

COST CONTROL ANALYSIS USING THE EARNED VALUE METHOD ON THE WAREHOUSE CONSTRUCTION PACKAGE AND ITS SUPPORTING FACILITIES AT JUWATA AIRPORT

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ABSTRACT

The construction of warehousing and supporting facilities at Juwata Airport has several obstacles that cause delays in the implementation of the work, so a work control method is needed, namely the earned value method by assessing the cost and time performance of project implementation such as Cost Variance (CV), Schedule Variance (SV), Schedule Performance Index (SPI), and Cost Performance Index (CPI) as well as the estimated cost and time of project completion. The purpose of this research is to calculate the amount of cost needed to complete the project of Warehousing Development Package and Supporting Facilities of Juwata Airport on time according to the plan schedule. The method used is the Earned Value Method in evaluating cost performance and time performance. The analysis carried out uses 3 (three) indicators, namely ACWP (Actual Cost of Work Performance), BCWP (Budgeted Cost of Work Performance) and BCWS (Budgeted Cost of Work Scheduled). By using the earned value method, the final project cost estimate obtained from the EAC is Rp. 15,019,062,678.43 and the estimated time / Time Estimate (TE) at week 26 shows 239 calendar days so that the completion time is 28 days late from the contract schedule. And the solution to the delay is to accelerate the work with an additional cost of Rp. 68,970,000. Future research should explore optimization strategies to enhance efficiency in cost estimation and project scheduling.

Keywords: *earned value; cost and time performance; work acceleration*

INTRODUCTION

Juwata Airport, as the largest international airport in North Kalimantan, requires the construction of a cargo warehouse to support smooth operations and flight safety (Marhani & Albana, 2023). However, in the development process, there was an increase in the volume of work while the actual realization was still low, causing project delays. These delays occurred due to various factors such as ineffective management, limited resources, changes in the scope of work, technological issues, poor communication, external factors and force majeure. The impacts include schedule delays, increased costs, and decreased quality of work, which ultimately affects the overall project completion (Dwi, 2017; Wiryamanta Sistira et al., 2023).

To overcome these delays, the Earned Value Method (EVM), a project management technique that integrates cost and time, was used (Emblemsvåg, 2024; Sruthi & Aravindan, 2020). In construction projects, delays often occur, but there are also cases of accelerated work completion. With EVM, project performance can be measured objectively through a comparison between plan, cost realization, and work progress, thus enabling more accurate decision-making to control the project to stay on target (Eirgash, 2021; Fauzy, 2019; Li, 2023; Rahmanto & Janizar, 2022).

The three indicators are ACWP (Actual Cost of Work Performance), which is the actual amount of expenditure used to carry out work in a certain period of time, this cost is obtained from project financial data (Nur Salsabila et al., 2021; Sruthi & Aravindan, 2020). BCWP (Budgeted Cost of Work Performance) is the amount of costs that should be incurred for work that has been carried out during a certain period of time according to planning. And BCWS (Budgeted Cost of Work Scheduled) is a work package budget that is compiled and linked to the implementation schedule (Yuliana & Ni Kadek Sri Ebtha Yuni, 2021; Zakariyya et al., 2020). So, based on these three indicators, there is a relationship between cost, schedule, and scope of work, where each part of the work has been allocated time and cost, which becomes a benchmark in the implementation of the work. The Earned Value method plays an important role in increasing effectiveness in supervising and controlling all project activities to

identify the overall performance of project work activities (Wibowo et al., 2021; Wiryamanta Sistira et al., 2023).

