

Application of the Earned Value Analysis (EVA) Method to Assess Performance Costs and Time in Campus X Lecture Building

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ABSTRACT

Rapid economic growth has driven increased infrastructure development, including the construction of lecture halls. In the implementation of construction projects, deviations between plans and actual outcomes are often encountered, both in terms of cost and time. This research aims to evaluate the cost and time performance of the construction project for the Academic Building at Campus X using the Earned Value Analysis (EVA) method. This study uses a descriptive quantitative approach. Data were collected from project documents such as the Bill of Quantities (BoQ), Project Implementation Plan (PIP), time schedule, and monthly reports. Performance indicators, such as the Schedule Performance Index (SPI) and Cost Performance Index (CPI), were analyzed to evaluate time and cost efficiency. The analysis results show that the project is cost-efficient, with the CPI value consistently above 1, peaking at 1.382. Time performance is relatively good, although there were minor delays in the 4th and 11th months, with the SPI value ranging from 0.96 to 2.72. The project was successfully completed within 12 months as originally planned. The final cost estimate (Estimate at Completion) of Rp 28,433,930,871.17 was lower than the initial budget (Budget at Completion) of Rp 33,793,610,189.25, resulting in an efficiency of 15.86%. This research concludes that EVA is an effective tool for quantitatively evaluating project performance, providing a clear picture of cost and time deviations, and can serve as a reference for project managers in making strategic decisions.

INTRODUCTION

Along with Indonesia's economic growth, the need for construction projects has also increased. These projects often require good management to achieve optimal results (Putra et al., 2020). When making a construction project plan, always refer to the estimated value at the time the schedule was made (Pamadi et al., 2021).

Construction management is the process of planning, scheduling, and controlling projects to ensure that project objectives are achieved correctly. To run the program during the construction project operation cycle, good cost organization and control systems are required. Management needs to compare program costs, time, and performance by considering the cost, time, and performance budget plans for each activity (Putra et al., 2020). Project management is a structured approach to

planning, managing, and completing projects with regard to time, budget, and labor (Paharuddin et al., 2024). Project management will be successful if these three tasks are performed well.

In the process of implementing construction projects, there is a concept called the “Triple Constraint,” which refers to the three main constraints that must be managed and balanced in every project, namely quality, time, and cost (Ralahallo & Fery Hendi Jaya, 2024). Useful evaluation measures are needed to overcome obstacles in the work implementation process. These evaluation measures are needed to check the extent to which the project's objectives and targets have been achieved, to determine whether the performance that has been carried out is relevant to the plan that has been made, and to determine whether the project time and costs will increase, as well as the amount of time needed to complete the work and the amount of costs needed to complete it. Optimal project performance is reflected in the alignment between work outcomes and established plans, where costs and implementation schedules are lower than planned, and product quality meets desired quality standards (Harmes, 2024). Regular project performance evaluations are essential to ensure that projects proceed according to plan. Therefore, an appropriate evaluation method is necessary for building construction projects. (Sentana et al., 2024).

The focus of this research is to assess the cost and time performance of a campus lecture building construction project using the Earned Value Analysis (EVA) method. This research focuses on analyzing the conformity between project implementation and the initial plan, both in terms of schedule and budget. Through the EVA approach, measurements will be conducted on the earned value (EV), planned value (PV), and actual cost (AC), which will then be analyzed using indicators such as the Schedule Performance Index (SPI), Cost Performance Index (CPI), and Estimate at Completion (EAC). By analyzing these indicators, this research aims to determine whether the project is experiencing delays or cost overruns, as well as to provide a quantitative overview of the project's overall performance. By applying the EVA method, delays or losses from construction projects can be controlled.

The earned value method is used to determine whether the performance in terms of time, cost, and work achievement is in line with the plan and implementation. During the reporting period, this method provides information related to Cost Variant, Schedule Variant, Cost Performance Index, and Schedule Performance Index (Wicaksono, 2021).

The purpose of this research is to show whether the work that has been completed has met the planned time and cost and whether it has been efficient. In addition, this research also aims to provide an overview of the time and costs required for the project.

METHOD

This study employed a quantitative descriptive approach, focusing on the conditions of a specific project through the analysis of actual data (F. Johan, 2020). Analytical methods were used to process the collected data and draw conclusions, while the descriptive approach aimed to reveal the actual conditions based on the observed data.

