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Analysis of Time and Budget Efficiency In The Bungur-Kedoyo Road Project Using Earned Value Method

M. Sulton Bahrudin, Andi Patriadi, Sajiyo
Universitas 17 Agustus 1945 Surabaya, Indonesia
E-mail: msultonbahrudin21@gmail.com, andipatriadi@untag-sby.ac.id, sajiyo@untag-sby.ac.id

***Correspondence:** msultonbahrudin21@gmail.com

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earned value, schedule variance, schedule performance index

ABSTRACT
The Bungur-Kedoyo road construction project in Tulungagung Regency represents a critical infrastructure initiative aimed at enhancing connectivity and transportation efficiency. However, challenges in managing time and cost effectively remain significant in ensuring project success. This study aims to evaluate the performance of the project using the Earned Value Method (EVM), a comprehensive framework that integrates cost and schedule analysis. EVM metrics, including Schedule Estimate To Completion (SETC), Schedule Estimate At Completion (SEAC), Budget Estimate To Completion (BETC), and Budget Estimate At Completion (BEAC), were employed to monitor and forecast project progress. The findings indicate that the project is largely on schedule, with an estimated additional week required to complete the remaining 96.908% of work, extending the contracted timeline of 180 days slightly. The remaining cost is projected at Rp. 273,570,437.28, and the total expenditure remains below the contract value at Rp. 8,847,685,552.51 out of Rp. 10,640,186,000. These results highlight the effectiveness of EVM in providing precise tracking and forecasting, ensuring the project stays within budget while achieving its objectives. The study concludes that EVM is a valuable tool for managing complex construction projects, offering actionable insights to improve time and cost efficiency for similar future endeavors.

Introduction

Road construction projects are one of the important components in infrastructure development that plays a role in supporting community mobility and economic growth. The construction of the Bungur-Kedoyo road section in Tulungagung Regency is one of the strategic projects that aims to improve connectivity and support smooth transportation flows in the region.

However, the complexity in implementing construction projects often presents

challenges in scheduling and cost control (Klau et al., 2024). Uncertainty in the field, weather changes, and other technical problems can cause project delays and budget overruns. Therefore, evaluations need to be carried out continuously (Patriadi et al., 2021). After the evaluation results are obtained, an approach is needed that can provide accurate predictions of the time and cost of completing the project.

The Earned Value Method (EVM) is a project management tool that not only helps evaluate current performance but also projects the estimated completion time and remaining costs required. By using indicators such as Estimate at Completion (EAC) and Estimate to Complete (ETC), EVM provides a comprehensive picture of how close the project is to the predetermined target (Castollani et al., 2020).

This study aims to calculate the estimated final completion time and remaining costs required to complete the Bungur-Kedoyo road construction project using the EVM method. The results of this analysis are expected to be a reference for project managers for more effective planning and better decision making in future project management (Witjaksana & Reresi, 2012).

Problem Formulation

From the background above, the following problem formulation can be made:

1. How to calculate the estimated final completion time of the Road Construction Project on the Bungur-Kedoyo Road Section, Tulungagung Regency using the Earned Value method?
2. How to calculate the remaining costs for project completion according to the initial schedule plan?

Research Objectives

The objectives of this research are as follows:

1. Calculate the estimated final time for completion of the Road Construction Project on the Bungur-Kedoyo Road Section, Tulungagung Regency.
2. Calculate the remaining costs for project completion according to the initial schedule plan.

Literature Review

Project

A project is a desire within a certain period of time that is organized in order to achieve important goals, objectives, and expectations that must be completed using the budget and available resources (Sudipta, 2013). Construction Project is a series of activities in construction that are carried out once and short-term by processing project resources into a result of activities the form of buildings (Rani & Fuadi, 2016).

Project Management

Project management, according to Lewis (2000), is the planning, scheduling and supervision of project activities to achieve performance, cost and time objectives, for a given scope of work using resources efficiently and effectively.

Project management has several input elements. The input elements are expressed as follows:

1. **Project Time Management**

Time management on a project incorporates all the processes needed in an effort to ensure project completion time. There are five main processes in project time management, namely:

a. Activity Definition.

