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EVALUATION OF TIME AND COST PERFORMANCE ON THE GX OFFICE & CO WORKING BALI PROJECT USING THE EARNED VALUE METHOD

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Abstract: In rapid construction developments, delays still occur frequently and have not been resolved, as experienced by the GX Office & Co Working Bali project. The project will be completed in 42 weeks, but in the 27th week, there is an indication of a delay of -4.31% from the initial plan. Earned Value Method (EVM) is a time and cost performance assessment method that can be used to develop strategies to minimize delays. This research aims to evaluate the time and cost performance of the GX Office & Co Working Bali project using the EVM method. A quantitative approach is used to collect and analyze project schedules, actual costs, and progress reports. EVM key indicators such as Planned Value (PV), Earned Value (EV), and Actual Cost (AC) are analyzed to determine Schedule Variance (SV), Cost Variance (CV), Schedule Performance Index (SPI), and Cost Performance Index (CPI). The results showed that the project experienced delays, especially from week 1 to week 14 and week 19 to week 27, with SPI values mostly below 1. However, the project showed increased efficiency in cost management with values CPI above one after week 14 to week 27, indicating that the actual costs incurred are lower than the value of the work completed. These findings highlight the need for corrective actions and more effective management strategies to address delays efficiently in terms of costs.
Keywords: Earned Value Method, Project Delay, Schedule Performance Index, Cost Performance Index,

INTRODUCTION

The construction industry is currently growing rapidly along with the increasing demand for modern infrastructure and high-tech buildings. Major projects such as the construction of toll roads, bridges, skyscrapers, and other public facilities continue to emerge in various countries [1]. New technologies like Building Information Modeling (BIM), the Internet of Things (IoT), and the use of drones are increasingly being applied to enhance efficiency and accuracy in the planning and execution of construction projects. Additionally, the focus on sustainability and green building is driving innovation in selecting environmentally friendly materials and construction methods [2].

Amid the rapid development of the construction industry, issues such as project delays remain unavoidable. These delays are often caused by various complex factors, including material problems, sudden design changes, and unpredictable weather conditions [3]. Additionally, coordination among the various parties involved in a project, such as contractors, subcontractors, and suppliers, often poses its challenges. A lack of effective communication and inadequate planning can lead to significant delays, resulting in increased costs and postponed project completion [4].

Project delays in construction significantly impact the overall project schedule and budget [5]. To address these challenges, contractors must develop more effective project management strategies. Such delays are currently being experienced by the GX Office & Co Working Bali project. This project involves the construction of an office building and co-working space with a contract value of Rp 10,245,546,471 and a timeline of 670 calendar days. During its execution, the project has encountered various obstacles, particularly related to time and cost performance not aligning with the initial plans. Based on the S-Curve, the delay in constructing the GX Office & Co Working project for structural work up to February 2024 is estimated to be -4.31% from the original plan. This delay underscores the importance of promptly addressing project issues to control delays and ensure the project can be completed within the budget and timeline.

Addressing project delays in construction, such as those experienced by the GX Office & Co Working Bali project, requires an effective management approach. One method that can be used to manage and control delays is the Earned Value Method (EVM). EVM is a project management technique that combines performance measurements in terms of cost and time [6]. By using EVM, project managers can more accurately track project progress, identify deviations from the initial plan, and take timely corrective actions to bring the project back on track [7].

EVM allows project managers to evaluate overall project performance by comparing earned value against planned value and actual cost. With this data, project managers can calculate performance indices such as the Cost Performance Index (CPI) and Schedule Performance Index (SPI), which provide insights into the cost and schedule efficiency of the project [8]. Implementing EVM can help identify sources of delays and cost overruns and provide a basis for re-planning and more effective resource allocation. The use of EVM can be a powerful tool to ensure that projects remain on target for cost and time, thereby reducing the risk of delays and ensuring project success [9].

Previous research has shown various approaches in applying the Earned Value Method (EVM) to measure the performance of construction projects. Priyo & Zhafira used this method on the construction of the Emergency Room building at RSUD Sunan Kalijaga Demak and found that the project was completed 5 weeks ahead of schedule and under budget [10]. Another study applied EVM to the construction of public housing in West Java and found that several activities were not on schedule, although the budget remained on track [11]. Additionally, the construction of a health center in Probolinggo Regency yielded similar results, with no delays or cost overruns, demonstrating the efficiency of EVM in controlling costs and time [12].