The research analyzed the cost and time performance of construction projects using the *Earned Value Analysis* (EVA) method. EVA is an integrated control technique for project budgets and schedules that provides information on performance status over a given period and estimates the time and cost required to complete the work based on performance indicators at reporting. The principle of earned value analysis is to measure the performance of completed work against planned cost and scheduled time (Revisdah et al., 2023).

Data collection involved primary and secondary sources. Primary data included initial planning documents such as the Budget Plan (RAB), which served as the basis for project financing and cost control, and the Time Schedule Plan, which guided the project timeline. Secondary data included implementation outcome documents such as the Implementation Budget Plan (RAP), the

Realization Time Schedule, and the Monthly Project Progress Report. The RAP reflected the contractor's internal strategy and was used to assess cost efficiency. The Time Schedule for Implementation showed the actual physical progress, while the monthly reports contained physical and financial data, including information required to calculate Earned Value (EV) and Actual Cost (AC).

The research followed systematic stages to achieve its objectives. The first stage involved a literature review to deepen the theoretical understanding of the topic, followed by problem formulation and data collection. The second stage involved managing primary and secondary data, such as monthly progress reports, work weights, RAB, and actual cost data. These data were used to calculate Planned Value (PV), Earned Value (EV), and Actual Cost (AC). In the third stage, AC was calculated from monthly actual cost reports, EV from the assumed work weight, and PV from the planned budget weight (Ristiyana & Virgiawan, 2019).

The fourth stage consisted of calculating Cost Variance (CV), Cost Performance Index (CPI), Schedule Performance Index (SPI), and Estimate to Complete (ETC). CV was derived from the difference between EV and AC; CPI from the ratio of EV to AC; SPI from the ratio of EV to PV; and ETC from the difference between Budget at Completion (BAC) and EV divided by CPI. The final stage calculated the Estimate at Completion (EAC) using the formula $AC + (BAC - EV) / (CPI \times SPI)$ to project the final project cost (Ristiyana & Virgiawan, 2019).

RESULTS

1. Planned Value Analysis

The PV value is calculated based on the baseline schedule and the planned work weight, multiplied by the total project budget (RAB).

$$PV = (\text{Work Plan Weight } \%) \times (\text{Total Project Budget})$$

Example calculation for work in month 1:

$$\begin{aligned} PV &= (\text{Work Plan Weight } \%) \times (\text{Total Project Budget}) \\ &= 0.75\% \times \text{IDR } 33,793,610,189.25 \\ &= \text{IDR } 252.729.871,74 \end{aligned}$$

The PV calculation for each month can be seen in Table 1 below:

Table 1. Planned Value (PV)

PERIODS	TOTAL COST (IDR)	MONTHLY WEIGHT (%)	BOBOT (%) CUMULATIVE	PV (IDR)	
				TOTAL	CUMULATIVE
Month 1	IDR 33,793,610,189.25	0.75	0.75	IDR 252,729,871.74	IDR 252,729,871.74
Month 2	IDR 33,793,610,189.25	4.43	5.18	IDR 1,497,324,023.48	IDR 1,750,053,895.22
Month 3	IDR 33,793,610,189.25	6.97	12.15	IDR 2,356,883,366.61	IDR 4,106,937,261.83
Month 4	IDR 33,793,610,189.25	5.99	18.15	IDR 2,024,927,347.09	IDR 6,131,864,608.92
Month 5	IDR 33,793,610,189.25	3.64	21.78	IDR 1,228,981,606.38	IDR 7,360,846,215.30
Month 6	IDR 33,793,610,189.25	4.04	25.82	IDR 1,365,114,540.64	IDR 8,725,960,755.94
Month 7	IDR 33,793,610,189.25	6.84	32.66	IDR 2,312,349,204.30	IDR 11,038,309,960.24
Month 8	IDR 33,793,610,189.25	14.73	47.40	IDR 4,979,150,521.44	IDR 16,017,460,481.68
Month 9	IDR 33,793,610,189.25	13.81	61.21	IDR 4,666,925,571.80	IDR 20,684,386,053.48
Month 10	IDR 33,793,610,189.25	17.25	78.46	IDR 5,830,055,950.07	IDR 26,514,442,003.56
Month 11	IDR 33,793,610,189.25	17.32	95.78	IDR 5,852,894,914.92	IDR 32,367,336,918.48
Month 12	IDR 33,793,610,189.25	4.22	100.00	IDR 1,426,273,270.77	IDR 33,793,610,189.25