A series of interrelated and complex construction activities can cause problems from various things, such as unskilled labor, untimely completion time, and excessive or wasteful use of materials, which cause waste of costs that are not according to plan. The successful implementation of construction work is critical in supporting the development of an area, so in the implementation of construction work must consider the value of the costs used because it affects the complexity of the work and the materials used so that it requires the development of a work management system in terms of engineering or proper scheduling planning and efficient and effective cost control and management. Construction of Warehousing and Supporting Facilities for Juwata Airport during the construction implementation process involves several cost and time obstacles. The work has delayed progress so that it can result in cost overruns, and if the work is not completed on time, it will result in the payment of late fees (Marhani & Albana, 2023; Song & Mao, 2020). The analysis is carried out using 3 (three) indicators, namely ACWP (Actual Cost of Work Performance), BCWP (Budgeted Cost of Work Performance) and BCWS (Budgeted Cost of Work Scheduled) (Soltan & Ashrafi, 2020). By using these 3 (three) indicators, various factors can be calculated that show the progress of project implementation performance such as Cost Variance (CV), Schedule Variance (SV), Schedule Performance Index (SPI), and Cost Performance Index (CPI) as well as project completion cost and time forecasts. (Przywara & Rak, 2021; Sruthi & Aravindan, 2020) Then the Earned Value Method (EVM) analysis method is one way that can be used in controlling or managing projects so that delays that have occurred can be prevented and optimized to be completed according to the planned time (Ahmed et al., 2020; Aidan et al., 2020; Csiszér, 2018; Dharmawan et al., 2023; Jaber et al., 2020).

To address these challenges, this research applies the Earned Value Method (EVM), a widely recognized project management technique that integrates cost and time performance metrics. While EVM is not a novel concept, its application to the Juwata Airport warehouse construction project introduces a degree of novelty by addressing specific gaps in knowledge and practice. For instance, the research explores whether EVM is rarely utilized in similar infrastructure projects in Indonesia or whether the unique operational complexities of Juwata Airport require tailored performance monitoring approaches. By explicitly highlighting these aspects, this research aims to contribute valuable insights into optimizing construction project management under challenging conditions.

The choice of EVM as the analytical framework is grounded in its ability to objectively measure project performance through indicators such as Actual Cost of Work Performance (ACWP), Budgeted Cost of Work Performance (BCWP), and Budgeted Cost of Work Scheduled (BCWS). These indicators establish relationships between cost, schedule, and scope of work, offering benchmarks for implementation. Compared to other project management techniques, EVM provides a comprehensive view of cost and schedule performance while enabling proactive decision-making to effectively address delays and cost overruns. This rationale strengthens the logical flow of the research by connecting identified problems—delays and cost overruns—to the suitability of EVM as the analytical tool.

This research seeks to analyze the cost and time performance of the Juwata Airport warehouse construction project using EVM indicators such as Cost Variance (CV), Schedule Variance (SV), Schedule Performance Index (SPI), and Cost Performance Index (CPI). Additionally, it forecasts project completion costs and timelines while offering recommendations for improving construction project management practices. The research aims to provide actionable solutions for mitigating delays and optimizing resource utilization by addressing this project's specific challenges and leveraging EVM's capabilities.

METHOD

This research employs a quantitative approach using the Earned Value Method (EVM) to evaluate cost and time performance in constructing warehousing and supporting facilities at Juwata Airport. The EVM approach is well-justified as it allows for a structured assessment of project progress through cost and schedule performance metrics, providing insights into deviations from planned targets. Data for this research were collected over a 12-week period, from the colloquium phase to the finalization of the research report in early January 2025. The primary data sources include secondary data obtained from CV Fajar Karya, the implementing contractor. These data sources consist of the Contract Budget Plan (RAB), which contains unit price analysis, wage lists, and material costs agreed upon in the work

contract; the Time Schedule (S-Curve), which includes the master schedule and weekly updates reflecting work progress; and weekly and monthly project reports, which provide information on work volume, progress weight, and financial expenditures.