It is the process of identifying all specific activities that must be carried out in order to achieve all project goals and objectives. This process results in the grouping

of all activities that are the scope of the project from the highest level to the smallest level or called the Work Breakdown Structure (WBS).

b. Activity Sequence.

The activity sequencing process involves the identification and documentation of interactive logical relationships. Each activity must be accurately sequenced to support the development of the schedule so that a realistic schedule is obtained. Computer tools can be used to facilitate this process or it can be done manually. The manual technique is still effective for small projects or in the early stages of a large-scale project, i.e. when no great detail is required.

c. Activity Duration Estimation.

Activity duration estimation is the process of retrieving information related to the project scope and required resources which is then continued with the calculation of duration estimates for all activities required in the project which are used as input in schedule development. The accuracy of duration estimation is highly dependent on the amount of information available.

d. Schedule Development.

Schedule development means determining when an activity in the project will start and when it should be completed. Project schedule development is an iterative process from the input process involving duration and cost estimation to the determination of the project schedule.

e. Schedule Control.

Schedule control is a process to ensure that the performance performed is in accordance with the planned time allocation.

2. **Project Cost Management**

Project cost management involves all the processes required in project management to ensure project completion within the approved cost budget. The main thing that is highly considered in project cost management is the cost of the resources required to complete the project, as follows:

a. Resource Planning

Resource planning is the process of determining the physical resources (people, equipment, materials) and their quantities required to carry out project activities. This process is closely related to the cost estimation process.

b. Cost Estimation.

Cost estimation is the process of estimating the cost of the resources required to complete a project. When the project is executed through a contract, it is necessary to distinguish between the cost estimate and the contract value. Cost estimation involves a quantitative calculation of the costs incurred to complete the project. Whereas contract value is a business decision where the cost estimate obtained from the estimation process is one of the considerations of the decision taken.

c. Cost Budgeting.

Cost budgeting is the process of making cost allocations for each activity from the overall costs that arise in the estimation process. From this process, a cost baseline is obtained which is used to assess project performance.

d. Cost Control.

Cost control is carried out to detect whether the actual cost of project implementation deviates from the plan or not. All causes of cost deviations must be well documented so that corrective measures can be taken. inspection, as well as corrections made during the implementation process.

Delay Definition

According to Callahan et al (1992), delay is when an activity or construction project activity that experiences additional time or not held according to the expected plan. Project delays can be clearly defined through the schedule. By looking at the schedule, the consequences of delays in an activity on other activities can be seen and are expected to be anticipated immediately. Construction project delays mean an increase in time of project completion that has been planned and stated in the contract documents.

Factors Causing Delay

The delay factors studied in this study are a grouping of delay factors that have been described by Proboyo (1999), Andi et al. (2010) and Assaf, A, (Assaf et al., 1995) and grouped into eleven factors, namely:

1. Labors
2. Material
3. Equipment
4. Site characteristic
5. Financing
6. Environment
7. Change
8. Contract document
9. Planning and scheduling
10. Faktor Sistem Inspeksi, Kontrol dan Evaluasi Pekerjaan
11. Managerial

Delay Impact

Project delays will cause losses to the Contractor, Consultant, and Owner, namely:

a. Contractor Party

   Delays in project completion result in an increase in overheads, due to the increase in execution time. Overhead costs include costs for the company as a whole, regardless of the contract being handled.

b. Consultant Party

   The consultant will experience a loss of time, and will be late in working on other projects, if the project implementation experiences delays in completion.

c. Owner's Party

   Project delays on the owner's side, means loss of income from buildings that should have been used or rented out. If the owner is the government, for public facilities such as hospitals, of course, delays will harm public health services, or harm the service program that has been prepared. This loss cannot be valued in money and cannot be repaid.