2. Earned Value Analysis

The earned value is calculated based on the estimated value of the work and unit costs determined independently by the researcher. The EV value reflects the extent to which the project work has been completed in monetary terms at a given point in time, using the following formula:

$$EV = (\text{Work Weight } \%) \times (\text{Total Project Budget})$$

Example calculation for work in month 1:

$$\begin{aligned} EV &= (\text{EV Weight } \%) \times (\text{Total Project Budget}) \\ &= 2.17\% \times \text{IDR } 31,661,456,506.12 \\ &= \text{IDR } 687,131,178.97 \end{aligned}$$

The EV calculation for each month can be seen in Table 2 below:

Table 2. Earned Value (EV)

PERIODS	TOTAL COST (IDR)	EV WEIGHT (%)	CUMULATIVE WEIGHT (%)	EVA (IDR)	
				MONTH	CUMULATIVE
Month 1	IDR 31,661,456,506.12	2.17	2.17	IDR 687,131,178.97	IDR 687,131,178.97
Month 2	IDR 31,661,456,506.12	5.64	7.81	IDR 1,785,571,851.11	IDR 2,472,703,030.09
Month 3	IDR 31,661,456,506.12	5.74	13.55	IDR 1,818,715,318.10	IDR 4,291,418,348.19
Month 4	IDR 31,661,456,506.12	5.04	18.59	IDR 1,595,700,058.62	IDR 5,887,118,406.81
Month 5	IDR 31,661,456,506.12	3.91	22.51	IDR 1,239,117,987.78	IDR 7,126,236,394.59
Month 6	IDR 31,661,456,506.12	7.08	29.58	IDR 2,240,531,902.59	IDR 9,366,768,297.18
Month 7	IDR 31,661,456,506.12	7.81	37.40	IDR 2,474,323,314.88	IDR 11,841,091,612.06
Month 8	IDR 31,661,456,506.12	15.64	53.04	IDR 4,951,851,797.56	IDR 16,792,943,409.62
Month 9	IDR 31,661,456,506.12	13.41	66.45	IDR 4,245,801,317.47	IDR 21,038,744,727.09
Month 10	IDR 31,661,456,506.12	16.03	82.48	IDR 5,074,704,151.84	IDR 26,113,448,878.93
Month 11	IDR 31,661,456,506.12	17.52	100.00	IDR 5,548,007,627.20	IDR 31,661,456,506.12

3. Actual Cost Analysis

Actual Cost (AC) is the total actual cost of work at a given time. (Ningsi & Nashir, 2023). This data comes from project financial reports or actual costs in the field.

a. Month 1

$$\text{Month 1} = \text{IDR } 640,858,220.12$$

$$\text{AC} = \text{IDR } 640,858,220.12$$

For further results, see Table 3 below:

Table 3. Actual Cost (AC)

PERIODS	ACTUAL WEIGHT (%)	AC (IDR)	
		MONTH	CUMULATIVE
Month 1	2.17	IDR 640,858,220.12	IDR 640,858,220.12
Month 2	5.64	IDR 1,665,327,427.17	IDR 2,306,185,647.29
Month 3	2.71	IDR 799,444,604.66	IDR 3,105,630,251.95
Month 4	4.07	IDR 1,201,106,478.67	IDR 4,306,736,730.62
Month 5	3.21	IDR 948,934,328.19	IDR 5,255,671,058.81
Month 6	7.08	IDR 2,089,649,445.64	IDR 7,345,320,504.46
Month 7	7.81	IDR 2,307,696,818.46	IDR 9,653,017,322.92
Month 8	14.64	IDR 4,323,103,995.60	IDR 13,976,121,318.51
Month 9	11.84	IDR 3,495,657,639.36	IDR 17,471,778,957.87
Month 10	13.03	IDR 3,847,083,077.30	IDR 21,318,862,035.17
Month 11	18.02	IDR 5,321,075,530.96	IDR 26,639,937,566.13

Month 12	8.05	IDR 2,378,566,441.65	IDR 29,018,504,007.79
Month 13	1.73	IDR 510,798,815.22	IDR 29,529,302,823.00