Since this research focuses on a single construction project, a case research design is applied, where all relevant project data from weeks 1 to 26 are comprehensively analyzed. The research does not involve respondent-based sampling but instead evaluates financial records and progress reports as the primary data sources. The analysis follows a structured process, beginning with the identification of factors influencing work progress through contractor interviews and evaluations of weekly reports to determine actual completion rates. The EVM analysis is then applied by calculating BCWS (Budgeted Cost of Work Scheduled), representing planned cost allocation for scheduled work; BCWP (Budgeted Cost of Work Performed), indicating actual cost allocation for completed work; and ACWP (Actual Cost of Work Performed), reflecting actual expenditures incurred during implementation.

While EVM is a robust method for performance analysis, it is important to acknowledge its limitations within the context of this project. EVM primarily focuses on quantifiable metrics related to cost and schedule but may not fully account for external factors such as force majeure, regulatory changes, or market fluctuations that can impact project performance. Additionally, EVM does not inherently address qualitative aspects like communication effectiveness or stakeholder engagement, which are also crucial in construction project management. Despite these limitations, EVM remains a logical choice for this research due to its proven ability to provide a comprehensive overview of cost and time performance.

The next stage is the analysis of cost requirements using the crashing method to ensure project completion according to the plan schedule. Finally, the analysis results are used to draw conclusions and make relevant recommendations for future project management improvements. This approach is expected to provide a comprehensive overview of project performance and strategic solutions for optimizing the implementation of construction work. By elaborating on why EVM was chosen over other potential methods—such as Critical Path Method (CPM) or Program Evaluation Review Technique (PERT)—and addressing its limitations, this research demonstrates a comprehensive understanding of the methodology's applicability to the Juwata Airport warehouse construction project. This approach ensures that the analysis is both methodologically sound and contextually relevant, providing valuable insights for optimizing construction project management under challenging conditions.

RESULTS AND DISCUSSION

Analysis and Interpretation of Results

Earned Value Indicator Analysis

The earned value indicators taken into account are Planned Value (PV) or BCWS (Budget Cost Of Work Schedule), Earned Value (EV) or BCWP (Budget Cost Of Work Performance) and Actual Cost (AC) or ACWP (Actual Cost Of Work Performance).

Planned Value (PV) or Budget Cost Of Work Schedule (BCWS)

Planned Value (PV) or BCWS (Budget Cost of Work Schedule) in this project is a cost budget allocated for the implementation of work based on a work plan against a certain time, where the value of the 1st change contract (Addendum 1) excluding ppn is Rp. 12,469,058,523.00. Then, PV or BCWS was calculated with data on the percentage of progress plans contained in the time schedule and the cost of implementing the project listed on the cost budget plan (RAB). The calculation with the formula is as follows:

The calculation of PV or BCWS in week 20 of the period September 2 - 8, 2024 is as follows:

PV or BCWS = % plan progress x total project budget

PV or BCWS = 5.79% x Rp. 12,469,058,523

PV or BCWS = Rp. 721,958,488.48

Next week's calculation will be done in the same way as the calculation above.

Table 1. Results of Planned Value (PV) or BCWS (Budget Cost Of Work Schedule)

Week Period	Physical Plan Per Week (%)	Cumulative Physical Plan (%)	PV or BCWS (Weekly) (Rp.)	PV or BCWS (Cumulative) (Rp.)
20th	5,79	36,40	721.958.488,48	4.538.737.302,37
21st	3,94	40,34	491.280.905,81	5.030.018.208,18
22nd	3,76	44,10	468.836.600,46	5.498.854.808,64
23rd	6,76	50,86	842.908.356,15	6.341.763.164,80
24th	6,76	57,62	842.908.356,15	7.184.671.520,95
25th	7,31	64,93	911.488.178,03	8.096.159.698,98
26th	8,49	73,43	1.058.623.068,60	9.156.029.673,44

Source: Processed by Researcher, 2024

From the results of the above calculations, the PV or BCWS for week 26 of the period October 14-20, 2024 is obtained as follows:

PV or BCWS = % plan progress x total project budget

PV or BCWS = 73.43% x Rp. 12,469,058,523

PV or BCWS = Rp. 9,156,029,673.44

The graph of the results of the calculation of PV or BCWS week 20 to week 26 can be seen in the following figure:

