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Cost Analysis and Supervision of the Rehabilitation Construction of Several Reservoirs in the Brantas River Area, East Java

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

Effective construction management is critical to ensuring projects are completed on time and within budget. However, budget overruns and schedule delays remain common due to factors such as material delays, price fluctuations, and challenging terrain. This study evaluates the cost and schedule performance of nine reservoir rehabilitation projects in the Brantas River area using the *Earned Value Method (EVM)* integrated with MS Project 2016. The research aims to analyze cost and schedule deviations through the *Schedule Performance Index (SPI)* and *Cost Performance Index (CPI)*, assess the effectiveness of EVM in improving project efficiency, and provide recommendations for better oversight. This research is carried out through the method of analyzing the concept of value (*Earned Value*), which can be determined from the performance of the activities undertaken to increase effectiveness and efficiency, as well as to evaluate and monitor project activities. Findings reveal variations in performance across projects, with the Kerjen Reservoir, for example, experiencing a cost overrun of Rp15,816,784 and an SPI of 0.66, indicating significant delays, while the CPI of 1.10 suggests cost inefficiencies. Delays were attributed to material shortages, difficult terrain, and unexpected price changes. The study demonstrates that EVM, supported by project management software, enhances transparency and decision-making in construction supervision. These insights contribute to optimizing public infrastructure projects by minimizing deviations and improving resource management.

Keywords: Earned Value; Project Performance; Cost and Schedule; Reservoir Rehabilitation; Construction Management

INTRODUCTION

In this modern era, construction project management faces increasingly complex challenges. Globally, many infrastructure projects experience significant cost overruns and delays, as reported by various research institutions (Gebrehiwet & Luo, 2025). For example, data from the World Bank (2022) show that more than 70% of major infrastructure projects worldwide exceed their budgets, and nearly 60% face substantial delays. These problems not only lead to financial losses but also cause dissatisfaction among stakeholders and reduce public confidence in project management (Narbaev & De Marco, 2017).

In Indonesia, embankment rehabilitation projects, such as those implemented at *WS Brantas*, often encounter various challenges resulting in inefficiencies in both cost and time (Scientific Reports, 2025). Several factors contribute to these management problems (Naderpour & Mofid, 2020). First, the lack of *integrated planning* often leads to unrealistic schedules and budgets (Endang Soetari, 2016). Second, delays in material delivery are a primary cause of schedule deviations (Irniawan et al., 2023). Third, fluctuations in material prices create uncertainty, making cost control difficult (Kustamar, 2018). Fourth, difficult access to project terrain adds unexpected costs and slows progress. Finally, inadequate supervision by project managers, including insufficient implementation of control methods such as the *S-curve* and *Earned Value*, further aggravates the situation (Wateno Oetomo, 2014).

The impact of these factors significantly affects project success. For instance, delays in material deliveries cause the *Schedule Performance Index (SPI)* to fall below 1, indicating reduced time efficiency (Irniawan et al., 2023). Similarly, fluctuations in material prices increase actual costs, negatively influencing the *Cost Performance Index (CPI)*. Difficult terrain often extends project duration beyond planned targets, while lack of oversight contributes to uncontrolled expenditures. Collectively, these factors result in cost overruns and delays, leading to dissatisfaction among project owners and the public (Fleming & Koppelman, 2016).

This study focuses on two primary variables—the cost and schedule performance of construction projects—evaluated through the *Earned Value Method (EVM)*. This method quantitatively measures project performance using 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 *EVM* analysis, projects can be assessed comprehensively in terms of budget efficiency and schedule effectiveness. Furthermore, *EVM* allows for forecasting the remaining time and cost until project completion, making it an essential tool in modern construction management (Acebes et al., 2015).