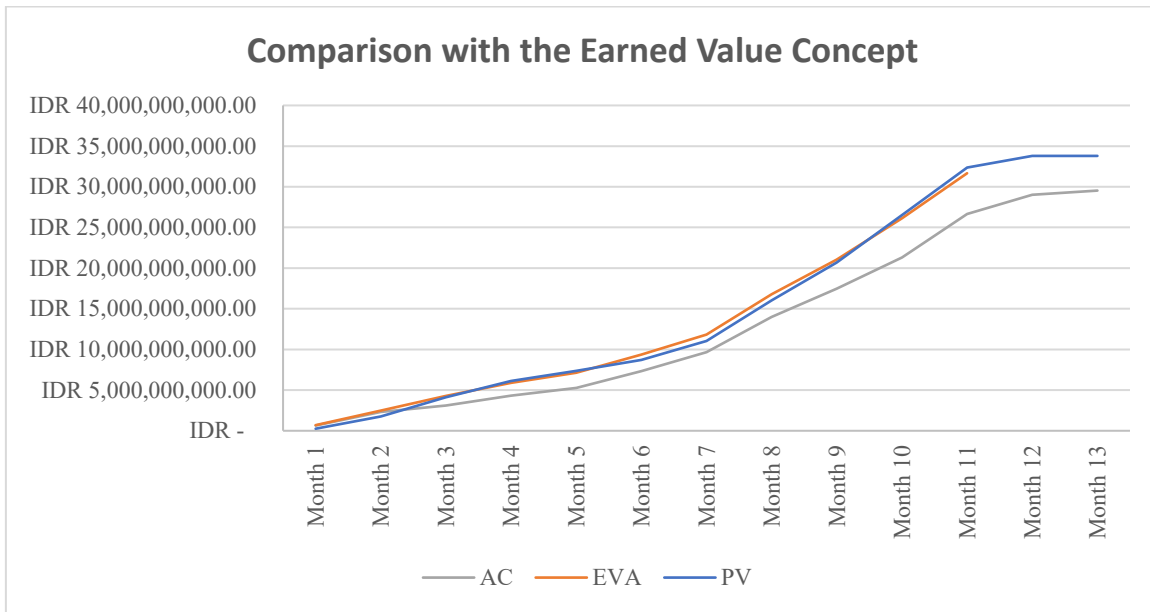


Figure 1. Comparison with the Earned Value Concept Chart

Based on Graph 1, the project showed good time performance until the 10th month, with EV greater than PV, indicating that the work was ahead of schedule. However, from the 11th to the 13th month, EV stagnated while PV increased, indicating that there was no additional physical progress. From a cost perspective, EV is generally higher than AC, indicating efficiency, although in the last two months EV did not increase while AC continued to rise. This suggests that expenses continued despite no physical progress, possibly due to finishing work or final administrative tasks.

4. Analysis of Variance

a. Schedule Variance (SV)

Schedule Variance Value (SV) is an indicator used to determine whether a project is still on schedule or not. (Janizar, 2023). Below is the Schedule Variance (SV) calculation:

$$SV = EV - PV$$

An example of the calculation for work in Month 1 is as follows:

$$\begin{aligned}
 SV &= EV - PV \\
 &= \text{IDR } 687,131,178.97 - \text{IDR } 252,729,871.71 \\
 &= \text{IDR } 434,401,306.23
 \end{aligned}$$

The next monthly calculations can be seen in Table 4 as follows:

Table 4. Schedule Variance (SV)

PERIODS	EV (IDR)	PV (IDR)	SV
Month 1	IDR 687,131,178.97	IDR 252,729,871.74	IDR 434,401,307.23
Month 2	IDR 2,472,703,030.09	IDR 1,750,053,895.22	IDR 722,649,134.86
Month 3	IDR 4,291,418,348.19	IDR 4,106,937,261.83	IDR 184,481,086.35
Month 4	IDR 5,887,118,406.81	IDR 6,131,864,608.92	-IDR 244,746,202.11
Month 5	IDR 7,126,236,394.59	IDR 7,360,846,215.30	-IDR 234,609,820.71
Month 6	IDR 9,366,768,297.18	IDR 8,725,960,755.94	IDR 640,807,541.24