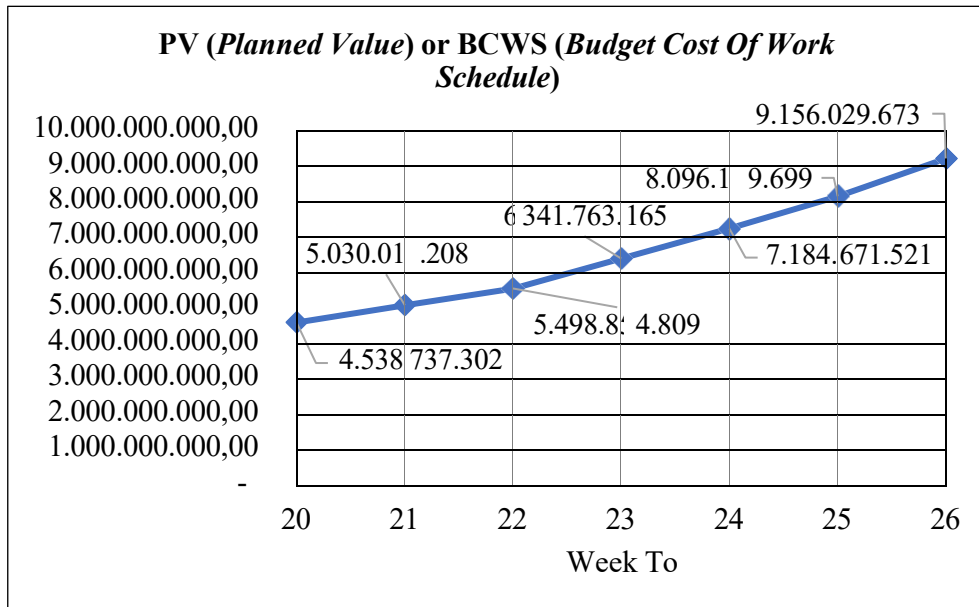


Figure 1. Graph of PV (Planned Value) or BCWS (Budget Cost Of Work Schedule) Week - 20 to Week - 26

Source: Processed by Researcher, 2024

Earned Value (EV) or Budget Cost Of Work Performance (BCWP)

Earned Value (EV) or BCWP (Budget Cost of Work Performance) in this project is a cost budget allocated for work that has been completed. Where EV or BCWP is obtained by multiplying the percentage of progress that the total project budget has carried out, and where the total project budget value for the 1st amendment contract excluding ppn is Rp. 12,469,058,523.00.

EV or BCWP = (% realized/actual progress) x (total project budget)

The calculation of EV or BCWP in week 20 of the period September 2 - 8, 2024 is as follows:

EV or BCWP = % realized/actual progress x total project budget

EV or BCWP = 3.8% x Rp. 12,469,058,523

EV or BCWP = Rp. 473,824,223.87

Table 2. Results of EV (Earned Value) or BCWP (Budget Cost Of Work Performance)

Week Period	Physical Realization Per Week (%)	Cumulative Physical Realization (%)	EV or BCWP (Weekly) (Rp.)	EV or BCWP (Cumulative) (Rp.)
20th	3,8	45,72	473.824.223,87	5.700.853.556,72
21st	2,7	48,42	336.664.580,12	6.037.518.136,84
22nd	1,72	50,13	214.467.806,60	6.250.739.037,58
23rd	4,08	54,22	508.737.587,74	6.760.723.531,17
24th	2,13	56,34	265.590.946,54	7.025.067.571,86
25th	3,82	60,16	476.318.035,58	7.501.385.607,44
26th	5,34	64,48	665.847.725,13	8.040.048.935,63

Source: Processed by Researcher, 2024

From the results of the above calculations, EV or BCWP is obtained in week 26 of the period October 14-20, 2024 as follows:

EV or BCWP = % plan progress x total project budget

EV or BCWP = 64.48% x Rp. 12,469,058,523

EV or BCWP = Rp. 8,040,048,935.63

The graph of the calculation results of EV or BCWP week 20 to week 26 can be seen in the figure.