The uniqueness of this study lies in the application of *EVM* integrated with MS Project 2016 software to manage reservoir rehabilitation projects (Batselier, 2017; Kerzner, 2017; Pinto et al., 2021; Zhang et al., 2018). Utilizing MS Project enables more accurate, real-time data processing, a feature less explored in prior research. Additionally, this study centers on government projects, specifically the rehabilitation of the *WS Brantas* reservoir, offering new insights into the method's applicability in small to medium-scale projects facing challenges like difficult terrain and price fluctuations (Fleming & Koppelman, 2016; Willems & Vanhoucke, 2015).

Given the urgency to improve infrastructure project management in Indonesia, this research is highly relevant (Mahamid, 2020). The *WS Brantas* reservoir rehabilitation is part of government efforts to enhance water resource management for community needs (Larsen et al., 2016). By applying *EVM*, this study aims to provide practical solutions to cost and schedule deviations common in similar projects. Furthermore, the findings can help inform government policies to promote more effective construction project management (Flyvbjerg et al., 2018).

The main objectives of this study are to identify cost and schedule deviations using *SPI* and *CPI* indicators, evaluate the effectiveness of the *Earned Value* method in enhancing project management efficiency, and develop standardized recommendations for project supervision by leveraging MS Project 2016 to support better decision-making. By addressing these goals, the research seeks to improve the management of reservoir rehabilitation projects at *WS Brantas*, ensuring timely and cost-effective completion while optimizing public resource utilization.

METHOD

In this research, a quantitative research design was used using measurable data to produce the desired value output. In the research, the *Earned Value* analysis method was used on the construction work schedule to obtain *the Cost Variance* (CV) value to determine the value of the project cost. The *Schedule Variance* (SV) Index is also used in determining project delays or acceleration. By using the MS Project 2016 application which has an interface that is easy to understand and apply, it is hoped that the application of *the Earned Value* method can be effective and efficient. The use of the MS Project 2016 application is used because it provides a relationship between activities so that it can quickly know the critical trajectory. After knowing the critical trajectory, the *Earned Value* method was applied to the MS Project 2016 application to get CV and SV scores.

This research was conducted in the Brantas River area, which includes nine reservoir rehabilitation project locations spread across Jombang Regency, Tulungagung Regency, and

Blitar Regency. This location was chosen because it has diverse project characteristics, both in terms of the scale of the work and the technical challenges faced. The study lasted for six months, starting from January to June 2025. This time span includes the stages of data collection, analysis, and interpretation of research results.

This research covers several key aspects, namely:

- Project Performance Evaluation: Analyze the cost and time performance of the reservoir rehabilitation project using the Earned Value method.
- Identify Deviations: Identify the factors causing deviations in the project's schedule and budget.
- Method Effectiveness: Evaluate the extent to which the Earned Value method can improve the efficiency and effectiveness of construction project management.
- Standardization Recommendations: Develop recommendations for standardization of project oversight using project management technologies such as MS Project 2016.

The population in this study is the entire reservoir rehabilitation project managed by BBWS Brantas in the 2024 fiscal year. From this population, nine projects were selected as research samples. Sample selection was carried out purposively, taking into account the variety of locations, project complexity, and available supporting data. This sample includes projects that have significant challenges in cost and time management, so it can provide a representative picture.

The research instruments used in this study include project documents, interviews, and project management software. Project documents include Cost Budget Plans (RABs), Progress Reports, and S-Curves. To dig deeper into the obstacles and solutions implemented, interviews were conducted with project managers, supervisory consultants, and contractors. In addition, the MS Project 2016 software is utilized to quantitatively analyze project performance data, including in the calculation of cost performance index (CPI) and schedule (SPI).

Research data is collected through three main stages:

Primary Data Collection: Involves in-depth interviews with project-related parties, such as project managers and supervisory consultants. This interview aims to dig up information about the causes of deviations and the mitigation measures taken.

- Secondary Data Collection: Includes analysis of project documents, such as RABs, RAPs, and progress reports. This data is used to calculate project performance indicators as well as compare between plans and realization.
- Simulation and Analysis: Using MS Project 2016 to simulate project performance based on the data that has been collected. This simulation allows for quantitative evaluation of project performance and prediction of cost and time requirements until project completion.