Earned Value Method

Flemming and Koppelman (1994) explain the earned value concept compared to traditional cost management. As explained in Figure 2.1 in Figure A, traditional cost management only presents two dimensions, namely a simple relationship between actual costs and planned costs. With traditional cost management, the performance status cannot be known, while in Figure B it can be seen that the actual cost is lower, but the fact that the actual cost is lower than the plan show that the performance has been carried out in accordance with the target plan. In contrast, the earned value concept provides a third dimension in addition to actual cost and plan cost, this third dimension is the amount of work physically completed or called earned value or percent complete.

With this third dimension, a project manager will be able to better understand how much performance is generated from a number of costs that have been incurred.

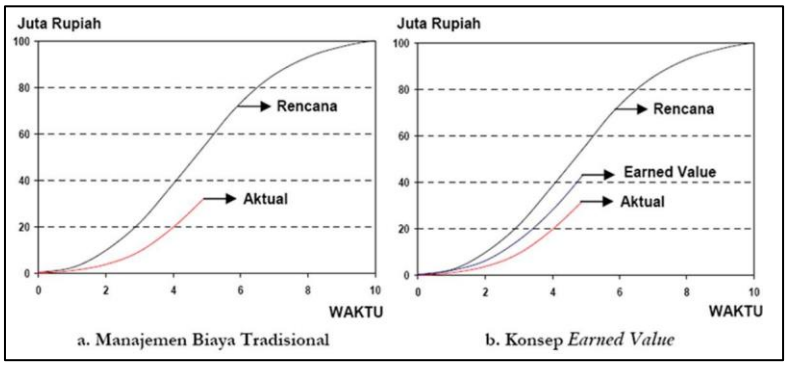

Figure 1. Comparison of Traditional Cost Management with Earned Value Concept
Source: google.com

The Result Value concept is part of the Variance Analysis concept. Where in the variance analysis only shows the difference in work results at the reporting time compared to the budget or schedule (PMBOK, 2004). The weakness of the Variance Analysis method is that it only analyzes variances and schedules separately so that it cannot reveal the performance problems of the activities being carried out. Whereas with the Result Value Concept method, the performance of the activities being carried out can be known and can increase the effectiveness in improving project activities. By using the assumption that the existing trends revealed at the time of reporting will continue, the methods of forecasting or projecting the future of the project, such as:

1. Can the project be completed with the existing conditions.
2. What is the estimated cost to complete the project.
3. How much delay/progress at the end of the project.

The Result Value concept is the concept of calculating the amount of costs according to the budget in accordance with the work that has been carried out. When viewed from the amount of work that has been completed, this concept regulates the amount of work units completed at a time when assessed based on the amount of budget provided for work.

Assessing the current status of a project using the Earned Value system requires three important data components namely:

1. Budgeted Cost Of The Work Scheduled (BCWS) describes the budget plan up to a certain period against the planned volume of the project to be carried out.
2. Budgeted Cost Of The Work Performed (BCWP) describes the project plan budget for a certain period against what has been done on the actual volume of work.
3. Actual Cost Of The Work Performed (ACWP) describes the actual budget spent on the execution of work in the state of actual work volume.

Analysis of Earned Value Indicators

There are three basic indicators that become the reference in analyzing the performance of the project based on the *earned value* concept. The three indicators are:

1. Budgeted Cost Of The Work Scheduled (BCWS)

   Describes the planned budget up to a certain period against the planned volume

of the project to be carried out. Can also be called PV (Planned Value) can be calculated from the accumulated cost budget planned for the work in a certain period of time.

2. Budgeted Cost Of The Work Performed (BCWP)

   Describes the project plan budget in a certain period against what has been done on the actual volume of work. Can be called EV (Earned Value) this can be calculated based on the accumulation of completed works.

3. Actual Cost Of The Work Performed (ACWP)

   (Adinata & Alfa, 2020) Describes the actual budget spent on the execution of work in the state of actual work volume. It is a representation of the overall expenditure incurred to complete the work in a certain period. It can be mentioned that this AC (Actual Cost) can be cumulative up to the performance calculation period or the total cost of expenditure within a certain time. (Maromi & Indryani, 2015).