Month 7	IDR 11,841,091,612.06	IDR 11,038,309,960.24	IDR 802,781,651.82
Month 8	IDR 16,792,943,409.62	IDR 16,017,460,481.68	IDR 775,482,927.94
Month 9	IDR 21,038,744,727.09	IDR 20,684,386,053.48	IDR 354,358,673.60
Month 10	IDR 26,113,448,878.93	IDR 26,514,442,003.56	-IDR 400,993,124.63
Month 11	IDR 31,661,456,506.12	IDR 32,367,336,918.48	-IDR 705,880,412.35

b. Cost Variance

The cost variance (CV) is the difference between the actual EV value of the project and the planned PV value. To calculate the cost variance (CV) for each period, the following formula is used:

$$CV = EV - AC$$

An example of the calculation for work in Month 1 is as follows:

$$\begin{aligned} CV &= EV - AC \\ &= \text{IDR } 5,031,252.43 - \text{IDR } 2,952,930.28 \\ &= \text{IDR } 2,078,322.15 \end{aligned}$$

The next monthly calculations can be seen in Table 5 as follows:

Table 5. Cost Variance (CV)

PERIODS	EV (IDR)	AC (IDR)	CV
Month 1	IDR 687,131,178.97	IDR 640,858,220.12	IDR 46,272,958.85
Month 2	IDR 2,472,703,030.09	IDR 2,306,185,647.29	IDR 166,517,382.79
Month 3	IDR 4,291,418,348.19	IDR 3,105,630,251.95	IDR 1,185,788,096.24
Month 4	IDR 5,887,118,406.81	IDR 4,306,736,730.62	IDR 1,580,381,676.19
Month 5	IDR 7,126,236,394.59	IDR 5,255,671,058.81	IDR 1,870,565,335.78
Month 6	IDR 9,366,768,297.18	IDR 7,345,320,504.46	IDR 2,021,447,792.73
Month 7	IDR 11,841,091,612.06	IDR 9,653,017,322.92	IDR 2,188,074,289.14
Month 8	IDR 16,792,943,409.62	IDR 13,976,121,318.51	IDR 2,816,822,091.10
Month 9	IDR 21,038,744,727.09	IDR 17,471,778,957.87	IDR 3,566,965,769.21
Month 10	IDR 26,113,448,878.93	IDR 21,318,862,035.17	IDR 4,794,586,843.76
Month 11	IDR 31,661,456,506.12	IDR 26,639,937,566.13	IDR 5,021,518,939.99

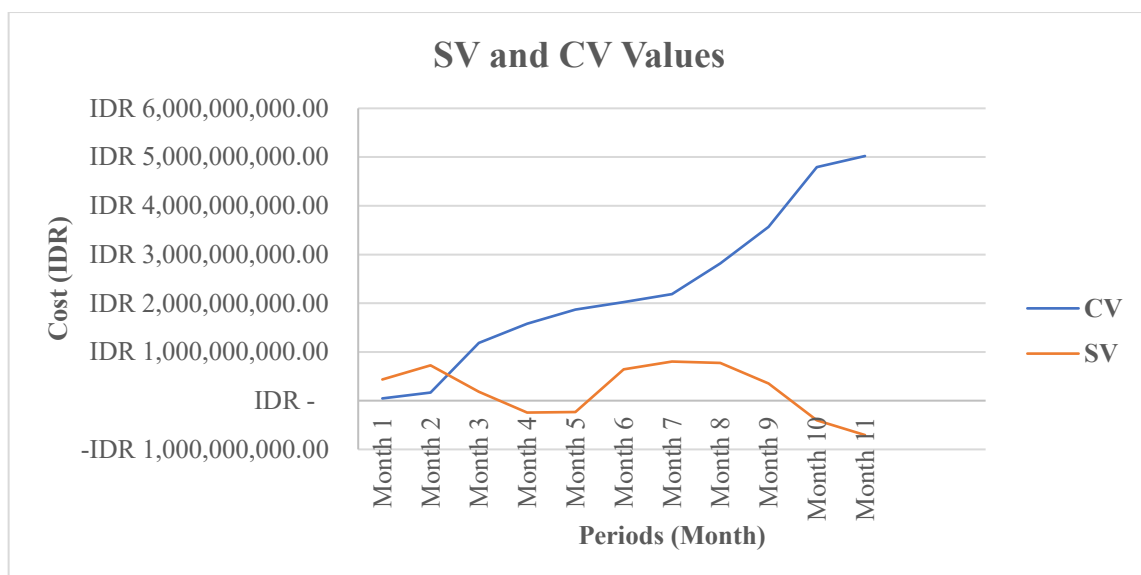


Figure 2. SV and CV Values Chart

Graph 2 shows the relationship between project performance (SV) and cost (CV). During months 1 to 11, SV fluctuated, while CV showed a consistent upward trend. At the start of the project, both values were positive, meaning the project was progressing faster and more cost-effectively. When delays occurred in months 4 and 5, CV remained positive and continued to rise, indicating that cost efficiency was maintained despite schedule disruptions. Even when significant delays occurred in months 10 and 11, CV reached its highest value. This demonstrates that cost efficiency can be achieved even when the project is behind schedule. Thus, cost management is rated as very good, while schedule control still needs improvement, particularly toward the end of the project.