The data that has been collected is analyzed using a descriptive approach, involving both quantitative and qualitative methods. For quantitative analysis, project performance indicators such as SPI and CPI are calculated based on data obtained from the MS Project. Meanwhile, qualitative analysis is used to interpret the results of interviews and project documents, as well as to identify factors that affect cost and time deviations. The findings of this analysis were then compared with the previous literature to validate the results of the study.

To ensure the validity and reliability of the data, we implement data source triangulation, which involves comparing interview results, project documents, and software analysis. We also consulted with project management experts to confirm that our analysis was in line with field conditions. These measures aim to improve the credibility and generalization of our research findings.

In the implementation of this research, we always pay attention to the principles of research ethics. We have obtained permission from relevant parties to access project data and maintain the confidentiality of sensitive information. In addition, interview respondents were given the freedom to convey information voluntarily without any pressure.

With this methodological approach, the research is expected to be able to provide a comprehensive solution to the problem of cost and time deviation in the WS Brantas reservoir rehabilitation project, as well as contribute to the development of project management science in Indonesia.

RESULTS AND DISCUSSION

Research Study Profile

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

Specific Overview of Research Variables

The main variables studied in this study include project cost performance and schedule, 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 was processed using MS Project 2016 software to generate the cost performance index (CPI) and schedule performance index (SPI) values. This research also includes an analysis of the factors that cause deviations and solutions applied to mitigate these constraints.

Data Used

Cost Budget Plan

Table 1. RAB Embung Kerjen – Blitar

COST BUDGET PLAN (RAB)

Unit : PPK OP VIProyek : Routine MaintenanceLocation : Embung Kerjen - Blitar

NO	WORK	UNIT	VOLUME	TOTAL NON PPN	KET
1	2	4	5	10	
A	**PREPARATORY WORK**				
A.1	Mobilization	Ls	1.00	3.575.000,00	
A.2	Demobilization	Ls	1.00	3.575.000,00	
	Total Cost of Preparatory Work			**7.150.000,00**	
B	**PAIR WORK**				
B.1	Unload Couple One Stone (Manual)	M3	89.55	11.904.851,50	
B.2	A pile of excavated material of choice	M3	10.00	1.846.492,00	
B.3	Pair of stones with Mortar type P.C:P:P	M3	8.55	8.956.803,10	
B.4	Broadcast with spec 1 PC : 2 PS	M2	86.72	7.876.546,52	
B.5	Stucco Work 1:5 P.C : P.S 15 mm thick	M2	147.85	6.681.856,38	
B.6	Installation of sewer pipes	M	10.00	1.500.000,00	
B.7	1 m Acian pair	m1	161,60	399.988,67	
B.8	Concrete Rebate Cast Disassembly	M3	3.65	1.825.000,00	
B.9	Quran Concrete Flap	M3	4.51	2.725.000,00	
	PAIR Work Price Amount			**151.017.845,50**	
	TOTAL NUMBER OF SUBS			**158.167.845,50**	
	TOTAL AMOUNT OF WORK PRICE + 11% VAT			**175.566.308,51**	

Source: Processed Researcher, 2024

Table 2. RAB Embung Ngrobyong (Inlet)