The use of the earned value concept in project performance assessment is explained as follows:

1. Schedule/Time Deviations

SV (Scheduling Variance), used to calculate the deviation between PV and EV. A positive value indicates that more project work packages were executed than planned.

$$SV = EV - PV$$

SPI (Scheduling Performance Index)is a performance efficiency factor in completing work that can be shown by the comparison between the value of work that has been physically completed (EV) and the planned cost expenditure incurred based on the work plan (PV). The SPI value shows how much work can be completed (relative to the overall project) compared to the planned unit of work.

$$SPI= EV/PV$$

2. Cost Deviations

CV (Cost Varians) is the difference between the value obtained after completing the work packages and the actual costs incurred during implementation project. A positive cost variance indicates that the value of the work packages obtained is greater than the costs incurred to carry out these work packages.

$$CV = EV – AC$$

CPI (Cost Performance Index) is a factor of cost efficiency that has been incurred that can be shown by comparing the value of work that has been physically completed (EV) to the costs that have been incurred in the same period (AC). This CPI value shows the weighting of the value gained (relative to the overall project value) against the costs incurred

$$CPI = EV / AC$$ (Kharina & Sambowo, 2019)

Estimating the cost and schedule for completion of a construction project based on indicators obtained at reporting time will provide clues or information for:

- Estimate at Completion (EAC) estimates the cost at the end of the project.
- Estimate to Completion (ETC) estimates the cost for the remaining work.
- Estimate Temporary Schedule (ETS) estimates the remaining work time.
- Estimate All Schedule (EAS) estimates the total project time. The estimated cost and schedule are informed as follows:

$$ETC = (BAC – BCWP) / CPI$$

$$EAC = ACWP+[(BAC-BCWP)/CPI)]$$

While estimated time to complete all work:

ETS= (Time Remaining)/SPI

EAS= Time Completed+ETS

S-Curve

The S-curve is a development and merger of the beam diagram and the Hannum Curve. The S- curve is used to describe and express quantity values in relation to time. The S-curve describes the cumulative progress of project implementation, criteria or measures of project progress which can be in the form of the weight of implementation or production achievements of the value of money spent, the amount of quantity or volume of work, the use of resources, hours, labor and much more. The curve is made with the x-axis showing the time parameter while the y-axis as the cumulative value of the percentage (%) of work weight.

This curve is referred to as an S-curve because it is in the shape of the letter S, this is due to:

a. In the early stages the curve is rather gentle, this is because in the early stages
b. project activities were relatively few and progress was initially slow.
c. Followed by fast-moving activities over a longer period of time. At this stage there are many project activities being undertaken with a greater volume of activities.
d. In the final stage the speed of progress decreases and stops at the end point where all project activities have been completed.

The use of S-curves can be used in cases:

a. Analyze overall project progress.
b. Analyze progress for a unit of work or its elements.
c. To prepare a drawing production plan, compile a proposal for purchasing materials, preparing tools and labor.

Project fund analysis. (Maddeppungeng, 2015)

The urgency of this research lies in the critical need to ensure efficient time and cost management in infrastructure projects like the Bungur-Kedoyo road construction. Delays and cost overruns can hinder regional connectivity improvements and economic growth, which are key objectives of such projects. Addressing these inefficiencies is essential to maximize the benefits of public investments and meet project timelines without exceeding budgets.

The research gap stems from the limited application of the Earned Value Method (EVM) in regional infrastructure projects in Indonesia. While EVM is widely recognized globally for its effectiveness in tracking project performance, its practical use in Indonesian construction projects remains underexplored. Additionally, there is a lack of comprehensive studies analyzing EVM's integration with local project management practices to forecast time and cost efficiencies accurately.

The novelty of this study lies in its application of EVM to a real-world regional road construction project, providing valuable insights into how this method can enhance project performance. By employing EVM metrics such as SETC, SEAC, BETC, and BEAC, this research demonstrates a systematic approach to addressing delays and cost inefficiencies, offering a practical model that can be adapted to similar projects in Indonesia.

