Performance Assessment of Construction Projects Using Earned Value Method: Bima Grand Mosque Case Study

Rini Pebri Utari, Lintang Satiti Mahabella, Lourina Evanale Orfa

Civil Engineering Department, University of Muhammadiyah Malang, Malang, INDONESIA

E-mail: rinipebriutari@umm.ac.id , lintangsatitimahabella@umm.ac.id , lourinaorfa@umm.ac.id

| Submitted: January 13, 2026 | Revised: May 30, 2026 | Accepted: August 29, 2026 |

| Published: September 16, 2026 |

ABSTRACT

This study evaluates the cost and schedule performance of the Bima Grand Mosque construction project using the Earned Value Management (EVM) method as an comprehensive project control approach. A descriptive quantitative case study was conducted using cumulative project progress data at two critical monitoring points, namely week 55 and week 69. The analysis employed key EVM indicators, including Budgeted Cost of Work Scheduled (BCWS), Budgeted Cost of Work Performed (BCWP), Actual Cost of Work Performed (ACWP), Schedule Variance (SV), Cost Variance (CV), Schedule Performance Index (SPI), and Cost Performance Index (CPI). The results indicate that at week 55 the project was slightly on schedule, with an SPI of 1.001, but experienced cost inefficiency, as reflected by a CPI of 0.990. At week 69, project performance declined, marked by schedule delays and increasing cost overruns, with SPI and CPI values of 0.963 and 0.956, respectively. In addition, the estimated cost at completion increased, accompanied by a slight extension of the projected completion time. The novelty of this study lies in the milestone-based application of EVM to capture dynamic changes in project performance, providing early warning information to support effective cost and schedule control. The findings confirm that EVM is a reliable approach for evaluating construction project performance and facilitating informed managerial decisions.

Keywords: construction management; earned value management; project performance; cost control; schedule control.

INTRODUCTION

Construction projects consist of temporary activities constrained by specific time, cost, and resource limitations to deliver outputs that meet contractual quality requirements [1]. As the complexity of modern construction projects increases, project management challenges are no longer limited to technical or structural aspects but also involve the integration of cost and schedule control to ensure optimal project performance [2], [3]. In practice, limitations related to resources, equipment, construction methods, materials, and budgets frequently lead to deviations from initial project plans. Inadequate control of these factors may reduce project performance, as reflected in cost overruns and schedule delays [4], [5]. Accordingly, effective cost and time planning and control play a vital role in construction project management, where project success is measured not only by product quality but also by conformity between planned and actual cost and schedule performance [6].

One widely applied approach for project performance control is Earned Value Management (EVM), which integrates physical work progress, actual costs, and planned budgets into a single performance evaluation framework [7]. EVM enables the assessment of cost and time variances and the calculation of performance indicators such as the CPI and SPI, which function as early warning indicators of potential project deviations [8], [9]. Early studies have demonstrated that the implementation of EVM improves the accuracy of project control and supports more objective managerial decision-making [10]. Other researchers have emphasized that integrating EVM into construction project control provides a more comprehensive overview of cost and schedule performance compared to conventional monitoring methods [11]. Furthermore, EVM has been shown to support sustainable project control when integrated with life-cycle cost approaches [12].

This study adopts a case study of the Bima Grand Mosque construction project, a large-scale public building characterized by high work complexity. The project experienced significant

pISSN 2302-4240
eISSN 2655-2086
Volume 15, Issue 3, September 2026, pp.01014-01021
DOI: http://dx.doi.org/10.32832/astonjadro.v15i3.22646 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

implementation disruptions during its early stages due to the COVID-19 pandemic. In the post-pandemic period, evaluating cost and schedule performance becomes crucial for evaluating the effectiveness of overall project control and extracting lessons for future similar projects [13]. Accordingly, This study adopts a quantitative approach grounded in the EVM method, utilizing project cost, schedule, and physical progress data to evaluate performance indicators such as SV, CV, SPI, and CPI, as well as to estimate final project cost and completion time [7], [9].

The aim of this study is to to examine the cost and schedule performance of the Bima Grand Mosque construction project using the EVM method and to examine its capability in assessing project performance under post-pandemic conditions. This study offers novelty through the application of a milestone-based EVM analysis to a public building project in Indonesia, enabling the identification of performance dynamics at different implementation stages. This approach is intended to contribute empirical evidence related to the effectiveness of EVM as a proactive monitoring and a decision-support framework to assist cost and schedule control in construction project management while also enriching empirical references related to post-pandemic construction project performance evaluation.