COST BUDGET PLAN (RAB)					
Unit : PPK OP VIProyek : Routine MaintenanceLocation: Embung Ngobryong - Blitar					
NO	**WORK**	**UNIT**	**VOLUME**	**TOTAL NON PPN**	**INFORMATION**
1	**2**	**4**	**5**	**10**	**11**
A	**PREPARATORY WORK**				
A.1	Mobilization	Ls	1,00	3.575.000,00	
A.2	Demobilization	Ls	1,00	3.575.000,00	
A.3	Stone Unloading / Stone Pairs (Manual)	M3	6,00	756.000,00	
A.4	Lifting 1 m3 of material or excavated products with a transport distance of 50 m	M3	65,73	6.324.846,25	
	Total Cost of Preparatory Work			**14.230.846,25**	
B	**PAIR WORK**				
B.1	Dismantling of the common kali stone pair	M3	29,90	1.821.187,15	
B.2	Ordinary soil excavation piles	M3	43,00	3.190.386,50	
B.3	A pile of excavated material of choice	M3	18,00	2.137.743,00	
B.4	Pairing of stones with Mortar type P.C: P.P	M3	8,25	7.336.864,25	
B.5	Flush with Spec 1 PC : 2 PS	M2	26,68	3.188.336,20	
B.6	Stucco Work 1 SP : 2 PP Thickness 15 mm	M2	26,68	2.075.232,50	
B.7	Installation of sewer pipes	M	4,00	1.625.000,00	
B.8	Olak Box Pool Molding	M3	14,70	12.226.123,65	
	PAIR Work Price Amount			**135.108.712,15**	
	TOTAL NUMBER OF SUBS			**149.339.558,40**	
	TOTAL AMOUNT OF WORK PRICE + 11% VAT			**165.766.909,82**	

Source: Processed Researcher, 2024

Table 3. RAB Embung Ngrobyong (Outlet)

COST BUDGET PLAN (RAB)					
Unit: PPK OP VIProyek: Routine MaintenanceLocation: Embung Ngrobyong - Blitar					
NO	**WORK**	**UNIT**	**VOLUME**	**TOTAL NON PPN**	**INFORMATION**
1	**2**	**4**	**5**	**10**	**11**
A	**PREPARATORY WORK**				
A.1	Mobilization	Ls	1,00	3.575.000,00	
A.2	Demobilization	Ls	1,00	3.575.000,00	
A.3	Dismantle 1 m3 Stone Pairs (Manual)	M3	3,165	3.879.000,00	
A.4	Field Cleaning and Leveling	M2	22,00	1.066.938,30	
	Total Cost of Preparatory Work			**11.095.938,30**	
B	**PAIR WORK**				
B.1	Ordinary soil excavation	M3	4,125	2.175.951,33	
B.2	Solid pile as an auxiliary material	M3	6,165	3.237.000,00	

COST BUDGET PLAN (RAB)					
Unit: PPK OP VIProyek: Routine MaintenanceLocation: Embung Ngrobyong - Blitar					
NO	**WORK**	**UNIT**	**VOLUME**	**TOTAL NON PPN**	**INFORMATION**
1	**2**	**4**	**5**	**10**	**11**
B.3	Pair of stones with Mortar type P.C:P.P	M3	4,260	4.158.666,00	
B.4	Flush with spec 1 PC : 2 PS	M2	19,24	2.064.984,00	
B.5	Stucco Work 1 : 5 P.C : P.S Thickness 15 mm	M2	45,68	2.213.600,00	
B.6	Pair of pipes and sewer pipes	M	135,40	9.611.455,92	
B.7	Solid Sirtu Excavation	M3	23,10	3.167.167,69	
	PAIR Work Price Amount			**164.693.825,28**	
	TOTAL NUMBER OF SUBS			**176.789.763,28**	
	TOTAL AMOUNT OF WORK PRICE + 11% VAT			**196.236.637,24**	