The study aims to evaluate the Bungur-Kedoyo road project’s time and cost performance using EVM, with the goal of providing actionable recommendations to optimize future project management. The findings benefit contractors, project managers,

and policymakers by offering a robust framework for improving project efficiency. Ultimately, this research contributes to advancing infrastructure development practices, ensuring that projects are completed within budget and on schedule, thereby enhancing their economic and social impact.

Research Methods

Research Objective

The research was conducted on the Bungur-Kedoyo Road Development Project. According to the contract the project was built with a budget of Rp. 10,640,186,000. source of funds from the regional revenue and expenditure budget for the 2024 fiscal year of the tulungagung district.

Research Time

The research time is estimated to be 6 months which began in stages from research preparation, literature review, problem identification, literature study, data collection, data analysis, thesis preparation, revising the thesis in consultation with the supervisor, and thesis examination.

Data

The types of data in this study include primary data and secondary data. The data collection process is as follows.

i. Primary data collection is done by direct observation in the field, including through observation, measurement, and documenting things that happen in the field.
ii. Conduct interviews with field implementers (Implementing Contractors) to find out the performance of implementers related to project control in the study area.
iii. Primary data collection is obtained from various sources including related agencies and literature reviews such as:
    a) Cost Plan from the annex of the contract that has been agreed between the implementer and the employer.
    b) Implementation Schedule / Time schedulle implementation.
    c) Progress report of work achievement.
    d) Accounting report from the implementing party.
    e) Monthly physical financial report/monthly .
    f) Plan drawing
iv. Secondary data is data obtained from related agencies, and also through literature studies in libraries and the internet. Literature studies are carried out to obtain data, theories related to and supporting research as well as the results of studies on the object of research and analysis later. The theories discussed include theories related to Earned Value, especially the components that support the method. Data collection time is done during the work of Project Delay Analysis and Impact on Cost Using Earned Value Method (On Bungur-Kedoyo Road Project).

Data Analysis Technique

The method used in this research is the Earned Value Method. Earned Value Method is part of the Variance Analysis Concept. Where in the variance analysis only shows the difference in work results at the reporting time compared to the budget or schedule. Earned Value Method is the concept of calculating the amount of costs according to the budget in accordance with the work that has been carried out. When viewed from the amount of work that has been completed, this concept regulates the amount of work units completed at a time when assessed based on the amount of budget provided for the work. With this calculation can be known relationship between what is

actually what is actually has been achieved physically against the amount of budget that has been spent, which can be written with the formula.

Result Value = (% completion) x (budget)

Description:
% of completion achieved at the time of reporting The budget is the real cost of the project

Results and Discussions

Budgeted Cost of Work Schedule (BCWS) Analysis

An example of BCWS calculation at week 25 is taken. The BCWS value can be calculated by multiplying the percentage of the plan on the implementation schedule (S curve) in the 25th week to be observed by the amount of the cost budget plan. The BCWS calculation at week 25 is:

- Cumulative plan weight : 99,873%
- Contract value of work : Rp. 10,640,186,000.00-

So that the BCWS value in week 25 is as follows
BCWS = 99,873% x Rp. 10.640.186.000,00-
BCWS = Rp. 1.062.667,296,378.00

Table 1 BCWS Calculation

WEEK TO	PLAN WEIGHT		BCWS
1	0.085	Rp	9,044,158.10
2	0.125	Rp	13,300,232.50
3	0.422	Rp	44,901,584.92
4	1.763	Rp	187,586,479.18
5	3.091	Rp	328,888,149.26
6	3.490	Rp	371,342,491.40
7	3.794	Rp	403,688,656.84
8	6.138	Rp	653,094,616.68
9	7.022	Rp	747,153,860.92
10	10.933	Rp	1,163,291,535.38
11	14.488	Rp	1,541,550,147.68
12	23.158	Rp	2,464,054,273.88
13	31.829	Rp	3,386,664,801.94
14	40.017	Rp	4,257,883,231.62
15	48.290	Rp	5,138,145,819.40
16	53.493	Rp	5,691,754,696.98
17	58.697	Rp	6,245,469,976.42
18	63.900	Rp	6,799,078,854.00
19	71.078	Rp	7,562,831,405.08
20	78.340	Rp	8,335,521,712.40
21	85.024	Rp	9,046,711,744.64
22	91.708	Rp	9,757,901,776.88
23	98.392	Rp	10,469,091,809.12
24	99.873	Rp	10,626,672,963.78
25	99.873	Rp	10,626,672,963.78
26	100	Rp	10,640,186,000.00