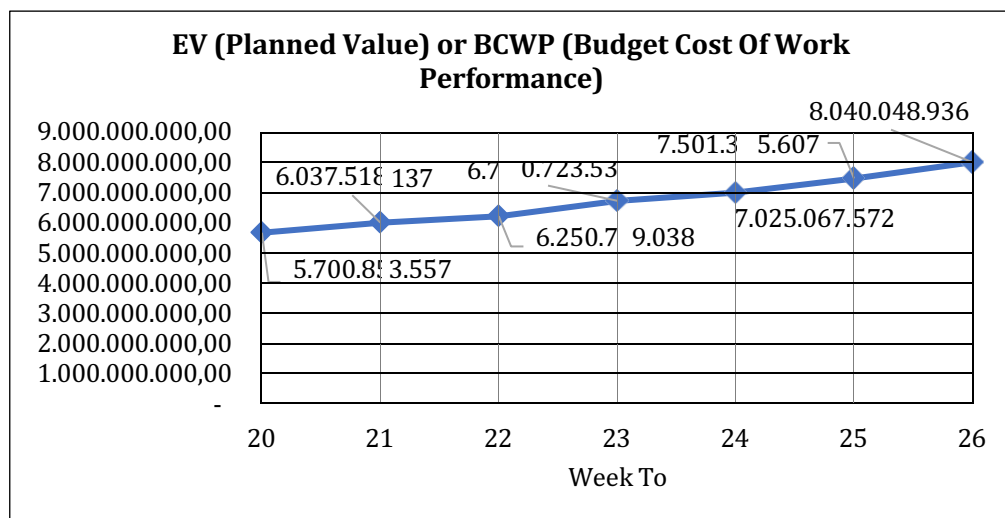


Figure 2. EV (Earned Value) or BCWP (Budget Cost Of Work Performance) Chart Week 20 to Week 26

Source: Processed by Researcher, 2024

Actual Cost (AC) or Actual Cost Of Work Performance (ACWP)

Actual Cost (AC) or ACWP (Actual Cost Of Work Performance) in this project is the direct costs and indirect costs incurred to complete the work during a certain period. The Actual Cost (AC) used is as follows:

a. Direct Costs

Direct costs for the implementation of the Juwata Airport Warehousing and Supporting Facilities Development project are material costs, labor costs, and equipment costs.

Table 3. Recapitulation of Direct Costs

Period Week To	Realization Weight (%)	Direct Cost (Rp.)
20th	3,80	473.824.223,87

21st	2,70	336.664.580,12
22nd	1,72	214.467.806,60
23rd	4,08	508.737.587,74
24th	2,13	265.590.946,54
25th	3,82	476.318.035,58
26th	5,34	665.847.725,13

Source: Secondary Data (Weekly Report of the Warehousing Development Project and Its Supporting Facilities in 2024 CV. Fajar Karya)

b. Indirect Costs

Indirect costs for implementing the Juwata Airport Warehousing and Supporting Facilities Development project are office overhead and field overhead, where details can be seen in the attachment.

Table 4. Recapitulation of Indirect Costs

No.	Week Period	Cost (Rp.)
1	Week 20 (September 2 - 8, 2024)	29.673.000
2	Week 21 (September 9 - 15, 2024)	18.005.630
3	Week 22 (September 16-22, 2024)	25.545.839
4	Week 23 (September 23 - 29, 2024)	46.222.900
5	Week 24 (September 30 - October 6, 2024)	23.458.133
6	Week 25 (October 7 - 13, 2024)	32.043.590
7	Week 26 (October 14-20, 2024)	21.245.664

