV = Planned Value, the budgeted cost for work scheduled for a specific period.

The Schedule Performance Index (SPI) value indicates the extent of work completed (relative to the overall project) relative to the planned work units. A

Schedule Performance Index (SPI) value of less than 1 indicates that work performance is not as expected because it is unable to achieve the planned work targets (Ir. Iman Soeharto, 1999).

5. Project Cost and Completion Time Prediction

The Earned Value method can also be used to estimate the final project cost and completion time. The estimate is calculated based on performance trends and the assumption that these trends will remain unchanged until the end of the project. This estimate is useful for providing the contractor with a forward-looking view so they can take necessary corrective measures. Soeharto (1995)

A. Estimate to Complete (ETC)

Estimate to Complete (ETC) is a cost estimate for the remaining work, assuming that the project's performance trends will remain unchanged until the end of the project. According to Soeharto, this estimate can be extrapolated in several ways:

- a. Remaining work costs the same as the budget
- b. Performance remains the same until the end of the project
- c. Mixed approach: This approach combines both methods:
 - ETC for progress <50%
 - $ETC = \text{Total Budget} - EV$
 - ETC for progress >50%

$$ETC = (\text{Total Budget} - EV) / CPI$$

B. Estimate at Complete (EAC)

Estimate at Complete (EAC) is the estimated total cost at the end of the project, obtained by adding the actual costs to the ETC.

$$EAC = AC + ETC$$

Were,

EAC = Estimate at Complete, the sum of the actual costs incurred and the remaining costs required to complete the project

AC = Actual Cost, the costs incurred for work already performed

ETC = Estimate to Complete, the estimated cost for the remaining work, assuming that the project performance trend will remain stable until the end of the project.

C. Time Estimate (TE)

TE is the estimated project completion time. The assumption used to estimate the completion time is that the project's performance will likely remain the same as during the review.

$$TE = ATE + (OD - (ATE \times SPI) / SPI)$$

Note:

TE (Time Estimated) = Estimated completion time

ATE (Actual Time Expended) = Time elapsed

OD (Original Duration) = Planned time

SPI (Schedule Performance Index) = Amount of work that can be completed.

Accelerating project completion time means making efforts to complete a construction project faster than the previously determined schedule. Project acceleration is a deliberate, systematic, and analytical process for examining all activities within a project, focusing on those on the critical path (Ervianto, 2004).

Project acceleration is an effort made to reduce or accelerate project completion. Project acceleration efforts will impact project completion time and costs. The reason for project acceleration is because delays have occurred and/or the project must be completed immediately according to the agreed contract. The following are ways to accelerate a project:

- a. Increasing working hours (overtime)
- b. Increasing the number of workers
- c. Using shifts
- d. Using more productive equipment
- e. Using materials that can be installed more quickly
- f. Using other, faster construction methods

The maximum acceleration duration of an activity is the shortest time to complete an activity that is technically possible, assuming resources are the constraint (Soeharto, 1999).

There are several reasons why project duration needs to be accelerated, including (Wati, 2015):

- a. The project activity in question is expected to be completed because it has been decided and approved by management or the owner for a specific reason.
- b. Due to project implementation delays that exceed a certain allowable tolerance limit and are assessed by management or the owner to significantly impact the progress and overall project completion deadline.

There are four factors that can be optimized to accelerate operations on an activity: scheduling additional working hours (overtime), increasing the number of workers, using heavy equipment, and changing construction methods in the field (Frederika, 2010).

Time Cost Trade Off Analysis

Time Cost Trade-Off (TCTO) is an analysis method used to accelerate project completion time by shortening the project's duration and achieving a more cost-effective schedule. The goal is to shorten the project to an acceptable duration and minimize total project costs. Project duration is shortened by selecting activities on the critical path (Florensia, 2016).

According to Ervianto (2004), the definition of the Time Cost Trade-Off Analysis method is a process of thoughtful, systematic, and analytical examination of all activities within a project, focusing on the critical path. Then, compression begins with the critical path with the lowest cost. Condensation continues until the critical path is completely saturated with activities that can no longer be compressed. According to Soeharto (1995), the time-condensing procedure is outlined as follows:

1. Calculate the project completion time, identify the float, and determine the critical path using the scheduling/work network method used.
2. Determine the normal cost of each activity.

3. Determine the accelerated cost of each activity.
4. Calculate the cost slope of each activity component.
5. Shorten the activity duration, starting with the critical activity with the lowest cost slope.
6. Each time you accelerate an activity, examine the possibility of any float that could be used to extend the activity's time to reduce costs.
7. If a new critical path is created during the project acceleration process, accelerate the critical activities with the lowest combined cost slope.
8. Continue shortening activity durations until the project completion point (TPD).
9. Tabulate cost versus time, graphing the relationship between the normal points (cost and normal time) formed each time you shorten an activity, up to the TPD (project completion point).
10. Calculate the direct and indirect costs of the project and plot them on the graph above.
11. Add the indirect costs to find the total cost before the desired time period.
12. Examine the total cost graph to achieve the optimum time, that is, the project completion period with the lowest cost.