***Budgeted Cost of Work Performance* (BCWP) Analysis**

Taken as an example of BCWP calculation in week 25, the BCWP value can be calculated by multiplying the percentage of realization on the implementation schedule (S curve) in week 25 to be observed by the amount of the cost budget plan. An example of BCWP calculation in week 25 is:

- Cumulative realization weight: 96,908 %
- Contract value of work :Rp. 10,640,186,000.00-
- So the BCWP value in week 25 is as follows:

BCWP = 96,908 % x Rp. 10.640.186.000,00-
BCWP = Rp. 10.311.191,448.88

For the calculation of the BCWP value for the week before and the following week, it is done in the same way as the calculation above. The BCWP calculation table is as follows:

Table 2 BCWP Calculation

WEEK TO	REALIZATION WEIGHT		BCWP
1	0.040%	Rp	4,256,074.40
2	0.562%	Rp	59,797,845.32
3	2.047%	Rp	217,804,607.42
4	5.034%	Rp	535,626,963.24
5	10.463%	Rp	1,113,282,661.18
6	10.797%	Rp	1,148,820,882.42
7	17.338%	Rp	1,844,795,448.68
8	24.638%	Rp	2,621,529,026.68
9	32.603%	Rp	3,469,019,841.58
10	33.677%	Rp	3,583,295,439.22
11	37.095%	Rp	3,946,976,996.70
12	40.688%	Rp	4,329,278,879.68
13	48.716%	Rp	5,183,473,011.76
14	55.272%	Rp	5,881,043,605.92
15	55.480%	Rp	5,903,175,192.80
16	56.214%	Rp	5,981,274,158.04
17	58.454%	Rp	6,219,614,324.44
18	60.963%	Rp	6,486,576,591.18
19	65.782%	Rp	6,999,327,154.52
20	73.481%	Rp	7,818,515,074.66
21	86.191%	Rp	9,170,882,715.26
22	89.320%	Rp	9,503,814,135.20
23	91.661%	Rp	9,752,900,889.46
24	94.578%	Rp	10,063,275,115.08
25	96.908%	Rp	10,311,191,448.88

Actual Cost For Work Performed (ACWP) Analysis

The ACWP or *Actual Cost* value is a collection of costs incurred by the contractor to complete the work in a certain period. This value is obtained from the financial *cash flow* issued by the contractor based on week 25, the *Actual Cost* that has been incurred is Rp. 8,574,115,115.23 with a realization weight of 96.908%. For the calculation of ACWP in the week before and the following week, the same method is carried out as the calculation above.

Table 3 ACWP Calculation

WEEK TO	WEEKLY EXPENSES		ACWP
1	Rp 2,979,252.08	Rp	2,979,252.08
2	Rp 44,433,416.74	Rp	47,412,668.82
3	Rp 142,206,085.89	Rp	189,618,754.71
4	Rp 286,040,120.24	Rp	475,658,874.94
5	Rp 462,124,558.35	Rp	937,783,433.30
6	Rp 24,876,754.87	Rp	962,660,188.16
7	Rp 626,396,261.97	Rp	1,589,056,450.13
8	Rp 621,386,862.40	Rp	2,210,443,312.53
9	Rp 762,741,733.41	Rp	2,973,185,045.94
10	Rp 80,067,399.65	Rp	3,053,252,445.59
11	Rp 290,860,124.50	Rp	3,344,112,570.09
12	Rp 344,167,456.36	Rp	3,688,280,026.44
13	Rp 683,355,305.66	Rp	4,371,635,332.11
14	Rp 557,971,353.84	Rp	4,929,606,685.95
15	Rp 19,918,428.19	Rp	4,949,525,114.14
16	Rp 54,669,275.67	Rp	5,004,194,389.81
17	Rp 166,838,116.48	Rp	5,171,032,506.29
18	Rp 213,484,691.90	Rp	5,384,517,198.19
19	Rp 461,571,268.68	Rp	5,846,088,466.87
20	Rp 737,173,366.45	Rp	6,583,261,833.32
21	Rp 1,027,799,406.86	Rp	7,611,061,240.18
22	Rp 282,991,706.95	Rp	7,894,052,947.13
23	Rp 199,269,403.41	Rp	8,093,322,350.54
24	Rp 294,855,514.34	Rp	8,388,177,864.88
25	Rp 185,937,250.35	Rp	8,574,115,115.23