Source: Author's Process Results 2024 (Secondary Data: Financial Statements of the Warehousing Development Project and Its Supporting Facilities in 2024 CV. Fajar Karya)

The calculation with the formula is as follows:

$$AC \text{ or } ACWP = \text{direct cost} + \text{indirect cost}$$

Calculation of AC or ACWP in week 20 of the period September 2 - 8, 2024 as follows:

$$\begin{aligned} AC \text{ or } ACWP &= \text{direct cost} + \text{indirect cost} \\ AC \text{ or } ACWP &= \text{Rp. } 473,824,223.87 + \text{Rp. } 29,673,000.00 \\ AC \text{ or } ACWP &= \text{Rp. } 503,497,224 \end{aligned}$$

Next week's calculation will be done in the same way as the calculation above.

Table 5. AC (Actual Cost) or ACWP (Actual Cost Of Work Performance) Results

Week Period	Direct Costs	Indirect Costs	ACWP	ACWP
	(Rp.)	(Rp.)	(Rp.)	Cumulative (Rp.)
20th	473.824.223,87	29.673.000	503.497.224	6.223.444.597
21st	336.664.580,12	18.005.630	354.670.210	6.578.114.807
22nd	214.467.806,60	25.545.839	240.013.646	6.818.128.453
23rd	508.737.587,74	46.222.900	554.960.488	7.373.088.941
24th	265.590.946,54	23.458.133	287.802.174	7.660.891.114
25th	476.318.035,58	32.043.590	943.531.768	8.604.422.882
26th	665.847.725,13	21.245.664	1.079.868.733,60	9.684.291.615

Source: Processed by Researcher, 2024

From the results of the above calculations, AC or ACWP is obtained in week 26 of the period October 14-20, 2024 as follows:

$$\begin{aligned} AC \text{ or } ACWP &= \text{direct cost} + \text{indirect cost} \\ AC \text{ or } ACWP &= \text{Rp. } 665,847,725.13 + \text{Rp. } 21,245,664.00 \end{aligned}$$

AC or ACWP = Rp. 1,079,868,733.60

The graph of the results of the calculation of AC or ACWP week 20 to week 26 can be seen in the following figure.

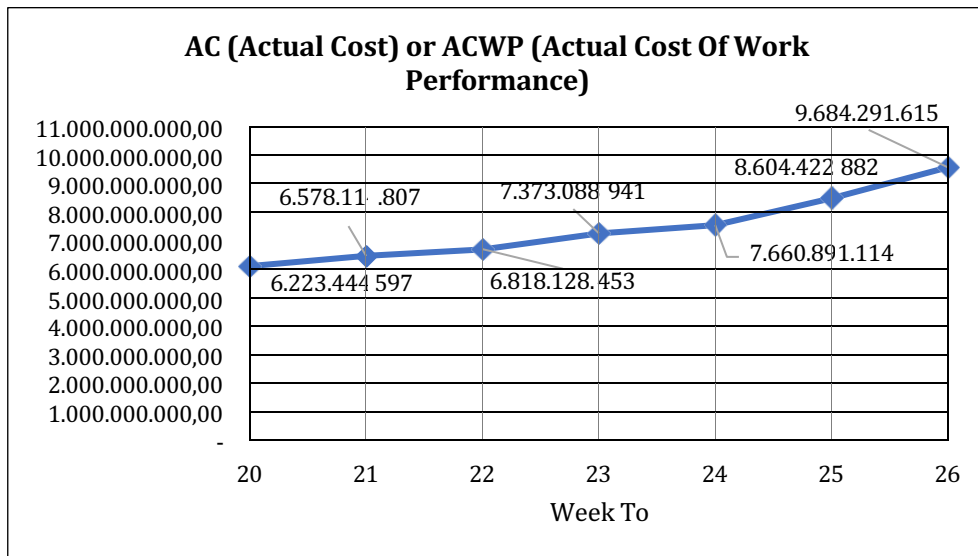


Figure 3. EV (Earned Value) or BCWP (Budget Cost Of Work Performance) Chart Week 20 to Week 26