Other research also highlights the use of EVM in various contexts of construction projects. The application of EVM on a construction project revealed performance values within acceptable limits, despite some delays in structural work [13]. Similarly, the use of EVM in the construction of a classroom building at MAN Kab. Karawang found that the project could be completed according to the planned schedule [14]. Additionally, the application of EVM in the construction of shop houses identified delays but with costs remaining under control [15]. Research by Trafolta & Fernando also showed that EVM can identify cost and time variability in educational building projects, aiding in further budget and schedule adjustments [16].

Although various studies have demonstrated the effectiveness of EVM in controlling costs and time in construction projects, there remains a gap that needs to be addressed. Many previous studies have focused on projects of different scales and locations, but specific studies on the application of EVM in the construction of modern workspaces like GX Office & Co Working Bali are still limited. This research aims to evaluate the time and cost performance of the GX Office & Co Working Bali project using the EVM method. This will yield values for the Schedule Performance Index (SPI) and Cost Performance Index (CPI), which can illustrate the project's cost and time performance. This research is expected to make a significant contribution to the development of more effective project management strategies, particularly in the application of EVM to similar projects. Additionally, the findings of this study are hoped to serve as a reference for practitioners and academics in optimizing construction project performance in the future.

RESEARCH METHOD

This research employs a quantitative approach to evaluate the time and cost performance of the GX Office & Co Working Bali project using the Earned Value Method (EVM). The research design involves the collection and analysis of project data, including project schedules, actual costs, and progress reports. The collected data will be analyzed using EVM indicators such as Planned Value (PV), Earned Value (EV), and Actual Cost (AC) to determine Cost Variance (CV) and Schedule Variance (SV). Additionally, the Cost Performance Index (CPI) and Schedule Performance Index (SPI) will be calculated to measure the efficiency and effectiveness of project implementation. This method is chosen for its ability to provide a comprehensive overview of project performance and predict the cost and time required for completion based on existing data.

Data

The data required for this research includes the project schedule (Time Schedule), the Budget Plan (RAB), weekly project progress reports, and the actual costs incurred during the project. This data is collected from project documents provided by the contractor and supervising consultant. The project schedule and Budget Plan will be used to determine the Planned Value (PV), which is the budgeted cost for scheduled work. The weekly project progress reports will be used to determine the Earned Value (EV), which is the budgeted cost for work that has been completed. The actual costs will be used to determine the Actual Cost (AC), which is the cost incurred for work that has been completed. This data will be analyzed to identify efficiencies and inefficiencies in project implementation.

Analisys

The analysis process in this research uses the Earned Value Method (EVM) involving several steps. First, calculate the Planned Value (PV) by multiplying the percentage of planned progress from the time schedule by the project execution cost listed in the Budget Plan (RAB). Second, calculate the Earned Value (EV) by multiplying the actual progress percentage by the total project budget. Third, the Actual Cost (AC) is based on the cost incurred for work that has been completed [17]. Next, calculate the Cost Variance (CV) using the formula CV = EV - AC and the Schedule Variance (SV) using the formula SV = EV - PV. The CV is positive if the expenditure is less than the budget and negative if the expenditure is greater than the budget. The SV is positive if the work is ahead of the planned schedule and negative if the work is behind the planned schedule [18]. The Cost Performance Index (CPI) is calculated using the formula CPI = EV / AC, and the Schedule Performance Index (SPI) is calculated using the formula SPI = EV / PV. If the SPI > 1, the project is ahead of schedule, and if the SPI < 1, the project is behind schedule. If the CPI > 1, the project is under budget, and if the CPI < 1, the project is over budget. This analysis will provide critical information for better decision-making and allow corrective actions to be taken if necessary [19].

RESULT AND DISCUSSION

The GX Office & Co Working Bali construction project is built on a 503.15 m² land area and consists of 6 floors. The project began in August 2023 and was planned to be completed by week 42. However, based on the evaluation until week 27, the project has experienced significant delays. The current project progress indicates a delay of -4.31% from the original plan, indicating that the project implementation is not proceeding according to the established schedule. This delay indicates the need for an in-depth analysis to identify the root causes and find solutions to overcome the delay. Therefore, in this Earned Value Method (EVM) analysis, the evaluation will focus on the project performance until week 27 to provide a clearer picture of the efficiency and effectiveness of the project implementation up to this point.