Source: Processed Researcher, 2024

Table 4. RAB Embung Sukosewu

COST BUDGET PLAN (RAB)					
	Unit: PPK OP VIProyek: Routine MaintenanceLocation: Embung Sukosewu - Blitar				
NO	**WORK**	**UNIT**	**VOLUME**	**TOTAL NON PPN**	**INFORMATION**
1	**2**	**4**	**5**	**10**	**11**
A	**PREPARATORY WORK**				
A.1	Mobilization	Ls	1,00	3.550.000,00	
A.2	Demobilization	Ls	1,00	3.550.000,00	
A.3	Transporting 1 m³ of material or excavated products with a transport distance of 50 m	M3	7,45	718.507,75	
A.4	Disassemble 1 m³ Stone Pairs (Manual)	M3	30,60	11.666.773,80	
	Total Cost of Preparatory Work			**18.990.281,55**	
B	**PAIR WORK**				
B.1	Ordinary soil excavation	M3	33,35	2.615.292,65	
B.2	Solid pile as an auxiliary material	M3	20,44	1.682.383,85	
B.3	Pairing Stone with Mortar type P.C:P.P	M3	9,00	7.387.323,25	
B.4	Flush with Spec 1 PC : 2 PS	M2	35,00	1.001.705,25	
B.5	Stucco Work 1 : 5 P.C : P.S Thickness 15 mm	M2	120,10	9.008.319,73	
B.6	Installation of sewer pipes	M	3,00	4.590.204,00	
B.7	1 m¹ Interlocking pipe pairs	M		4.592.204,00	
	PAIR Work Price Amount			109.995.487,68	
	TOTAL NUMBER OF SUBS			128.985.769,54	
	TOTAL AMOUNT OF WORK PRICE + 11% VAT			143.174.204,19	

Source: Processed Researcher, 2024

Table 5. RAB Doesn't Want to Eat

	COST BUDGET PLAN (RAB)				
	Unit: PPK OP VIProyek: Regular Maintenance of EmbungLocation: Embung Mangunan - Jombang				
NO	**WORK**	**UNIT**	**VOLUME**	**TOTAL NON PPN**	**INFORMATION**
1	**2**	**4**	**5**	**10**	**11**
A	**PREPARATORY WORK**				
A.1	Disassemble 1 m³ Stone Pairs (Manual)	M3	88,00	10.630.928,00	
A.2	Pairing Stone with Mortar type PC-PP	M3	88,00	15.948.700,00	
A.3	Flush with Spec 1 PC : 2 PS	M2	188	16.202.706,00	
A.4	Installation of Stucco 1 SP : 2 PP Thickness 15 mm	M2	32,10	2.279.355,08	
A.5	Acian Installation	M2	32,10	1.184.891,25	
A.6	1 m¹ Flute pipe pairs	M¹	139,80	5.228.520,00	
	Total Job Price			**122.175.121,01**	
	TOTAL NUMBER OF SUBS			**122.175.121,01**	
	TOTAL AMOUNT OF WORK PRICE + 11% VAT			**135.614.384,32**	

Source: Processed Researcher, 2024

Table 6. RAB Embung Madenan

	COST BUDGET PLAN (RAB)				
	Unit: PPK OP VIProyek: Routine MaintenanceLocation: Embung Mandeman Phase 2 - Jombang				
NO	**WORK**	**UNIT**	**VOLUME**	**TOTAL NON PPN**	**INFORMATION**
1	**2**	**4**	**5**	**10**	**11**
A	**PREPARATORY WORK**				
A.1	Disassemble 1 m³ Stone Pairs (Manual)	M3	136,13	16.444.716,75	
A.2	Sand piles as fillers	M3	2,25	343.755,00	
A.3	Masonry with mortar type PC:PP (1m3)	M3	136,13	132.951.926,25	
A.4	Installation of Stucco 1 SP : 2 PP Thickness 15 mm	M2	150,45	13.953.986,65	
A.5	Acian Installation	M2	150,45	5.591.008,13	
A.6	Flush with spec 1 PC : 2 PS (Mortar Type:M)	M2	192,5	6.732.000,00	
A.7	1 m¹ Flute pipe pairs	M¹	180,00	-	
	Total Job Price			**176.027.482,79**	
	TOTAL NUMBER OF SUBS			**176.027.482,79**	
	TOTAL AMOUNT OF WORK PRICE + 11% VAT			**195.390.505,89**	

