Available at https://journalenrichment.com/index.php/jr/

Enrichment: Journal of Multidisciplinary Research and Development

ANALYSIS OF COST AND TIME PERFORMANCE FOR REHABILITATION OF WS BRANTAS RETENTION BASIN USING THE EARNED VALUE METHOD

Atma Djendra Yuang Purbo, Esti Wulandari, Laksono Djoko Nugroho
Universitas 17 Agustus 1945 Surabaya, Indonesia
*Email: atmapurbo@gmail.com, laksonodjoko@untag-sby.ac.id, wulandariesti@untag-sby.ac.id

ABSTRACT

This research analyzes the cost and time performance of the WS Brantas reservoir rehabilitation project using the Earned Value method, addressing challenges such as cost overruns and schedule delays. The objectives include identifying cost and schedule deviations through the Schedule Performance Index (SPI) and Cost Performance Index (CPI) indicators, and evaluating the method's effectiveness in enhancing project management efficiency. Employing a qualitative descriptive approach, data were collected from nine project sites across Jombang, Tulungagung, and Blitar Regencies over six months, utilizing MS Project 2016 for analysis. Findings reveal significant deviations, with projects like Embung Kerjen incurring additional costs of Rp15,816,784 and an SPI of 0.66. The leading causes of delays included terrain constraints, material delays, and changes in work volume. The study underscores the importance of the Earned Value method as a standardization tool for project supervision, suggesting that its integration with project management technology can improve accountability and efficiency in budget use. This research provides valuable insights for academics and practitioners, offering practical solutions to common project management challenges and assisting government stakeholders in enhancing project supervision standards. By demonstrating the applicability of the Earned Value method in a government context, this study contributes to the development of effective infrastructure management strategies in Indonesia.

Keywords: *Earned Value, Project Performance, Cost and Schedule, Embung Rehabilitation, Construction Management*

INTRODUCTION

Project management is an essential process in managing resources to effectively complete a project from start to finish (Endang Soetari, 2016). The application of project management extends to various types of projects, including large and complex projects, which demand timely completion without delay (Irniawan et al., 2023). In the context of increasing development, resource management becomes crucial so that the products produced, especially in construction services, are of high quality despite facing limitations in time, cost, and scope of work (Endang Soetari, 2016). One method used for project control is the Earned Value method, which evaluates project implementation based on time and cost to detect delays and budget overruns (Almi et al., 2024).

Project management has different characteristics in non-profit government projects than commercial projects. Government projects usually depend more on political policies and evaluation of results rather than financial benefits (Wateno Oetomo, 2014). The role of the project manager is more focused on administrative aspects, while technical control is left to consultants (Utomo & Wibowo, n.d.). Challenges in modern construction projects, such as the rehabilitation of reservoirs in WS Brantas, include cost overruns and schedule delays, which are often caused by a lack of planning, material delays, price fluctuations, inaccessible project terrain, and weak supervision (Endang Soetari, 2016; (2023)v; Irniawan Kustamar, 2018).

The project budget plays an important role in ensuring the smooth implementation of the work. Projects cannot run without the availability of adequate costs (Wateno Oetomo, 2014). Project costs include all elements of work, including costs for planning consultants, supervisors, and service users (Endang Soetari, 2016). Therefore, it is important to distinguish between cost estimation and budgeting (Balido et al., 2024). Cost estimation is a calculation before the project starts, while budgeting is the allocation of approved costs from the results of the previous estimate (Al Juboori, 2021). Project performance evaluation can be done through the Earned Value method, which considers cost and time as indicators of project efficiency and effectiveness (Ahuja et al., 1994; Farida & Amir, 2018).

An important component in the Earned Value method is the Budgeted Cost for Work Scheduled (BCWS), which shows the planned cost for work in a certain period and is depicted in an S-curve (Wateno Oetomo, 2014). (Firmansyah, 2020)By comparing BCWS with actual costs (ACWP), the cost deviation from the plan can be seen (Firmansyah, 2020). Earned Value (EV) reflects the budget value based on completed work (Irika Widiasanti & Langgogeni, 2013). This method is different from traditional cost management because it adds the dimension of evaluating physical achievements to the costs that have been incurred (Ramabodu, 2014). With this approach, government projects are expected to demonstrate transparency and accountability for the use of the state budget more optimally (Pramadha et al., 2024).