Source: Processed by Researcher, 2024

Cost and Time Variant Analysis

Cost Variance (CV)

The cost variance (CV) is calculated in week 20 of the period September 2 - 8, 2024 as follows:

$$\begin{aligned}
 CV &= BCWP - ACWP \\
 CV &= 5,700,853,556.72 - 6,223,444,597.27 \\
 CV &= - 522,591,040.56
 \end{aligned}$$

The results of the CV calculation are negative, which means that the costs that have been incurred are greater than the plan. Next week's calculation is done the same way as the calculation above. And the results of the next week's calculations can be seen in table 4.9 below:

Table 6. Results of Cost Variant Value (CV)

Week Period	BCWP (Rp.)	ACWP (Rp.)	CV (Rp.)	Description
20th	5.700.853.556,72	6.223.444.597,27	- 522.591.040,56	Bigger
21st	6.037.518.136,84	6.578.114.807,39	- 540.596.670,56	Bigger
22nd	6.250.739.037,58	6.818.128.452,99	-567.389.415,41	Bigger
23rd	6.760.723.531,17	7.373.088.940,73	-612.365.409,56	Bigger
24th	7.025.067.571,86	7.660.891.114,42	-635.823.542,56	Bigger
25th	7.501.385.607,44	8.604.422.882,45	- 1.103.037.275,01	
26th	8.040.048.935,63	9.684.291.615,05	- 1.644.242.679,42	

Source: Processed by Researcher, 2024

From the above calculations, CV is obtained in week 20 to week 26 negative results (-), indicating that the project costs incurred for the implementation of the work are greater than planned.

Time Variance / Schedule Variance (SV)

Schedule Variance (SV) is calculated in week 20 of the period September 2 - 8, 2024 as follows:

$$\begin{aligned}
 SV &= BCWP - BCWS \\
 SV &= 5,700,853,556.72 - 4,538,737,302.37
 \end{aligned}$$

$$SV = 1,162,116,254.34$$

The result of the SV calculation is positive, meaning the work is faster than planned. Next week's calculation will be done in the same way as the calculation above. And the results of the next week's calculations can be seen in table 4.10 below:

Table 7. Results of Time Variant Value (SV)

Week Period	BCWP (Rp.)	BCWS (Rp.)	SV (Rp.)	Description
20th	5.700.853.556,72	4.538.737.302,37	1.162.116.254,34	Faster
21st	6.037.518.136,84	5.030.018.208,18	1.007.499.928,66	Faster

Table 8. Results of Time Variant Value (SV) Continued

Week Period	BCWP (Rp.)	BCWS (Rp.)	SV (Rp.)	Description
22nd	6.250.739.037,58	5.498.854.808,64	751.884.228,94	Faster
23rd	6.760.723.531,17	6.341.763.164,80	418.960.366,37	Faster
24th	7.025.067.571,86	7.184.671.520,95	-159.603.949,09	Too late
25th	7.501.385.607,44	8.096.159.698,98	-594.774.091,55	Too late
26th	8.040.048.935,63	9.156.029.673,44	-1.115.980.737,81	Too late

Source: Processed by Researcher, 2024

From the results of the above calculations, SV is obtained in week 24 to week 26 of the period September 30-October 20, 2024, amounting to - Rp. 1,115,980,737.81, indicating that the project is delayed from the planned schedule.

Cost and Time Performance Index Analysis

Cost Performance Index (CPI)

The cost performance index (CPI) was calculated in week 20 of the period September 2 - 8, 2024 as follows:

$$CPI = BCWP / ACWP$$

$$CPI = 5,700,853,556.72 - 6,223,444,597.27$$

$$CPI = 0.92$$

The result of the $CPI > 0$ calculation means that the incurred costs are smaller than the plan. Next week's calculation is done in the same way as the above calculation.

