Estimated Cost And Time For Completion Of The Bali GX Office And Co Working Project Using The Earned Value Method

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Abstract.

The GX Office & Co Working Bali construction project faced significant delays in the 27th week with a deviation of -4.31%, which could result in increased costs and delays in completion. So, an effective solution is needed to overcome project delays and ensure that the project is completed on time and within budget. This research aims to examine the application of the Earned Value Method (EVM) in evaluating the performance of the GX Office & Co Working Bali project by calculating the Estimated Temporary Schedule (ETS), Estimated All Schedule (EAS), Estimate Temporary Cost (ETC) and Estimate All Completion (EAC). The research uses descriptive quantitative methods by collecting data from weekly project progress reports, actual costs, and planned values. Data analysis was carried out by calculating Planned Value (PV), Earned Value (EV), Actual Cost (AC), Cost Performance Index (CPI), Schedule Performance Index (SPI), ETS, EAS, ETC, and EAC. The research results show an ETS value of 114 days with an EAS of 303 days. So, there is an additional time of 9 days from the planned schedule. ETC results amounted to IDR 3,723,631,710.12, with EAC amounting to IDR 7,699,818,710.12. So, the cost of completing the project is lower than planned, with a difference of IDR 2,545,727,760.88. The results of this research contribute to the project management literature by showing the effectiveness of EVM in identifying deviations and the basis for making strategic policies needed so that projects can be completed on time according to plan.
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Keywords: *Earned Value Method, Project Delays, Estimated Temporary Schedule, Estimated All Schedule, Estimate Temporary Cost, Estimate All Completion.*

I. INTRODUCTION

The rapid development of construction is driving the demand for buildings that are not only safe but also comfortable. The need for modern and flexible workspaces is increasing with the fast economic growth and urbanization. This has led developers to design and construct offices that meet safety standards and offer comfort to their occupants. Comfort includes a work environment that supports productivity, comprehensive facilities, and attractive and ergonomic designs [1]. The GX Office & Co Working Bali project is one initiative that will meet these needs. It is designed to provide modern and flexible coworking spaces in Bali, supporting professionals, entrepreneurs, and startups in their activities. Built on a 503.15 m² land with a total of six floors, the project commenced in August 2023. The GX Office & Co Working Bali construction project has a contract value of 10,245,546,471.00 IDR for 670 calendar days. However, the project is currently experiencing significant delays. According to the S-curve, the delay in structural work until February 2024 is estimated to reach -4.31% from the original plan. This delay affects the project completion schedule and raises concerns about increased costs and further delays.Delays in construction projects are a common issue faced by contractors. Various factors can cause delays, ranging from inadequate planning, design changes midway through, to issues with the availability of materials and labor [2]. Delays can become even more complex with additional constraints such as unfavorable weather conditions and lack of coordination among the parties involved [3]. These delays impact the project completion schedule and lead to increased costs and decreased quality of work.

Furthermore, they have the potential to damage the contractor's reputation. Therefore, it is important to evaluate delayed projects to find effective solutions to accelerate project completion [4].One common approach to addressing project delays is the Earned Value Method (EVM). EVM is a method used in project management to measure project performance by comparing the actual value of completed work with the

planned value [5]. EVM allows for early identification of deviations from the initial plan, both in terms of cost and time, so that corrective actions can be taken promptly before issues become critical. One of the main advantages of EVM is its ability to provide accurate estimates of project cost and completion time [6]. EVM analysis includes several key indicators such as Estimated Temporary Schedule (ETS), Estimated All Schedule (EAS), Estimate Temporary Cost (ETC), and Estimate at Completion (EAC) [7]. The importance of these indicators cannot be overlooked in construction project management. They provide information about the current status and enable accurate projections about the project's future [8]. By understanding and effectively using ETS, EAS, ETC, and EAC, project managers can optimize resource utilization, reduce the risk of delays and cost overruns, and ensure that the project is completed according to the set targets [9].Previous studies have shown various approaches in applying the EVM method to measure the performance of construction projects, particularly regarding indicators such as ETC, ETS, EAS, and EAC. Grace Maria Christy et al. analyzed a project for the construction of a four-way intersection road at Palangka Raya University, showing that ETS was 53 days, EAS was 102 days, ETC was 979,624,988 IDR, and EAC was 2,228,446,288 IDR, indicating that the project was completed three days ahead of the initial plan [10].