Cost Performance Index (CPI) Calculation

The CPI value can be calculated by comparing the value of physically completed work (BCWP) with the costs incurred in the same period (ACWP). Example of CPI calculation in week 25:

$$CPI = \frac{BCWP}{ACWP} = \frac{Rp.10.311.191{,}448.88}{Rp.8{,}574{,}115{,}115.23} = 1.203$$

So the CPI value in week 25 is 1.203

Table 3 CPI calculation

WEEK TO	BCWP		ACWP	CPI
1	Rp 4,256,074.40	Rp	2,979,252.08	1.429
2	Rp59,797,845.32	Rp	47,412,668.82	1.261
3	Rp217,804,607.42	Rp	189,618,754.71	1.149
4	Rp535,626,963.24	Rp	475,658,874.94	1.126
5	Rp1,113,282,661.18	Rp	937,783,433.30	1.187
6	Rp1,148,820,882.42	Rp	962,660,188.16	1.193
7	Rp1,844,795,448.68	Rp	1,589,056,450.13	1.161
8	Rp2,621,529,026.68	Rp	2,210,443,312.53	1.186
9	Rp3,469,019,841.58	Rp	2,973,185,045.94	1.167

10	Rp3,583,295,439.22	Rp	3,053,252,445.59	1.174
11	Rp3,946,976,996.70	Rp	3,344,112,570.09	1.180
12	Rp4,329,278,879.68	Rp	3,688,280,026.44	1.174
13	Rp5,183,473,011.76	Rp	4,371,635,332.11	1.186
14	Rp5,881,043,605.92	Rp	4,929,606,685.95	1.193
15	Rp5,903,175,192.80	Rp	4,949,525,114.14	1.193
16	Rp5,981,274,158.04	Rp	5,004,194,389.81	1.195
17	Rp6,219,614,324.44	Rp	5,171,032,506.29	1.203
18	Rp6,486,576,591.18	Rp	5,384,517,198.19	1.205
19	Rp6,999,327,154.52	Rp	5,846,088,466.87	1.197
20	Rp7,818,515,074.66	Rp	6,583,261,833.32	1.188
21	Rp9,170,882,715.26	Rp	7,611,061,240.18	1.205
22	Rp9,503,814,135.20	Rp	7,894,052,947.13	1.204
23	Rp9,752,900,889.46	Rp	8,093,322,350.54	1.205
24	Rp10,063,275,115.08	Rp	8,388,177,864.88	1.200
25	Rp10,311,191,448.88	Rp	8,574,115,115.23	1.203

Schedule Perfomance Index (SPI) calculation

The SPI value is obtained from the comparison between the value of physically completed work (BCWP) and the planned cost expenditure incurred based on the work (BCWS). Example of SPI value calculation in week 25:

$$SPI = \frac{BCWP}{BCWS} = \frac{Rp.10.311.191{,}448.88}{Rp.10{,}626{,}672{,}963.78} = 0.970$$

So the SPI value at week 25 is= 0.970, because the SPI value < 1, this means that the project is delayed or not as planned.