This research focuses on the main variables, namely the cost and schedule of construction projects, which are evaluated using the Earned Value method. This method allows quantitative measurement of project performance by utilizing indicators such as Budgeted Cost of Work Scheduled (BCWS), Budgeted Cost of Work Performed (BCWP), and Actual Cost of Work Performed (ACWP) (Wateno Oetomo, 2014). Through this analysis, projects can be evaluated more comprehensively regarding budget efficiency and schedule effectiveness. This method also provides the ability to predict the cost and time required until the project is completed, which makes it an essential tool in modern project management.

The novelty of this research lies in the application of the Earned Value method integrated with MS Project 2016 software in managing the reservoir rehabilitation project (Rahmawati et al., 2022). The use of MS Project allows for more accurate and real-time data processing, which is rarely found in previous studies (Mubarok & Malinda, 2024). In addition, the focus of this research on government projects, specifically the rehabilitation of WS Brantas reservoirs, provides a new contribution to understanding how this method can be applied in the context of small to medium-scale projects with various unique challenges, such as rugged terrain and fluctuations in material costs (Meliya et al., 2022).

This research has high urgency given the importance of efficient project management in facing the challenges of infrastructure development in Indonesia. The WS Brantas reservoir rehabilitation project is part of the government's efforts to improve the management of water resources for community needs. This research is expected to use the Earned Value method to provide practical solutions to overcome cost and time deviations that often occur in similar projects. In addition, the application of the results of this research can assist the government in making more effective policies in the management of construction projects (Asmoro et al., 2023).

This research analyzes the application of the Earned Value method in the WS Brantas reservoir rehabilitation project, focusing on identifying cost and schedule deviations through Schedule Performance Index (SPI) and Cost Performance Index (CPI) indicators, and evaluating the method's effectiveness in enhancing project management efficiency (Suparno et al., 2025). It aims to develop recommendations for standardizing project supervision using MS Project 2016 software, providing benefits for academics, practitioners, and government stakeholders by offering practical solutions to cost and schedule deviations and improving project supervision standards for accountability and efficient budget use (Fujimoto, 2013). This study fills a gap in existing literature, distinguishing itself from Handayani (2023), who review flood mitigation strategies without addressing cost and schedule performance, and Hariyadi (2024), who apply the Earned Value method generally. The novelty lies in its integration with MS Project 2016, allowing for enhanced real-time project management and insights into effective public resource management in infrastructure development.

METHOD

This research employs a qualitative study with a descriptive approach to understand the application of the Earned Value method in construction project management, focusing on the rehabilitation of reservoirs in the Brantas River region. The study examines project cost and time deviations and evaluates the effectiveness of the methods applied to improve project management efficiency (Wahyu et al., 2024). It focuses on nine project sites in Jombang, Tulungagung, and Blitar Regencies over six months (January-June 2025), utilizing the Earned Value method and MS Project 2016 software to standardize project supervision. Data were collected through interviews and analysis of project documents such as RAB and S-curves. The research population included all reservoir rehabilitation projects managed by BBWS Brantas in fiscal year 2024, with nine projects selected based on location, complexity, and data availability variations. The evaluation covers project performance through SPI and CPI indicators, identifies factors causing cost and time deviations, and develops

recommendations for standardizing technology-based project supervision. Data analysis included quantitative methods via MS Project and qualitative interpretation of interviews and documents, ensuring validity and reliability through data triangulation and expert consultation. This approach aims to provide solutions for cost and time deviations and contribute to advancing project management science in Indonesia.

RESULTS AND DISCUSSION

Research Study Profile

The embung rehabilitation project in the Brantas River area includes nine work sites spread across Jombang, Tulungagung, and Blitar regencies. The Brantas River Basin Center (BBWS) manages the project with a lump sum-based contract. This research focuses on applying the Earned Value method to evaluate project performance in terms of cost and time. These projects were selected because they have varied work characteristics, including slope reinforcement rehabilitation, sediment dredging, and boundary protection. The research period covers the planning stage to project implementation in fiscal year 2024.