Table 9. Cost Performance Index (CPI) results

Week Period	BCWP (Rp.)	ACWP (Rp.)	CPI (Rp.)	Description
20th	5.700.853.556,72	6.223.444.597,27	0,92	Smaller
21st	6.037.518.136,84	6.578.114.807,39	0,92	Smaller
22nd	6.250.739.037,58	6.818.128.452,99	0,92	Smaller
23rd	6.760.723.531,17	7.373.088.940,73	0,92	Smaller
24th	7.025.067.571,86	7.660.891.114,42	0,92	Smaller
25th	7.501.385.607,44	8.604.422.882,45	0,87	Smaller
26th	8.040.048.935,63	9.684.291.615,05	0,83	Smaller

Source: Processed by Researcher, 2024

The above calculations show that the CPI from weeks 20 to 26 is greater than 0 ($CPI > 0$), indicating that the costs incurred are less than the plan's.

Estimated Cost of Project Completion

Estimate to Complete (ETC)

ETC is the estimated cost for the remaining work until the end of the project. Calculation of ETC week 26 with progress value > 50% as follows:

$$\begin{aligned}\text{ETC} &= (\text{BAC} - \text{BCWP}) / \text{CPI} \\ &= (\text{Rp. } 12,469,058,523.00 - \text{Rp. } 8,040,048,935.63) / 0.83 \\ &= \text{Rp. } 5,334,771,063.38\end{aligned}$$

The cost to implement work weeks 27 to 29 totaled 5,334,771,063.38.

Estimate at Complete (EAC)

EAC is the estimated total cost until the end of the project. The EAC calculation at week 26 is as follows:

$$\begin{aligned}\text{EAC} &= \text{ACWP} + \text{ETC} \\ &= \text{Rp. } 9,684,291,615.0496 + \text{Rp. } 5,334,771,063.38 \\ &= \text{Rp. } 15,019,062,678.43\end{aligned}$$

The total cost required until the work is completed is Rp. 15,019,062,678.43. The difference in budget between the contract and the estimate is Rp. 15,019,062,678.43 - Rp. 12,469,058,523.00, which equals Rp. 2,550,004,155.43.

CONCLUSION

This research analyzed cost and time performance in constructing warehousing and supporting facilities at Juwata Airport using the Earned Value Method (EVM). The results indicate that the estimated cost for completing the remaining work (Estimate to Complete/ETC) is Rp. 5,334,771,063.38, while the total project completion cost (Estimate at Completion/EAC) is projected at Rp. 15,019,062,678.43. Furthermore, the estimated project completion time (Time Estimate/TE) is 239 calendar days, 29 days behind the original contract schedule. To mitigate these delays, an additional cost of Rp. 68,970,000 is required to accelerate the work and ensure timely project completion. These findings have several important implications for future project management practices. First, the application of cost overruns and schedule deviations. Integrating EVM allows construction teams to make data-driven decisions and proactively implement corrections. Additionally, the results stress the importance of accurate planning and risk management to anticipate cost changes and delays. Regular performance reviews and contingency planning can improve project execution reliability.

Additionally, this research highlights the importance of resource optimization and strategic scheduling in preventing delays. Construction projects should adopt work acceleration techniques, such as increasing workforce allocation or optimizing workflow efficiency, to maintain progress within the planned timeframe. Furthermore, project managers should leverage digital project tracking tools to improve real-time monitoring and facilitate better stakeholder coordination. Future research should explore advanced methodologies, such as machine learning-based forecasting models or BIM (Building Information Modeling)-integrated cost management—to enhance project performance predictions and decision-making processes. By adopting these strategies, construction project managers can minimize inefficiencies and improve overall cost and time management. By applying the insights from this research, future infrastructure projects can achieve greater financial control, improved scheduling accuracy, and enhanced execution efficiency, ultimately leading to more sustainable and cost-effective project outcomes.

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