5. Performance Index Analysis

a. Schedule Performance Index (SPI)

SPI is used to determine time productivity indicators by comparing performance/workload in the field with planned progress. (Junaidi et al., 2022). The schedule productivity index is a measure of resource utilization efficiency at the time of evaluation. SPI is calculated using the following formula:

$$SPI = EV \div PV$$

An example of the calculation for work in Month 1 is as follows:

$$\begin{aligned} SPI &= EV \div PV \\ &= IDR\ 687,131,178.97 \div IDR\ 252,729,871.74 \\ &= 2.72 \end{aligned}$$

The next monthly SPI calculation can be seen in Table 6 as follows:

Tabel 6. Schedule Performance Index (SPI)

PERIODS	EV (IDR)	PV (IDR)	SPI	DESCRIPTION
Month 1	IDR 687,131,178.97	IDR 252,729,871.74	2.72	Faster Projects
Month 2	IDR 2,472,703,030.09	IDR 1,750,053,895.22	1.41	Faster Projects
Month 3	IDR 4,291,418,348.19	IDR 4,106,937,261.83	1.04	Faster Projects
Month 4	IDR 5,887,118,406.81	IDR 6,131,864,608.92	0.96	Delayed Projects
Month 5	IDR 7,126,236,394.59	IDR 7,360,846,215.30	0.97	Delayed Projects
Month 6	IDR 9,366,768,297.18	IDR 8,725,960,755.94	1.07	Faster Projects
Month 7	IDR 11,841,091,612.06	IDR 11,038,309,960.24	1.07	Faster Projects
Month 8	IDR 16,792,943,409.62	IDR 16,017,460,481.68	1.05	Faster Projects
Month 9	IDR 21,038,744,727.09	IDR 20,684,386,053.48	1.02	Faster Projects
Month 10	IDR 26,113,448,878.93	IDR 26,514,442,003.56	0.98	Delayed Projects
Month 11	IDR 31,661,456,506.12	IDR 32,367,336,918.48	0.98	Delayed Projects

b. Cost Performance Index (CPI)

To calculate the Cost Performance Index (CPI) value for each period, the following formula is used:

$$CPI = EV \div AC$$

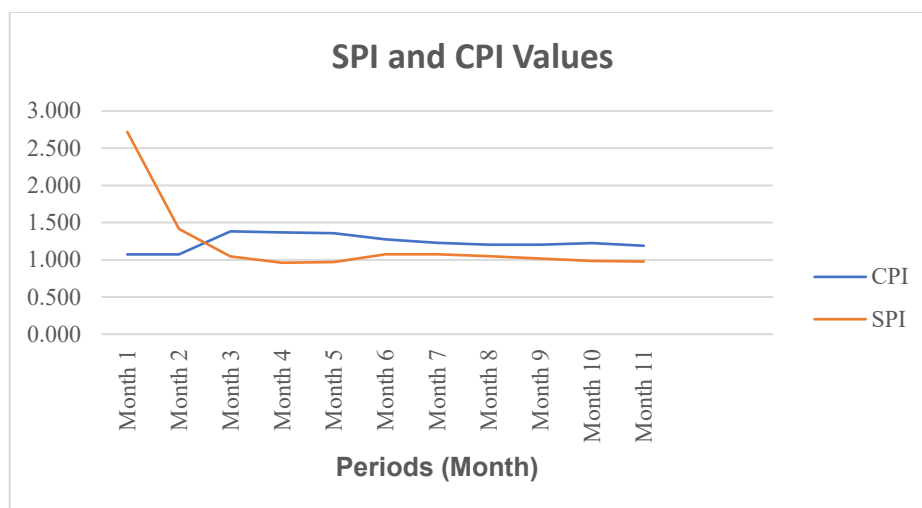
An example of the calculation for work in Month 1 is as follows:

$$\begin{aligned} CPI &= EV \div AC \\ &= IDR\ 687,131,178.97 \div IDR\ 640,858,220.12 \\ &= 1.072 \end{aligned}$$