RESEARCH METHODS

Materials

This study uses primary and secondary data obtained from the Bima Grand Mosque Construction Project located in Bima Regency, West Nusa Tenggara Province. Primary data were acquired via direct field observations and documentation of project implementation, while secondary data were obtained from the project management team and the supervising consultant, including the Cost Budget Plan, project time schedule, and daily and weekly progress reports. The object of this research is a large-scale public building construction project with a land area of approximately ±40,000 m² and a building area of approximately ±10,000 m², consisting of three floors, with a contract value of about IDR 78.02 billion, and implemented during the 2020–2021 fiscal years. All data used in this study have undergone a verification process to ensure completeness, consistency, and reliability prior to further analysis. The project site plan of the Bima Grand Mosque and the planned elevation drawing of the Bima Grand Mosque building can be seen in **Figures 1 and 2.**

. **Figure 1.** Project Site Plan of the Bima Grand Mosque

Figure 2. Planned Elevation Drawing of the Bima Grand Mosque Building

Methods

This study employs a descriptive quantitative method with a case study approach, with the objective of describing and evaluating cost and schedule performance of a construction project under actual field conditions. The research stages, as illustrated in **Figure 3**, begin with preliminary observations of project implementation to identify issues related to cost and schedule performance, followed by a literature review to establish the theoretical basis of construction project management and EVM method. Based on the literature review, the indicators and analysis variables used in this study are determined. Data collection was carried out systematically following the structured research stages shown in **Figure 3**, encompassing primary data obtained from field observations and secondary data derived from project documents such as cost plans, progress reports, and schedules. The collected data were then processed and analyzed using the Earned Value Management method.

The novelty of this study lies in the application of EVM through a milestone-based evaluation framework, where project performance is assessed at two critical monitoring points (week 55 and week 69), enabling the identification of dynamic shifts in cost and schedule performance over time. This approach allows EVM not only to function as a performance measurement tool but also as an a proactive monitoring system for detecting prospective deviations in project execution. The main indicators used in the analysis contain the BCWS, BCWP, and ACWP, which collectively represent the relationship between planned progress, actual physical accomplishment, and incurred project costs within an integrated performance evaluation framework.