Specific Description of Research Variables

The main variables studied in this research include project cost and schedule performance, which are measured using indicators such as Budgeted Cost of Work Scheduled (BCWS), Budgeted Cost of Work Performed (BCWP), and Actual Cost of Work Performed (ACWP). This data is processed using MS Project 2016 software to produce cost performance index (CPI) and schedule performance index (SPI) values. This research also includes an analysis of the factors causing the deviation and the solutions implemented to mitigate the constraints (Lewis, 2011).

Data Used

This study used primary and secondary data. Primary data was obtained through interviews with project managers, supervisory consultants, and contractors, while secondary data included project documents such as the Budget Plan (RAB), weekly progress reports, and audit reports. This data includes details of cost, schedule, and volume of work at each project site. The following is the amount of data analyzed:

Table 1. Data Analysis

Location	BCWS (Rp)	BCWP (Rp)	ACWP (Rp)	SPI	CPI
Embung Kerjen	150,000,000	120,000,000	132,000,000	0.80	0.91
Sukosewu Embung	200,000,000	180,000,000	185,000,000	0.90	0.97
Embung Mangunan	180,000,000	160,000,000	172,000,000	0.89	0.93
Embung Ngrobyong	250,000,000	220,000,000	240,000,000	0.88	0.92
Embung Madenan	220,000,000	210,000,000	215,000,000	0.95	0.98
Embung Blendis	300,000,000	280,000,000	290,000,000	0.93	0.97
Embung Branjang	240,000,000	230,000,000	235,000,000	0.96	0.98

Source: Processed by Researcher, 2024

Research Findings

Standardization Recommendation

The results of this study recommend the consistent use of the Earned Value method in reservoir rehabilitation projects. In addition, integration with software such as MS Project allows for more effective project supervision. It is expected that this method can become a standard in the management of construction projects, especially those involving public funds (Sujarwo & Oetomo, 2022)For example, in the Branjang Embung rehabilitation project, the application of the Earned Value method resulted in an SPI value of 0.96 and CPI of 0.98, showing significant efficiency in both time and cost management. This supports the claim that this method can improve transparency and accuracy in project evaluation. In a broader context, the implementation of this standard can help the government optimize the use of public funds, minimize waste, and increase public confidence in infrastructure projects.

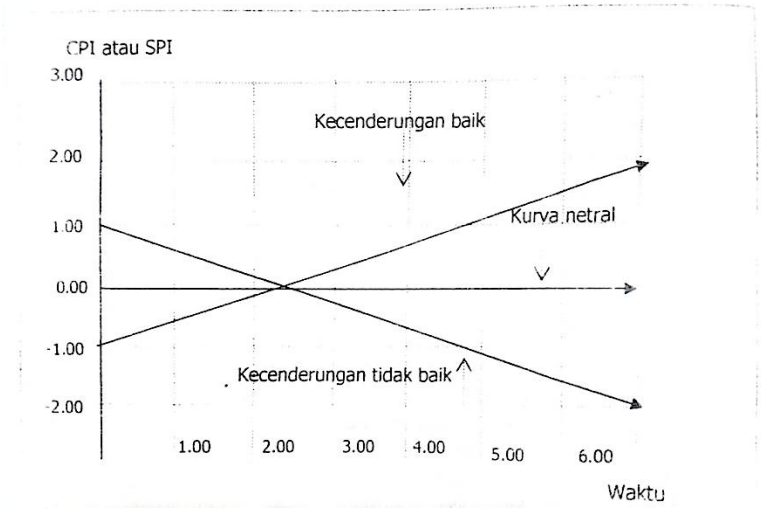

Figure 1. Comparison Chart of SPI and CPI at Each Location

The graph above compares SPI and CPI values at each project site. Sites with SPI values below 0.9 require special attention to improve the implementation schedule.