Table 4 SPI calculation

WEEK TO	BCWP	BCWS	SPI
1	Rp 4,256,074.40	Rp 9,044,158.10	0.471
2	Rp59,797,845.32	Rp13,300,232.50	4.496
3	Rp217,804,607.42	Rp44,901,584.92	4.851
4	Rp535,626,963.24	Rp187,586,479.18	2.855
5	Rp1,113,282,661.18	Rp328,888,149.26	3.385
6	Rp1,148,820,882.42	Rp371,342,491.40	3.094
7	Rp1,844,795,448.68	Rp403,688,656.84	4.570
8	Rp2,621,529,026.68	Rp653,094,616.68	4.014
9	Rp3,469,019,841.58	Rp747,153,860.92	4.643
10	Rp3,583,295,439.22	Rp1,163,291,535.38	3.080
11	Rp3,946,976,996.70	Rp1,541,550,147.68	2.560
12	Rp4,329,278,879.68	Rp2,464,054,273.88	1.757
13	Rp5,183,473,011.76	Rp3,386,664,801.94	1.531
14	Rp5,881,043,605.92	Rp4,257,883,231.62	1.381
15	Rp5,903,175,192.80	Rp5,138,145,819.40	1.149
16	Rp5,981,274,158.04	Rp5,691,754,696.98	1.051
17	Rp6,219,614,324.44	Rp6,245,469,976.42	0.996
18	Rp6,486,576,591.18	Rp6,799,078,854.00	0.954

19	Rp6,999,327,154.52	Rp7,562,831,405.08	0.925
20	Rp7,818,515,074.66	Rp8,335,521,712.40	0.938
21	Rp9,170,882,715.26	Rp9,046,711,744.64	1.014
22	Rp9,503,814,135.20	Rp9,757,901,776.88	0.974
23	Rp9,752,900,889.46	Rp10,469,091,809.12	0.932
24	Rp10,063,275,115.08	Rp10,626,672,963.78	0.947
25	Rp10,311,191,448.88	Rp10,626,672,963.78	0.970

Estimate To Complete (ETC)

The percentage of work up to the 25th week has only reached 96.908%, so the assumption used to predict the budget for the remaining work uses the formula:

$$ETC = \frac{RAB - BCWP}{CPI} = \frac{Rp.10.640.186.000{,}00 \; - \; Rp.10.311.191{,}448.88}{1{,}203}$$
$$= Rp\ 273{,}570{,}437.28$$

So the estimated funds needed to complete the project implementation are Rp. 273,570,437.28

Estimate AT Completion (EAC)

The EAC calculation is an estimate of the total cost at the end of the project obtained from the ACWP added to the remaining work costs or ETC.

EAC = ACWP + ETC
= Rp 8,574,115,115.23 + Rp 273,570,437.28
= Rp 8,847,685,552.51

The estimated funds absorbed when this work is completed is Rp. 8,847,685,552.51

Schedule Estimate To Completion (SETC)

The SETC calculation is an estimate of the time for the remaining work calculated using a formula assuming that conditions are the same as when the evaluation was carried out:

$$SETC = \frac{Remaining\ time}{SPI} = \frac{7}{0.970} = 7.214$$

From the Estimate Temporary Schedule (ETC) calculation above, an estimate of the total project completion time is obtained.

Schedule Estimate At Completion (SEAC)

The SEAC calculation is an estimate of the total project completion time plus the remaining work time calculated using the formula:

SEAC = Reporting time + SETC
SEAC = 173 + 7
SEAC = 180 days

From the values above, when analyzing in the 4th week, the project experienced a delay from the initial project completion plan from 120 days to 180 days.

Conclusion

Based on the Earned Value analysis, it can be concluded that the remaining time required to complete the Road Construction Project on the Bungur-Kedoyo Road Section, Tulungagung Regency, is 26 weeks. The Schedule Estimate to Completion (SETC) indicates that the remaining 3.092% of the project, equating to 1 week, will bring the total project duration to 180 days, aligning with the initial contract period, assuming the

contractor maintains the same performance. By the 25th week, the Budget Estimate to Completion (BETC) reflects a remaining cost of Rp. 273,570,437.28, while the total estimated project cost at completion (BEAC) is Rp. 8,847,685,552.51. This calculation demonstrates that the overall project cost is projected to be below the contract value of Rp. 10,640,186,000.00, indicating cost efficiency in project implementation.

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