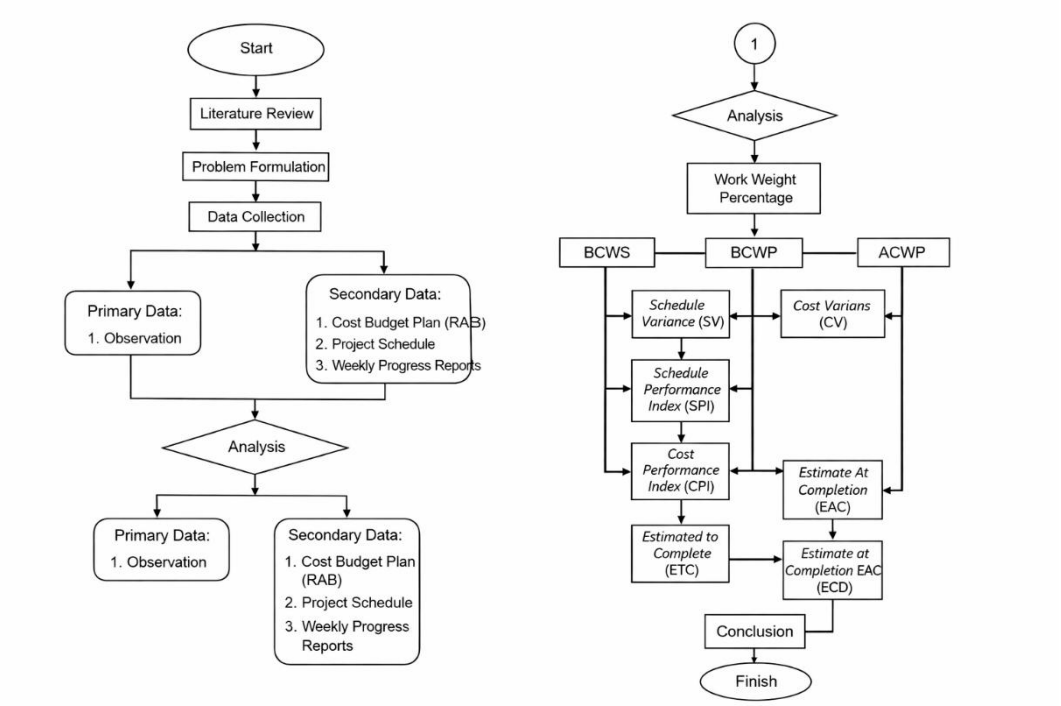

Figure 3. Flow chart

Data Analysis

Data were analyzed using the EVM method to quantitatively evaluate project cost and schedule performance. Based on the values of BCWS, BCWP, and ACWP, SV and CV were calculated to examine differences between planned and actual project implementation. Furthermore, the SPI and CPI were measured to evaluate project performance levels efficiency in terms of time and cost. To obtain a summary of the project's final condition, the analysis was extended by predicting the cost and time required to entire the project using the relevant indicators ETC, EAC and ECD. All calculation and data tabulation processes were performed using Microsoft Excel software to facilitate data processing and presentation of the analysis results. The results were then interpreted

pISSN 2302-4240
eISSN 2655-2086
Volume 15, Issue 3, September 2026, pp.01014-01021
DOI: http://dx.doi.org/10.32832/astonjadro.v15i3.22646 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

descriptively to to offer an overall overview of project performance and to serve as the basis for drawing the study's conclusions.

RESULT AND DISCUSSION

The Earned Value Management (EVM) method is commonly applied in construction projects because it is able to integrate cost control, schedule control, and physical progress monitoring simultaneously, as well as provide early warnings of potential deviations in project performance [14], [15]. Therefore, the results of this study are discussed with reference to the main EVM indicators, namely the Budgeted Cost of Work Scheduled (BCWS), Budgeted Cost of Work Performed (BCWP), and Actual Cost of Work Performed (ACWP), which are subsequently used to to evaluate cost and schedule variances, performance metrics, and projections of project cost and completion time.

Overview of the Study Object and Project Cost Recapitulation

The object of this study is the Construction Project of the Bima Regency Grand Mosque, which was implemented during the 2020–2021 fiscal years with a contract value of IDR 78.02 billion. The project cost recapitulation indicates that the ground-floor building works constitute the largest cost component, thereby having a dominant influence on the cumulative cost and time performance of the project. This condition is consistent with the findings of several prior studies, which state that work packages with the highest cost weight have the greatest potential to become the main sources of cost overruns and schedule delays if not optimally controlled [16], [17]. Detailed project cost information is presented in **Table 1**.

Table 1. Recapitulation of Project Work Items and Costs

Description of Work Items	Cost
Ground Floor Building	Rp 41.758.260.615,88
First Floor Building	Rp 15.869.884.187,24
Second Floor Building	Rp 2.631.429.359,06
Tower Building	Rp 6.580.796.609,43
Ground Tank Building	Rp 83.465.329,11
Generator House Building	Rp 193.619.287,99
Mechanical and Electrical (M&E) Costs	Rp 2.585.226.106,96
Site Development Works	Rp 1.224.593.428,22
Real Cost	**Rp 70.927.274.923,89**
Tax / VAT 10%	Rp 7.092.727.492,39
Total Construction Cost	Rp 78.020.002.416,28
Rounding	**Rp 78.020.000.000,00**

Work Weighting as the Basis for Earned Value Analysis

The determination of work weights is based on the proportion of the cost of each item to the total construction cost. This weighting serves as the basis for calculating earned value and for developing the project's planned curve. The results show that the ground floor building works have the most dominant weight, at approximately 58.87%, followed by the first-floor building works at 22.37% and the tower building works at 9.28% (see **Table 2**). The dominance of these major work components indicates that even small deviations in progress or cost for these items can have a significant impact on overall project performance. This finding is consistent with studies stating that imbalances in the control of major work packages will directly affect EVM indicators such as the CPI and SPI [18].