To accelerate project completion, efforts must be made to minimize additional costs. The cost management applied is direct costs, as these costs increase as the duration decreases. Furthermore, it's important to note that only features on the critical path are compressed.

RESULTS AND DISCUSSION

The information collected for this study includes:

1. Cost Budget Plan (RAB)

This refers to the budget assigned for every work element. The RAB is part of the agreement between the project owner and the contractor. The contract also covers price details for units, wage rates, and material costs. The RAB data is essential for computing planned value and earned value.

2. The time schedule is divided into two groups:

a. Project Plan Time Schedule

This outlines the execution plan for the project. The timeline includes descriptions of tasks, task volumes, and unit weights (%).

b. Actual Project Time Schedule

This resembles the project timeline, but it also tracks the work that has been carried out, along with details about both the completed and outstanding tasks.

3. Weekly Project Report

This document outlines the progress made on the project each week. This weekly summary serves as data for work completion and value earned.

Calculation of Planned Value (PV)/BCWS

Planned Value (PV) is the budgeted cost for work scheduled for a specific period and specified in the budget, also known as the Budgeted Cost of Work Scheduled (BCWS). It is obtained by multiplying the percentage of planned

progress in the time schedule by the project implementation costs listed in the Bill of Quantities (RAB).

PV or BCWS = (% of planned progress) x (Budget) Calculation of PV or BCWS in Week 1

PV or BCWS = (% of plan) x (total project budget) PV or BCWS = (0.07%) x (Rp. 2,270,000,000)

PV or BCWS = Rp. 1,589,000

Calculation of Earned Value (EV) or BCWP

Earned Value (EV) or BCWP is the budgeted cost for completed work, obtained by multiplying the percentage of progress by 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 = (0.07%) x (Rp. 2,270,000,000)

EV or BCWP = Rp. 1,589,000

Time Variance Calculation

In the week 1 review, the SV value for week 1 is obtained by subtracting the Earned Value/BCWP and Planned Value/BCWS for week 1.

$$SV = EV - PV$$

SV = Rp 1,589,000 - Rp 1,589,000 = Rp 0

A value of 0 indicates that the project implementation time is in accordance with the initial plan.

Cost Variance Calculation

Reviewing the cost variance (CV) calculation for week 1, obtained by subtracting the Earned Value and Actual Cost for week 1.

$$CV = EV - AC$$

CV = Rp 1,589,000 - Rp 2,065,000 = -Rp 476,000

A negative value indicates that costs exceeded the planned budget.

These SV and CV values indicate that the project is delayed or running ahead of schedule, and that costs are greater than or less than the planned budget. Calculations for subsequent weeks can be performed using the same method as above, as shown in the following table.

CONCLUSION AND RECOMMENDATION

Creating a financial estimate or a timeline for project completion based on the metrics gathered during reporting will offer insight into the overall expenses by the project's end (estimate at completion = EAC) and a timeline estimate for project finish (estimate all schedule = EAS).

Calculation of Estimated Final Project Time

Forecasts regarding cost or schedule are highly beneficial as they alert us to potential future developments, assuming the trends at the time of the report do not change.

By the conclusion of the review in week 18, the forecasted remaining work duration, the Estimate Temporary Schedule (ETS), is computed as follows:

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

ETS = (133 days - 126 days) / 1.003

ETS = 7 / 1.003 = 6.97 ≈ 7 days

Meanwhile, the estimated completion time for all work, the Estimate All Schedule (EAS), is:

$$\text{EAS} = \text{completion time} + \text{ETS} = 126 + 7$$

$$\text{EAS} = 133 \text{ days}$$

From the above calculation, the completion time is 7 days faster than the planned schedule of 133 days.

Calculation of Estimated Final Project Costs

At the end of the review, in week 18, the estimated remaining work time, Estimate Temporary Cost (ETC), is as follows:

$$\text{ETC} = (\text{Total Budget} - \text{BCWP}) / \text{CPI}$$

$$\text{ETC} = (\text{Rp } 2,270,000,000 - \text{Rp } 2,270,000,000) / 28,148$$

$$\text{ETC} = (\text{Rp } 0) / 28,148$$

$$\text{ETC} = \text{Rp } 0$$

$$\text{EAC} = \text{ACWP} + \text{ETC}$$

$$\text{EAC} = \text{Rp } 80,645,000 + \text{Rp } 0$$

$$\text{EAC} = \text{Rp } 80,645,000$$

$$\text{Result} = \text{Rp } 2,270,000 - \text{Rp } 80,645,000$$

$$= \text{Rp } 2,189,355,000$$

From the calculation above, the final cost is less than the contract cost by Rp. 2,189,355,000 so it can be said to be cost-effective.

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