Planned Value (PV), Earned Value (EV), and Actual Cost (AC)

To understand the time and cost performance of the GX Office & Co Working Bali project, an analysis using the Earned Value Method (EVM) was conducted. This analysis includes PV, EV, and AC. PV represents the budget allocated for planned work. EV measures the value of completed work, while AC indicates the actual costs incurred. The results of the PV, EV, and AC analysis are shown in Table 1.

Table 1. Results of PV, EV, and AC Analysis

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

The analysis results indicate that from week 1 to week 14, the project experienced delays. This is evident from the Earned Value (EV) being smaller than the Planned Value (PV) for each week during this period. For example, in the first week, the PV was IDR 77,866,153.18 while the EV was only IDR 33,810,303.35. This trend continued until week 14, where the PV reached IDR 2,858,507,465.41 while the EV was only IDR 2,842,114,591.06. During this period, the Actual Cost (AC) remained consistently above the EV, indicating cost inefficiency, where the expenses incurred were higher than the value of work completed. This reflects resource wastage and ineffective cost management.

From week 15 to week 18, the project showed performance improvement, indicated by the EV values approaching or even exceeding the PV values. For example, in week 16, the EV reached IDR 3,508,075,111.67, slightly higher than the PV of IDR 3,485,534,909.43. This indicates that the project has overcome previous delays and is moving towards achieving the planned targets. During this period, the AC values were below the EV values, indicating that the costs incurred for completed work were more efficient. For instance, in week 18, the AC was IDR 3,146,023,000.00, below the EV of IDR 4,531,605,204.12, showing cost savings and increased efficiency in project implementation.

However, from week 19 to week 27, there was a recurrence of delays. This can be seen from the EV values being smaller than the PV values for each week during this period. For example, in week 19, the PV was IDR 4,947,574,390.85 while the EV was only IDR 4,856,389,027.25, and in week 27, the PV reached IDR 5,732,383,250.52 while the EV was only IDR 5,290,800,197.62. During this period, the AC values were below the EV values, indicating that despite the project experiencing delays, the costs incurred for the work done were more efficient. For example, in week 27, the AC was IDR 3,976,187,000.00, lower than the EV of IDR 5,290,800,197.62. This indicates that the project was able to maintain cost efficiency even though the work completion schedule was still behind the plan.

Schedule Variance (SV) and Cost Variance (CV)

To gain a deeper understanding of the performance of the GX Office & Co Working Bali project, further analysis was conducted on SV and CV. This analysis aimed to identify deviations between planned work and work completed and compare budgeted costs with actual costs incurred. The results of the SV and CV analysis are shown in Table 2.

Table 2. Result of SV and CV

Week	SV	CV	Week	SV	CV
1	- 44.055.849,83	- 1.360.689.696,65	15	17.417.429,00	245.921.220,13
2	- 90.160.808,94	- 1.592.349.879,52	16	22.540.202,24	535.565.111,67
3	- 134.216.658,77	- 1.616.505.507,76	17	29.712.084,77	1.115.840.077,64
4	- 100.406.355,42	- 1.588.614.950,10	18	36.883.967,30	1.385.582.204,12
5	- 89.136.254,30	- 1.509.707.651,92	19	- 91.185.363,59	1.610.706.027,25
6	- 77.866.153,18	- 1.434.864.353,74	20	- 270.482.426,83	1.610.751.836,20
7	- 167.002.407,48	- 1.358.845.610,20	21	- 302.243.620,89	1.611.878.645,14
8	- 279.703.418,66	- 1.099.155.467,37	22	- 240.770.342,07	1.597.680.680,85
9	- 228.475.686,30	- 879.548.300,00	23	- 241.794.896,72	1.520.190.109,85
10	- 158.805.970,30	- 621.614.719,99	24	- 244.868.560,66	1.443.706.984,21
11	- 129.093.885,53	- 357.611.139,97	25	- 286.875.301,19	1.372.164.413,21
12	- 108.602.792,59	- 199.796.142,14	26	- 310.440.058,07	1.295.882.287,56
13	- 57.375.060,24	- 150.277.600,84	27	- 441.583.052,90	1.314.613.197,62
14	- 16.392.874,35	47.667.591,06			

Source: Data Processing by Researchers, 2024

The analysis results indicate that during the period from week 1 to week 14, the project experienced significant delays. The SV values during this period were consistently negative, indicating that the completed work was always less than planned. For example, in the first week, the SV was -44,055,849.83 IDR and reached -16,392,874.35 IDR in week 14. Additionally, the CV values during this period were mostly negative, indicating that the actual costs incurred were higher than the value of the work completed, except for in week 14 where the CV was positive at 47,667,591.06 IDR, indicating some cost efficiency in that week.