The weight of each work item is calculated from the proportion of its cost relative to the total building cost, as follows:

$$PBP = \frac{Volume \times Unit\ Price}{Total\ Building\ Cost}\ x\ 100\%$$

Table 2 Recapitulation of Work Descriptions and Prices

Description of Work Items	Cost	Weight
Ground Floor Building	Rp 41.758.260.615,88	58.87%
First Floor Building	Rp 15.869.884.187,24	22.37%
Second Floor Building	Rp 2.631.429.359,06	3.71%
Tower Building	Rp 6.580.796.609,43	9.28%
Ground Tank Building	Rp 83.465.329,11	0.12%
Generator House Building	Rp 193.619.287,99	0.27%
Mechanical and Electrical (M&E) Costs	Rp 2.585.226.106,96	3.64%
Site Development Works	Rp 1.224.593.428,22	1.73%
Real Cost	**Rp 70.927.274.923,89**	**100%**

Cost and Schedule Performance Analysis Based on Earned Value

The results of the EVM analysis are focused on two main review points, namely week 55 and week 69. In week 55, the SPI value of 1.001 indicates that the project was almost on schedule or slightly ahead of the planned schedule. However, the CPI value of 0.990 suggests that the realized project costs exceeded the earned value corresponding to the work performed. This condition indicates cost inefficiency, even though schedule performance was still relatively well maintained. A similar pattern has also been identified in other studies, which state that a project may be on schedule but still experience cost overruns due to weak control of operational costs [14].

In week 69, the project performance shows a fairly significant decline. The SPI value decreased to 0.963 with a negative Schedule Variance (SV), indicating a delay in project execution. In addition, the CPI value of 0.956 with a negative Cost Variance (CV) indicates that cost overruns were increasing. These findings are consistent with studies stating that a decrease in SPI accompanied by a CPI below one is a strong indication of declining project performance that requires immediate corrective action[19][20] . A summary of the EVM analysis results at both review points is presented in **Table 3**, while the formulas used are presented as follows. In addition, the Earned Value Chart is shown in **Figure 4**.

Table 3 Results of Earned Value Analysis (Review Points at Week 55 and Week 69)

Indicator	Week 55	Week 69
BCWS	Rp 47.312.297.189,82	Rp 61.572.438.140,61
BCWP	Rp 47.358.633.287,86	Rp 59.304.493.983,08
ACWP	Rp 47.832.219.620,74	Rp 62.032.500.706,30
SV = BCWP − BCWS (Rp)	Rp 46.336.098,04	-Rp 2.267.944.157,53
CV = BCWP − ACWP	-Rp 473.586.332,88	-Rp 2.728.006.723,22
SPI = BCWP/BCWS	1.001	0.963
CPI = BCWP/ACWP	0.990	0.956
ETC= (BCWS-BCWP)/CPI	-Rp 46.799.459,02	Rp 2.372.269.588,77
EAC = ACWP + ETC	Rp 47.785.420.161,72	Rp 64.404.770.295,07
ECD (day)	546	548

- Budget Cost Of Work Schedule (BCWS) = Planned Work Percentage x Budget
- Budget Cost Of Work Performance (BCWP) = Actual Work Percentage × Budget

pISSN 2302-4240
eISSN 2655-2086
Volume 15, Issue 3, September 2026, pp.01014-01021
DOI: http://dx.doi.org/10.32832/astonjadro.v15i3.22646 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

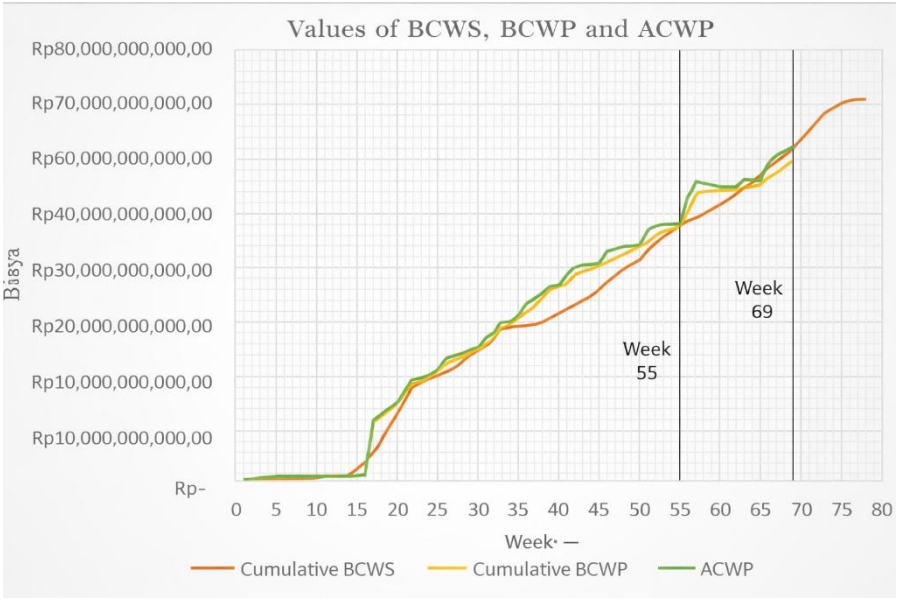

Figure 4 Earned Value Chart

Projection of Project Cost and Completion Time

One of the main advantages of the Earned Value Management (EVM) is its ability to project project cost and completion time. In week 55, the Estimated to Complete (ETC) value was negative, indicating that the additional cost required for the remaining work was relatively small based on the performance trend at that time. However, the Cost Performance Index (CPI), which remained below one, indicated that cost efficiency had not yet reached an optimal level.