Julia Dewi Leatemia et al. applied it to the construction project of the BPKB Service Building at the Maluku Regional Police Traffic Directorate, with the result of the EAC value showing a cost deviation of 106,014,970.36 IDR from the contract value, indicating that the actual costs incurred were higher than the planned costs. Julia Dewi Leatemia et al. applied it to the construction project of the BPKB Service Building at the Maluku Regional Police Traffic Directorate, with the result of the EAC value showing a cost deviation of 106,014,970.36 IDR from the contract value, indicating that the actual costs incurred were higher than the planned costs [11]. Aryawitra Y. Ginting and Adita Utami conducted a study on the RSU. The results of the Vina Estetica project showed that the ETS value was 3 weeks, the EAS was 58 weeks, and the EAC value was smaller than planned. This study emphasizes the importance of utilizing EVM to ensure that projects are completed on time and within budget [12]. Feriyanto et al. conducted a cost and time evaluation of the construction project of the Pasuruan Regent Office Building and found that in week 17, the project experienced a delay deviation of -14.204% with actual costs lower than the planned budget. Feriyanto et al. conducted a cost and time evaluation of the construction project of the Pasuruan Regent Office Building and found that in week 17, the project experienced a delay deviation of -14.204% with actual costs lower than the planned budget [13]. Lamato et al. analyzed the renovation project of the BPJN Office Building using EVM and found that the project experienced a delay of 24 days from the planned schedule, with an EAS of 204 days, and the EAC indicating a budget overrun.

Lamato et al. analyzed the renovation project of the BPJN Office Building using EVM and found that the project experienced a delay of 24 days from the planned schedule, with an EAS of 204 days, and the EAC indicating a budget overrun. [14].Although various previous studies have applied the EVM method to evaluate the performance of construction projects, there is a lack of research specifically focusing on implementing this method in developing modern and flexible co-working spaces. Projects like GX Office & Co Working Bali have unique characteristics that distinguish them from conventional construction projects, including the need for ergonomic interior design and facilities that support collaboration and productivity. This research aims to examine the application of the EVM method in evaluating the performance of the GX Office & Co Working Bali project. The study will focus on key indicators such as Estimated Temporary Schedule (ETS), Estimated All Schedule (EAS), Estimate Temporary Cost (ETC), and Estimate All Completion (EAC). Thus, the results of the research can make a significant contribution to project management literature. Additionally, the findings of this study are expected to serve as a reference for project managers in planning and managing construction projects, thereby reducing the risk of delays and cost overruns and ensuring that projects can be completed according to the set targets.

II. METHODS

The research design employs a quantitative method to analyze the performance and estimate the cost and time of the GX Office & Co Working Bali project using EVM. This study involves several important steps such as collecting data in the form of weekly project progress reports, actual costs incurred, and

planned value data collected directly from the project site. Subsequently, data analysis is conducted by calculating key performance indicators such as Planned Value (PV), Earned Value (EV), and Actual Cost (AC) to determine the Cost Performance Index (CPI) and Schedule Performance Index (SPI). Variance analysis is performed to identify deviations from the planned budget and schedule. This research also includes predictive analysis such as Estimated Temporary Schedule (ETS), Estimated All Schedule (EAS), Estimate Temporary Cost (ETC), and Estimate All Completion (EAC) to project the cost and time of project completion.The data analysis in this study was conducted by calculating the Planned Value (PV), Earned Value (EV), and Actual Cost (AC) as key indicators to measure the performance of the GX Office & Co Working Bali project. Planned Value (PV) is the planned value of the work that should have been completed at a specific point in time according to the project schedule. To calculate PV, budget data planned for each project activity is collected and summed up to the reporting date [15]. Earned Value (EV) is the value of the work that has been completed at a specific time. EV is calculated by multiplying the work's completion percentage by the total budget allocated for that work [16].