The next monthly SPI calculation can be seen in Table 7 as follows:

Table 7. Cost Performance Index (CPI)

PERIODS	EV	AC	CPI	DESCRIPTION
	(IDR)	(IDR)		
Month 1	IDR 687,131,178.97	IDR 640,858,220.12	1.072	More Economical Projects
Month 2	IDR 2,472,703,030.09	IDR 2,306,185,647.29	1.072	More Economical Projects
Month 3	IDR 4,291,418,348.19	IDR 3,105,630,251.95	1.382	More Economical Projects
Month 4	IDR 5,887,118,406.81	IDR 4,306,736,730.62	1.367	More Economical Projects
Month 5	IDR 7,126,236,394.59	IDR 5,255,671,058.81	1.356	More Economical Projects
Month 6	IDR 9,366,768,297.18	IDR 7,345,320,504.46	1.275	More Economical Projects
Month 7	IDR 11,841,091,612.06	IDR 9,653,017,322.92	1.227	More Economical Projects
Month 8	IDR 16,792,943,409.62	IDR 13,976,121,318.51	1.202	More Economical Projects
Month 9	IDR 21,038,744,727.09	IDR 17,471,778,957.87	1.204	More Economical Projects
Month 10	IDR 26,113,448,878.93	IDR 21,318,862,035.17	1.225	More Economical Projects
Month 11	IDR 31,661,456,506.12	IDR 26,639,937,566.13	1.188	More Economical Projects



Graph 3. SPI and CPI Values Chart

Figure 3 shows the trends in cost efficiency (CPI) and time effectiveness (SPI) during months 1 to 11. In the first month, SPI was very high (close to 2.72), indicating that the project was well ahead of schedule. However, the SPI value then declined and stabilized around 1, even falling below 1 in the final months, indicating minor delays, particularly during the completion phase. Conversely, CPI showed a stable trend and remained above 1, peaking in the third month (around 1.382), indicating that cost efficiency was maintained throughout the project. The differing patterns between SPI and CPI suggest that while costs were well managed, time control still needed improvement, especially toward the end of the project.

6. Estimated Project Completion Date

After obtaining the schedule variance (SV), cost variance (CV), schedule performance index (SPI), and cost performance index (CPI), the next step is to calculate the estimated time and cost of project completion. The data obtained is as follows.

Project plan duration (PD)	= 12 month
Elapsed time (AT)	= 11 month
Time remaining for completion	= 1 month
Schedule Performance Index (SPI)	= 0.98

- a. Estimate Temporary Schedule (ETS)
 - ETS = $(PD - AT) \div SPI$
 - = $(12 \text{ month} - 11 \text{ month}) \div 0.98$
 - = 1.02
- b. Estimate All Schedule (EAS)
 - EAS = $AT + ETS$
 - = $11 \text{ month} + 1.02 \text{ month}$
 - = $12.02 \approx 12 \text{ months}$
- c. Remaining Duration
 - = $PD - EAS$
 - = $12 \text{ month} - 12 \text{ month}$
 - = 0 month

7. Estimated Final Project Completion Cost

The results of this analysis involve calculations that take into account all project performance parameters, enabling more informed and data-driven decision-making (Jaenudin, 2025). Therefore, the data obtained and analyzed will be explained in more detail in the following section to identify the status of the project and projections of the final results.

- Budget at Completion (BAC) = IDR 33,793,610,189.25
- Cumulative EV for the 11th month = IDR 31,661,456,506.12
- Cumulative AC for the 11th month = IDR 26,639,937,566.13
- Cost Performance Index (CPI) = 1.188
- a. Estimate to Completion (ETC)
 - ETC = $(BAC - EV) \div CPI$
 - = $(IDR 33,793,610,189.25 - IDR 31,661,456,506.12) \div 1.188$
 - = IDR 1,793,993,305.04
- b. Estimate at Completion (EAC)
 - EAC = $ETC + AC$
 - = $IDR 1,793,993,305.04 + IDR 26,639,937,566.13$
 - = IDR 28,433,930,871.17
- c. Remaining Budget
 - = $BAC - EAC$
 - = $IDR 33,793,610,189.25 - IDR 28,433,930,871.17$
 - = IDR 5,359,679,318.07
- d. Efficiency
 - = $\text{Remaining Budget} \div BAC \times 100$
 - = $IDR 5,359,679,318.07 \div IDR 33,793,610,189.25 \times 100$
 - = 15.86 %