In week 69, the ETC value turned positive at IDR 2.37 billion, and the Estimate at Completion (EAC) increased to IDR 64.40 billion. This indicates that, if no improvements in control are implemented, the project has the potential to experience cost overruns by the end of execution. This finding is consistent with the study by [18] which emphasizes that EAC is a critical indicator for strategic decision-making by project managers.

From the schedule perspective, the Estimated Completion Date (ECD) value in week 55 indicates that the estimated project completion was in accordance with the original plan. However, in week 69, the ECD increased to 548 days, indicating a potential delay of approximately two days. This condition shows that small changes in the SPI value can have a significant impact on the projected project completion time.

Implications of the Analysis Results for Project Control

The analysis results indicate that the application of the Earned Value Management method is able to provide a comprehensive overview of project performance conditions, both with respect to cost and schedule. The combination of declining SPI and CPI values in week 69 indicates the need for improved project control, particularly for work items with dominant weights. Overall, the findings of this study reinforce previous research stating that EVM is an efficient tool for examining project performance and supporting data-driven decision making in construction management[16], [17].

CONCLUSION

This study evaluated the cost and schedule performance of the Bima Grand Mosque construction project using the Earned Value Management (EVM) method. The results show that at week 55 the project was slightly ahead of schedule, with an SPI value of 1.001, but experienced cost inefficiency, indicated by a CPI of 0.990. At week 69, project performance declined, as reflected by schedule delays and increasing cost overruns, with SPI and CPI values decreasing to 0.963 and 0.956, respectively. Cost projections indicate a significant increase in the Estimate at Completion (EAC),

accompanied by a slight extension of the estimated project completion time. These findings confirm that early schedule acceleration does not necessarily guarantee cost efficiency or timely project completion. Overall, the Earned Value Management method proved effective in providing early warning information on project performance dynamics and supporting data-driven managerial decision-making for cost and schedule control in construction projects.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the project management team and the supervising consultant of the Bima Grand Mosque Construction Project for their support and for providing essential data. The authors also express their sincere appreciation to Universitas Muhammadiyah Malang for institutional support during the implementation of this paper. Acknowledgment is further sincerely extended to all parties whose contributions supported the completion of this study.

REFERENCES

[1] S. Wahyudiono and R. Utari, "Earned Value Management (EVM) Analysis for Maintenance Projects: Insights from GKB 4 at Universitas Muhammadiyah Malang," *Bentang J. Teor. dan Terap. Bid. Rekayasa Sipil*, vol. 13, pp. 276–286, Jul. 2025, doi: 10.33558/bentang.v13i2.10632.

[2] R. P. Utari and L. S. Mahabella, "Pengendalian Biaya dan Waktu dengan Pendekatan Metode Earned Value Concept Cost and Time Control with the Earned Value Concept (EVM) Method Approach (Case Study : Class 3 Inpatient Building Development Project Cempaka District Hospital Tabanan-Bali)," vol. 17, pp. 9–15.

[3] L. Mayo-alvarez, A. Alvarez-risco, S. Del-aguila-arcentales, M. C. Sekar, and A. Y. Jaime, "A Systematic Review of Earned Value Management Methods for Monitoring and Control of Project Schedule Performance : An AHP Approach," 2022.

[4] R. Widyarso, B. Witjaksana, and J. Purnama, "Analysis Of Time And Cost Performance In Construction Projects Using The Earned Value Management Method," *Asian J. Eng. Soc. Heal.*, vol. 4, no. 4, pp. 770–779, 2025, doi: 10.46799/ajesh.v4i4.590.

[5] M. B. Febriantoro, S. Susanto, and E. Siswanto, "Meminimalisir Keterlambatan Waktu dan Pembengkakan Biaya Proyek Pembangunan Gedung Kecamatan Dongko, Trenggalek dengan Metode Nilai Hasil (Earned Value Management (EVM))," vol. 5, 2022.