Implications of Findings

The findings of this study indicate that cost and time deviations on construction projects can be minimized by applying the Earned Value method. Projects with SPI and CPI values close to 1 indicate that integrated project management can improve the efficiency of budget and time use.

Research Contribution

This research contributes to the development of project supervision methods in Indonesia by emphasizing the integration of the Earned Value method and MS Project 2016 software. In contrast to previous research that generally focuses only on manual evaluation, this study shows that the combination of quantitative analysis and project management technology can provide more precise results. In addition, the focus on a reservoir rehabilitation project as a case study adds insight into this method's application in medium-scale projects with unique challenges, such as rugged terrain and budget limitations. As such, this research complements previous findings by offering a more comprehensive and technology-based solution. Using MS Project 2016 software, this research demonstrates that technology can support more transparent and accountable project management (Sugiyanto & Kosbiamtoro, 2022).

Limitations and Suggestions

The limitation of this study lies in the limited site coverage of nine projects. To broaden the scope of data, further research could involve more reservoir rehabilitation projects in various regions with different characteristics. Strategies that could be applied include using a broader purposive sampling method or a mixed methods approach to obtain richer data, both quantitatively and qualitatively. In addition, integration with other technologies, such as drones to map field conditions in real-time, can provide a more accurate picture of the project terrain. In terms of analyzing the factors causing deviations, it is recommended to include additional variables such as government policies, contractor competency levels, as well as weather influences, which can provide a more comprehensive perspective on project management.

This study's limitation lies in the limited location coverage of nine projects. Further research can include more locations to get a more representative picture. In addition, the analysis of factors causing deviations can be expanded by involving more variables.

CONCLUSION

This study evaluates the cost and schedule performance of reservoir rehabilitation projects in the Brantas WS using the Earned Value method integrated with MS Project 2016 software. The findings reveal significant performance variations among the nine project sites, with some, like Embung

Branjang and Madenan, showing optimal performance, while others, such as Embung Kerjen and Ngrobyong, need improvements in material management and logistics. Specific additional costs and schedule setbacks were identified, including Rp15,816,784 for Embung Kerjen, with an SPI value of 0.66, and Rp17,678,976 for Embung Ngrobyong (Inlet) with an SPI value of 0.95. Factors contributing to deviations include material delays, difficult terrain, and changes in work volume. The study acknowledges limitations in location coverage and the absence of external variable analysis, recommending future research to expand project coverage, incorporate diverse characteristics, and use technologies like drones for real-time monitoring. This research aims to enhance the efficiency and effectiveness of construction project management in Indonesia.

REFERENCES

Al Juboori, A. A. (2021). *Exploring Project Costs Estimator Practices that Increase the Budget Estimate's Accuracy during the Initial Phase of the Construction Project's Life Cycle*. Colorado Technical University.

Almi, H., Tjendani, H. T., & Witjaksana, B. (2024). Analysis Of Cost And Time Performance On The East Surabaya Hospital Construction Project Using The Earned Value Method. *International Journal of Science and Technology*, *3*(2), 1–11. https://doi.org/10.56127/ijst.v3i2.1482

Asmoro, M. R., Witjaksana, B., & TJendani, H. T. (2023). Cost And Time Analysis Using Earned Value Method Construction Of Upbjj Building Open University Of Surabaya Phase Ii. *Asian Journal Of Engineering, Social And Health*, *2*(12), 1799–1810. https://doi.org/10.46799/ajesh.v2i12.206

Balido, P. T. S., Tjendani, H. T., & Witjaksana, B. (2024). Analysis Of Implementation Delays Using The Earned Value Method (On The Purwosari-Sekarmojo Road Works, Pasuruan District). *Int. J. Adv. Technol. Eng. Inf. Syst*, *3*(1), 105–118.

Firmansyah, M. A. (2020). *Estimasi Biaya Dan Waktu Serta Metode Pelaksanaan Proyek Rehabilitasi Waduk Muara Nusa Dua Kota Denpasar, Bali*. Institut Teknologi Sepuluh Nopember.

Fujimoto, K. (2013). Brantas river basin development plan of Indonesia. In *Aid as handmaiden for the development of institutions: A new comparative perspective* (pp. 161–194). Springer.