Actual Cost (AC) is the actual cost incurred to complete the work up to the reporting date. AC is collected from project expenditure reports that cover all costs incurred [17].he data analysis is continued by calculating the Cost Performance Index (CPI) and Schedule Performance Index (SPI) to measure cost and time efficiency in the GX Office & Co Working Bali project. The Cost Performance Index (CPI) is calculated by dividing Earned Value (EV) by Actual Cost (AC), where CPI = EV / AC. A CPI value > 1 indicates that the project is running more cost-efficiently than planned, while CPI < 1 indicates that the project costs are higher than planned [18]. The Schedule Performance Index (SPI) is calculated by dividing Earned Value (EV) by Planned Value (PV), where SPI = EV / PV. An SPI value > 1 indicates that the project is ahead of schedule, while SPI < 1 indicates that the project is delayed [19].Next, we will calculate the Estimated Temporary Schedule (ETS), Estimated All Schedule (EAS), Estimate Temporary Cost (ETC), and Estimate All Completion (EAC). Estimated Temporary Schedule (ETS) is the estimated additional time needed to complete the remaining work, calculated by dividing the remaining time by the SPI. Estimated All Schedule (EAS) is the total estimated time to complete the entire project, calculated by adding the elapsed time and ETS [20]. Estimate Temporary Cost (ETC) is the estimated additional cost required to complete the remaining work, calculated by subtracting the total contract value from EV and then dividing by CPI. Estimate All Completion (EAC) is the total estimated cost to complete the entire project, including costs already incurred and ETC. EAC can be calculated using the formula EAC = AC + ETC [21].

III. RESULT AND DISCUSSION

The GX Office & Co Working Bali construction project was planned to be completed by week 42. However, as of the evaluation at week 27, the project has experienced significant delays with progress showing a decrease of -4.31% from the original plan. Therefore, in this Earned Value Method (EVM) analysis, the focus will be on the project's performance up to week 27 as well as the Estimated Temporary Schedule (ETS), Estimated All Schedule (EAS), Estimate Temporary Cost (ETC), and Estimate All Completion (EAC) after week 27.

Tabel 1. The Result Planned Value (PV), Earned Value (EV), and Actual Cost (AC)

Week	PV (IDR)	EV (IDR)	AC (IDR)
1	77.866.153,18	33.810.303,35	1.394.500.000,00
2	204.910.929,42	114.750.120,48	1.707.100.000,00
3	330.931.151,01	196.714.492,24	1.813.220.000,00
4	420.067.405,31	319.661.049,90	1.908.276.000,00
5	573.750.602,38	484.614.348,08	1.994.322.000,00
6	727.433.799,44	649.567.646,26	2.084.432.000,00
7	980.498.797,27	813.496.389,80	2.172.342.000,00
8	1.433.351.951,29	1.153.648.532,63	2.252.804.000,00
9	1.694.613.386,30	1.466.137.700,00	2.345.686.000,00

10	1.973.292.250,31	1.814.486.280,01	2.436.101.000,00
11	2.291.928.745,56	2.162.834.860,03	2.520.446.000,00
12	2.524.502.650,45	2.415.899.857,86	2.615.696.000,00
13	2.614.663.459,40	2.557.288.399,16	2.707.566.000,00
14	2.858.507.465,41	2.842.114.591,06	2.794.447.000,00
15	3.117.719.791,13	3.135.137.220,13	2.889.216.000,00
16	3.485.534.909,43	3.508.075.111,67	2.972.510.000,00
17	4.143.298.992,87	4.173.011.077,64	3.057.171.000,00
18	4.494.721.236,83	4.531.605.204,12	3.146.023.000,00
19	4.947.574.390,85	4.856.389.027,25	3.245.683.000,00
20	5.217.032.263,03	4.946.549.836,20	3.335.798.000,00
21	5.338.954.266,04	5.036.710.645,14	3.424.832.000,00
22	5.362.519.022,92	5.121.748.680,85	3.524.068.000,00
23	5.380.961.006,57	5.139.166.109,85	3.618.976.000,00
24	5.400.427.544,86	5.155.558.984,21	3.711.852.000,00
25	5.459.851.714,40	5.172.976.413,21	3.800.812.000,00
26	5.499.809.345,63	5.189.369.287,56	3.893.487.000,00
27	5.732.383.250,52	5.290.800.197,62	3.976.187.000,00