From week 15 to week 18, the project showed significant improvement. The SV values began to show a positive trend or approach zero, indicating that the completed work was approaching the planned schedule. For example, in week 15, the SV was 17,417,429.00 IDR and increased to 36,883,967.30 IDR in week 18. During this period, the CV values also showed significant improvement, all of which were positive, indicating that the costs incurred were lower than the value of the work completed. In weeks 17 and 18, the CV values

were 1,115,840,077.64 IDR and 1,385,582,204.12 IDR, respectively, indicating a significant cost efficiency during this period.

However, from week 19 to week 27, the project experienced delays again. The SV values during this period returned to negative, indicating that the completed work was again less than planned. For example, in week 19, the SV was -91,185,363.59 IDR and worsened to -441,583,052.90 IDR in week 27. Nevertheless, the CV values remained positive during this period, indicating that the costs incurred remained lower than the value of the work completed.

Schedule Performance Index (SPI) and Cost Performance Index (CPI)

To complete the understanding of the performance of the GX Office & Co Working Bali project, further analysis is conducted by calculating the values of SPI and CPI. These indices provide a clearer picture of time and cost efficiency in project implementation. SPI is used to measure the schedule efficiency of the project by comparing EV with PV, while CPI measures cost efficiency by comparing EV with AC. The results of the SPI and CPI analysis are shown in Table 3.

Table 3. Result of SPI and CPI

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 analysis results indicate that from week 1 to week 14, the Schedule Performance Index (SPI) showed values below 1, indicating a delay in the project schedule. In the first week, the SPI was 0.434 and gradually increased to 0.994 by week 14. This increase indicates that the project has improved, allowing it to catch up with the delay. During this period, the Cost Performance Index (CPI) showed a significant improvement from 0.024 in the first week to 1.017 in week 14, indicating that despite the delay, the cost performance also improved, with costs being lower than budgeted in week 14.

From week 15 to week 18, the project showed significant performance improvement in schedule and cost efficiency. The SPI values remained consistently around 1, indicating that the project was progressing according to the planned schedule. The SPI was slightly above 1 during this period, ranging from 1.006 to 1.008. The Cost Performance Index (CPI) also increased significantly during this period, from 1.085 in week 15 to a peak of 1.440 in week 18. This indicates that the project not only progressed according to schedule but was also very efficient in cost utilization, with the value of work completed exceeding the actual costs incurred.

However, from week 19 to week 27, the schedule efficiency decreased again, although cost efficiency remained high. The SPI value decreased from 0.982 in week 19 to 0.923 in week 27, indicating that the project experienced delays again. On the other hand, the CPI remained high throughout this period, from 1.496 in week 19 to 1.331 in week 27. This indicates that there are indications of project delays due to costs not aligning with the established budget. This could also indicate that the project is running quite efficiently in terms of cost.

CONCLUSION

The GX Office & Co Working Bali project has faced various implementation challenges that have affected its time and cost performance. The analysis using the Earned Value Method (EVM) up to week 27 indicates that the project has experienced overall delays, with the Schedule Performance Index (SPI) is mostly below 1, especially in weeks 1 to 14 and from weeks 19 to 27. Although there was a period of improvement from weeks 15 to 18, where the SPI was around or above 1, the project experienced delays again thereafter until week 27. On the other hand, the Cost Performance Index (CPI) shows cost efficiency with values mostly

above 1, especially after week 14 to week 27, indicating that the actual costs incurred were lower than the value of work completed. These research findings provide insights into the application of EVM in construction projects and suggest specific steps to improve project performance. Additionally, the results of this study can serve as a reference for practitioners and academics in developing more effective project management strategies to minimize delays.

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