EVA Performance Analysis Integration with Previous Research

The results of this research demonstrate the effectiveness of Earned Value Analysis (EVA) as a comprehensive project control tool, aligning with findings from previous studies while providing specific insights for educational infrastructure projects. The consistently positive Cost Performance Index (CPI) values, ranging from 1.072 to 1.382, indicate superior cost management throughout the project lifecycle, which supports the conclusions of Putra et al. (2020) regarding the importance of systematic cost control in construction projects. The peak CPI value of 1.382 in the third month

suggests particularly effective resource utilization during the early construction phases, possibly due to economies of scale in material procurement and optimized workforce deployment.

The Schedule Performance Index (SPI) analysis reveals a more complex temporal pattern, with initial excellent performance (SPI = 2.72 in month 1) gradually stabilizing and occasionally falling below 1.0 in months 4, 5, 10, and 11. This pattern is consistent with Sentana et al. (2024) findings that construction projects often experience schedule variations due to external factors, weather conditions, and coordination complexities. However, the project's ability to recover from delays and maintain overall schedule compliance demonstrates effective project management interventions.

The 15.86% cost savings achieved in this project significantly exceeds typical construction efficiency benchmarks reported in literature. Harmes (2024) noted that well-managed construction projects typically achieve 5-10% efficiency gains, making this project's performance exceptional. This superior performance can be attributed to several factors: comprehensive pre-construction planning, effective vendor relationships, optimized resource allocation, and proactive risk management strategies implemented throughout the project lifecycle.

Comparative analysis with similar studies reveals that this project's performance metrics exceed those reported by Ristiyana & Virgiawan (2019) for hospital construction projects, where CPI values typically ranged from 0.95 to 1.15. The educational facility's superior performance may reflect the relative simplicity of academic building systems compared to complex medical facilities, as well as the institution's experience in managing similar projects.

The variance analysis results provide additional insights into project dynamics. The positive Cost Variance (CV) throughout the project, reaching IDR 5,021,518,939.99 by month 11, demonstrates sustained cost control effectiveness. This finding reinforces Wicaksono's (2021) assertion that EVA provides early warning systems for cost overruns, enabling proactive corrective actions. The Schedule Variance (SV) fluctuations, while showing overall positive trends with temporary negative periods, illustrate the method's sensitivity to temporal variations and its utility in identifying critical periods requiring management attention.

Methodological Validation and Practical Implications

The research validates EVA's practical applicability in medium-scale educational construction projects, addressing a gap identified by Pamadi et al. (2021) regarding limited EVA implementation studies in institutional settings. The successful integration of EVA with existing project management systems demonstrates the method's compatibility with contemporary construction management practices. The ability to predict final project costs with high accuracy (EAC calculation showing 15.86% savings) provides strong evidence for EVA's forecasting capabilities, supporting its adoption for similar future projects.

The temporal analysis reveals important insights for project planning and execution. The early high performance followed by mid-project stabilization and late-project minor delays suggests that academic building construction follows predictable patterns that can inform future scheduling strategies. Project managers can anticipate that complex finishing work and final inspections may require additional time allocation, while structural and envelope work can often be accelerated beyond planned schedules.

CONCLUSION

This research demonstrates that Earned Value Analysis (EVA) is an effective project control tool for educational infrastructure development, successfully evaluating cost and time performance while setting quantitative benchmarks for campus construction projects. The Academic Building at Campus X showed exceptional outcomes, maintaining a Cost Performance Index (CPI) consistently

above 1.0—averaging 1.225 and peaking at 1.382—indicating strong cost efficiency. The Schedule Performance Index (SPI) started high at 2.72 and stabilized near 1.0, with only minor delays in months 4, 5, 10, and 11; the project was completed on schedule within 12 months. Financially, the project achieved significant cost savings of IDR 5.36 billion, representing 15.86% efficiency over the original budget, reflecting superior resource management. This study contributes empirical evidence for EVA's utility in educational facility projects, offering practical integrated cost-schedule control benchmarks for medium-scale institutional construction in developing countries. Future research could explore the application of EVA in larger-scale or multi-site educational projects, investigate its integration with emerging digital project management technologies, and assess its impact on stakeholder communication and risk management to further optimize resource utilization and project outcomes.

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