Source: Data Processing by Researchers, 2024

Based on Table 1 of the GX Office & Co Working Bali construction project up to the 27th week, there are significant variations between PV, EV, and AC. In the first week, PV was recorded at 77,866,153.18 IDR, EV at 33,810,303.35 IDR, and AC at 1,394,500,000.00 IDR. The lower EV than PV indicates that less work was completed than planned, indicating a slow start to the project implementation. Over time, the difference between PV and EV became more pronounced. For example, in the 10th week, PV reached 1,973,292,250.31 IDR, EV was 1,814,486,280.01 IDR, and AC was 2,436,101,000.00 IDR. This indicates that although there was an increase in the value of work completed, the costs incurred began to exceed the planned budget. In the 15th week, PV was recorded at 3,117,719,791.13 IDR, EV at 3,135,137,220.13 IDR, and AC at 2,889,216,000.00 IDR. In this week, EV was slightly higher than PV, indicating an improvement in work completion that even exceeded the initial plan, although costs remained controlled. However, in the 27th week, the PV reached 5,732,383,250.52 IDR, while the EV was only 5,290,800,197.62 IDR, and the AC was 3,976,187,000.00 IDR. The significant difference between PV and EV indicates that the project is experiencing delays, with work completed not aligning with the planned schedule. Nevertheless, the actual costs incurred are lower than budgeted.

Tabel 2. The Result Cost Performance Index (CPI) and Schedule Performance Index (SPI)

Week	SPI	CPI	Week	SPI	CPI
1	0,434	0,024	15	1,006	1,085
2	0,560	0,067	16	1,006	1,180
3	0,594	0,108	17	1,007	1,365
4	0,761	0,168	18	1,008	1,440
5	0,845	0,243	19	0,982	1,496
6	0,893	0,312	20	0,948	1,483
7	0,830	0,374	21	0,943	1,471
8	0,805	0,512	22	0,955	1,453
9	0,865	0,625	23	0,955	1,420
10	0,920	0,745	24	0,955	1,389
11	0,944	0,858	25	0,947	1,361
12	0,957	0,924	26	0,944	1,333
13	0,978	0,944	27	0,923	1,331
14	0,994	1,017			

Source: Data Processing by Researchers, 2024

The results of the Schedule Performance Index (SPI) and Cost Performance Index (CPI) calculations for the GX Office & Co Working Bali construction project up to the 27th week indicate fluctuations in schedule and cost efficiency. In the first week, the SPI value was 0.434 and the CPI value was 0.024, suggesting that the project was progressing much slower than planned and that costs were significantly higher than budgeted. This indicates an inefficient start both in terms of time and cost. As the project progressed, the SPI and CPI values began to show improvement. By the 10th week, the SPI reached 0.920 and the CPI was 0.745. Although the project was still behind schedule, cost efficiency started to improve, indicating efforts towards improvement. More significant improvement was observed by the 15th week, where the SPI reached 1.006 and the CPI was 1.085. An SPI close to 1 indicates that the project was on schedule, while a CPI greater than 1 indicates better cost efficiency, with actual expenditures lower than the budget. By the 27th week, the SPI was 0.923 and the CPI was 1.331.