Handayani, D. A., Kurniadi, A., & Bahar, F. (2023). Upstream Brantas Watershed management strategies for flood mitigation (a review: Batu District). *IOP Conference Series: Earth and Environmental Science*, *1173*(1), 12053. https://doi.org/10.1088/1755-1315/1173/1/012053

Hariyadi, S., Tjendani, H. T., & Witjaksana, B. (2024). Cost and Time Analysis Using the Earned Value Analysis Method. *Eduvest-Journal of Universal Studies*, *4*(9), 8273–8283. https://doi.org/10.59188/eduvest.v4i9.6402

Irniawan, D., Oetomo, W., & Marleno, R. (2023). Cost and Time Analysis Using Earned Value Method In Administration Building Contruction Project At Polije Campus. *International Journal on Advanced Technology*, *2*(4), 423–432.

Lewis, J. P. (2011). *Project planning, scheduling & control*.

Meliya, K. R., Sari, D. P., & Rafshanjani, M. A. (2022). Evaluasi Pelaksanaan Pembangunan Proyek Dengan Menggunakan Metode Earnede Value. *ETNIK: Jurnal Ekonomi Dan Teknik*, *1*(5), 374–382. https://doi.org/10.54543/etnik.v1i5.74

Mubarok, A. A., & Malinda, Y. (2024). Analisis Kinerja Proyek Rehabilitasi Bangunan Pelabuhan Kayangan Menggunakan Metode Earn Value. *Jurnal Dunia Rekayasa Sipil, Design, Dan Infrastruktur*, *1*(1), 24–30.

Pramadha, I. Y., Tjendani, H. T., & Witjaksana, B. (2024). Cost and Time Analysis Using Earned Value Method on the Construction of the National Kediri Airport Access Road Phase 1 Kediri-Nganjuk. *Int. J. Adv. Technol. Eng. Inf. Syst*, *3*(1), 119–130.

Rahmawati, R., Ahadian, E. R., & Saputra, M. T. Y. (2022). Cost and Time Performance Analysis Using Earned Value Analysis Method on Tiley Modular Dam Rehabilitation and Improvement Project. *Journal Of Science and Engineering*, *5*(1), 55–63. https://doi.org/10.33387/josae.v5i1.4797

Ramabodu, M. S. (2014). *Procurement guidelines for project success in cost planning of construction projects*. University of the Free State.

Sugiyanto, S., & Kosbiamtoro, A. (2022). Analisis Kinerja Biaya Pada Proyek Rehabilitasi Drainase Dan Trotoar Jalan Teuku Umar Paket I Dengan Metode Earned Value. *Analisis Kinerja Biaya Pada Proyek Rehabilitasi Drainase Dan Trotoar Jalan Teuku Umar Paket I Dengan Metode Earned Value*, *5*(2), 126–141.

Sujarwo, A., & Oetomo, W. (2022). Analisis Waktu Dan Biaya Pembangunan Gedung Ikfm, Ips, Ipl Dan

Parkir Kendaraan Karyawan. *Jurnal Kacapuri: Jurnal Keilmuan Teknik Sipil*, *5*(1), 269–278.

Suparno, S., Tjendani, H. T., & Witjaksana, B. (2025). Analysis of Cost and Schedule Variances Using Earned Value Method on Waru-Buduran Frontage Road Bridge Construction Project. *Asian Journal of Engineering, Social and Health*, *4*(2), 288–297. https://doi.org/10.46799/ajesh.v4i2.528

Utomo, B. S., & Wibowo, K. (n.d.). Earned Value Concept as a Method to Analyze Cost and Time Control. *JACEE (Journal of Advanced Civil and Environmental Engineering)*, *5*(2), 103–112.

Wahyu, A. A., Gunasti, A., & Dewi, I. C. (2024). Standardization of Time and Cost Performance with Earned Value Method at the Structure Work Stage of the Project. *Sustainable Civil Building Management and Engineering Journal*, *1*(1), 40. https://doi.org/10.47134/scbmej.v1i1.2138