[6] S. U. Dewi, P. Studi, T. Sipil, U. Sang, and B. Ruwa, "Analisis manajemen waktu dan biaya pada proyek pembangunan gedung menggunakan konsep metode nilai hasil 1," vol. 04, no. 01, pp. 34–42, 2023.

[7] Q. Fleming and J. Koppelman, *Earned Value Project Management*, vol. 39. 2000.

[8] A. K. Nica and W. Wody, "Enhancing Facility Management through BIM 6D," vol. 164, no. June, pp. 299–306, 2016, doi: 10.1016/j.proeng.2016.11.623.

[9] B. Okanlawon, "The Role of Earned Value Management in Enhancing Pipeline Project Scheduling and Performance Tracking Enhancing Pipeline Project Scheduling and," pp. 0–20, 2025, doi: 10.20944/preprints202509.1208.v1.

[10] D. Przywara and A. Rak, "Monitoring of time and cost variances of schedule using simple Earned Value Management (EVM) indicators," *Appl. Sci.*, vol. 11, no. 4, pp. 1–13, 2021, doi: 10.3390/app11041357.

[11] R. P. Utari, M. N. Hadad, and S. Wahyudiono, "Analisis Percepatan Proyek dengan Metode Time Cost Trade Off (Studi Kasus Pada Gedung Student Center UIN Datokrama Palu) Project Acceleration Analysis with Time Cost Trade Off Method (A Case Study on the Student Centre Building at UIN Datokrama Palu)," vol. 20, no. 1, pp. 7–13, 2022.

[12] R. P. Utari, A. Samad, and A. T. Wahono, "Analisis Biaya Konstruksi Menggunakan Metode Life Cycle Cost pada Gedung Cordova Edupartment Semarang Construction Cost Analysis Using the Life Cycle Cost Method in the Cordova Edupartment Building

pISSN 2302-4240
eISSN 2655-2086
Volume 15, Issue 3, September 2026, pp.01014-01021
DOI: http://dx.doi.org/10.32832/astonjadro.v15i3.22646 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

Semarang," vol. 21, no. 2, pp. 77–83, 2023.

[13] H. Guo, M. Liu, J. Xue, I. Y. Jian, Q. Xu, and Q. Wang, "Post-COVID-19 Recovery : An Integrated Framework of Construction Project Performance Evaluation in China," 2023.

[14] L. Fan, S. M. Nejad, M. Bagherpour, and M. R. Feylizadeh, "Modeling Sustainable Earned Value Management (EVM) Under Grey Uncertain Conditions," pp. 1–29, 2025.

[15] S. Getahun, R. Ketema, T. Belachew, B. Asteray, D. Samson, and K. Ali, "Performance evaluation of construction project by earned value management system in Amhara waterworks construction enterprise," *Discov. Civ. Eng.*, 2025, doi: 10.1007/s44290-025-00193-0.

[16] H. R. Putra and W. Oetomo, "Cost and time analysis using methods earned value," vol. 3, no. 1, pp. 18–33, 2024.

[17] V. V. Engineering, S. A. D. Survey, E. Nejatyan, H. Sarvari, S. A. Hosseini, and H. Javanshir, "Determining the Factors Influencing Construction Project Management Performance Improvement through Earned," 2023.

[18] V. F. Bahari and M. A. Rizki, "Cost and Schedule Performance Analysis Using the Earned Value Concept in the Construction of the Integrated Lecture Building at the State Shipbuilding Polytechnic of Surabaya [Analisis Kinerja Biaya dan Waktu Menggunakan Konsep Nilai Hasil Pada Pembangunan Gedung Kuliah Terpadu Politeknik Perkapalan Negeri Surabaya]," pp. 1–12.

[19] S. D. Gil, G. R. Pacheco, and S. A. D. L. Ríos, "Life-Cycle Cost Assessment in Real Estate Decision-Making Processes : Scope , Limits and Shortages of Current Practices — An Integrative Review," vol. 2019, 2025.

[20] N. Puspita and Y. Lutfiansyah, "Cost and Time Performance Analysis with Concept of Earned Value (Case Study Jakarta - Cikampek II Elevated Project)," *IJIEEB Int. J. Integr. Educ. Eng. Bus.* , vol. 3, no. 2, pp. 64–70, 2020, doi: 10.29138/ijieeb.v3i2.1167.