An SPI less than 1 indicates that the project was still experiencing delays, despite improvements from previous weeks. However, a CPI greater than 1 shows that the project was managed very efficiently in terms of cost, with actual expenditures lower than the planned budget. This indicates that while the project was delayed, the costs incurred were still below the planned budget.The analysis of Estimated Temporary Schedule (ETS), Estimated All Schedule (EAS), Estimate Temporary Cost (ETC), and Estimate All Completion (EAC) is crucial in construction project management as it provides accurate projections of the time and costs required to complete the project. This analysis is used to control schedules and costs, ensuring that the project can be completed within the set targets, thereby reducing the risk of delays and cost overruns.

Tabel 2. The results of the Estimated Temporary Schedule (ETS), Estimated All Schedule (EAS), Estimate Temporary Cost (ETC), and Estimate All Completion (EAC

Indicator		Value
ETS	=	Remaining Time / SPI
	=	(294 - 189) / 0,922967
	=	113,764 = 114 days
EAS	=	Current Time + ETS
	=	189 + 114
	=	303 days
ETC	=	(Total Project Cost - EV)/CPI
	=	(10.245.546.471,00 IDR – 5.290.800.197,62 IDR) / 1,330622
	=	4.954.746.273,38 IDR / 1,330622
	=	3.723.631.710,12 IDR
EAC	=	AC + ETC
	=	3.976.187.000,00 IDR + 3.723.631.710,12 IDR
	=	7.699.818.710,12 IDR

Source: Data Processing by Researchers, 2024

Based on Table 3, which presents the calculations for Estimated Temporary Schedule (ETS), Estimated All Schedule (EAS), Estimate Temporary Cost (ETC), and Estimate All Completion (EAC) for the GX Office & Co Working Bali construction project, the projected time and costs required to complete the project can be observed. According to the calculations, the ETS indicates that an additional 114 days are needed to complete the project. The EAS calculation results in a total project completion time of 303 days. This indicates that the project will require more time than initially planned. There is a significant deviation compared to the initial schedule, which set the project completion time at week 42 (294 days). With an EAS of 303 days, an additional 9 days are beyond the planned schedule. This delay suggests that the project has encountered obstacles, causing the postponement of its completion.The calculation indicates that the Estimated To Complete (ETC) is 3,723,631,710.12 IDR, which reflects the additional costs required to complete the project based on current cost performance.

The Estimated At Completion (EAC) is 7,699,818,710.12 IDR, representing the total costs expected to complete the project. This includes the costs already incurred (3,976,187,000.00 IDR) and the additional required costs (ETC). Comparing this with the initial planned project cost of 10,245,546,471.00 IDR reveals

that the project is projected to be completed at a lower cost than the set budget. The estimated total completion cost (EAC) of 7,699,818,710.12 IDR indicates that the project can save approximately 2,545,727,760.88 IDR from the initial budget.The cost savings can be attributed to efficient resource management and strict cost control. However, it is essential to maintain a focus on scheduling aspects to ensure that delays do not persist and the project can be completed within the planned timeframe. Project managers need to consider strategic measures such as improving process efficiency, reprioritizing tasks, and optimizing labor utilization to address delays and fully leverage the cost savings achieved.

IV. CONCLUSION

Based on the EVM analysis, the project experienced a significant delay of -4.31% by the 27th week, indicating a deviation between planned and completed work. Nevertheless, the project's costs were managed efficiently, as evidenced by a Cost Performance Index (CPI) consistently above 1, with a final value of 1.331 in the 27th week. The analysis of the Estimated Temporary Schedule (ETS) and Estimated All Schedule (EAS) revealed that the project requires an additional 114 days, extending the total completion time to 303 days from the initially planned 294 days, resulting in a delay of 9 days from the original schedule.

In terms of costs, the analysis of the Estimated Temporary Cost (ETC) and Estimated All Completion (EAC) indicated that the total project completion cost is estimated at 7,699,818,710.12 IDR, which is lower than the initial budget of 10,245,546,471.00 IDR, providing a savings of approximately 2,545,727,760.88 IDR. These results demonstrate effective cost management despite the project's challenges of delay. This research makes a significant contribution to the project management literature by demonstrating that the use of EVM can aid in identifying deviations and form the basis for strategic policy decisions necessary for project completion on time according to plan.

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