Source: Processed Researcher, 2024

Table 7. RAB Embung Sumbergondang

	COST BUDGET PLAN (RAB)					
	Unit: PPK OP VI **Project:** Routine Maintenance **Location:** Embung Sumber Gondang Phase 2					
NO	**WORK**	**AHSP CODE**	**UNIT**	**VOLUME**	**TOTAL NON PPN**	**INFORMATION**
1	**2**	**3**	**4**	**5**	**10**	**11**
A	**PAIR WORK**					
A.1	Disassemble 1 m³ Stone Pairs (Manual)	AHSP-SDA-01.02.c	M3	140,32	16.951.195,91	
A.2	Sand piles as fillers	AHSP-SDA-11.14.c4	M3	3,12	476.479,60	
A.3	Masonry with mortar type Pc:PP (1m3)	AHSP-SDA-06.02.a	M3	140,32	137.046.699,08	
A.4	Installation of Stucco 1 SP : 2 PP Thickness 15 mm	AHSP-SDA-04.4.2.2.1	M2	36,00	3.385.295,75	
A.5	Acian Installation	AHSP-SDA-04.4.2.2.7	M2	36,00	1.346.882,80	
A.6	Flush with spec 1 PC : 2 PS (Mortar Type:M)	AHSP-SDA-09.3.8	M2	126,25	4.654.080,00	
A.7	1 m¹ Flute pipe pairs	AHSP-SDA-16. P.16	M¹	124,20	-	
	Total Job Price				**163.824.826,84**	
	TOTAL NUMBER OF SUBS				**163.824.826,84**	
	TOTAL AMOUNT OF WORK PRICE + 11% VAT				**181.845.557,79**	

Source: Processed Researcher, 2024

Table 8. RAB Embung Blendis

	COST BUDGET PLAN (RAB)				
	Unit: PPK OP VI **Project:** Routine Maintenance **Location:** Embung Blendis Gondang Tulungagung				
NO	**WORK**	**UNIT**	**VOLUME**	**TOTAL NON PPN**	**INFORMATION**
1	**2**	**4**	**5**	**10**	**11**
A	**PAIR WORK**				
A.1	Disassemble 1 m³ Stone Pairs (Manual)	M3	128,83	15.563.436,98	

COST BUDGET PLAN (RAB)					
	Unit: PPK OP VI **Project:** Routine Maintenance **Location:** Embung Blendis Gondang Tulungagung				
NO	**WORK**	**UNIT**	**VOLUME**	**TOTAL NON PPN**	**INFORMATION**
1	**2**	**4**	**5**	**10**	**11**
A.3	Sand piles as fillers	M3	3,52	537.785,60	
A.4	Masonry with mortar type PC:PP (1m3)	M3	128,83	125.216.972,70	
A.5	Installation of Stucco 1 SP : 2 PP Thickness 15 mm	M2	81,40	7.555.124,12	
A.6	Acian Installation	M2	81,40	3.025.027,50	
A.7	Flush with spec 1 PC : 2 PS (Mortar Type:M)	M2	105,07	-	
A.8	1 m¹ Flute pipe pairs	M¹	297,50	11.236.500,00	
	Total Job Price			**163.634.847,50**	
	TOTAL NUMBER OF SUBS			**163.634.847,50**	
	TOTAL AMOUNT OF WORK PRICE + 11% VAT			**181.634.680,73**	

Source: Processed Researcher, 2024

Table 9. RAB Embung Branjang

COST BUDGET PLAN (RAB)					
	Unit: PPK OP VIProyek: Routine MaintenanceLocation: Embung Branjangan Tulungagung				
NO	**WORK**	**UNIT**	**VOLUME**	**TOTAL NON PPN**	**INFORMATION**
1	**2**	**4**	**5**	**10**	**11**
A	**PAIR WORK**				
A.1	Disassemble 1 m³ Stone Pairs (Manual)	M3	108,20	13.071.009,20	
A.3	Sand piles as fillers	M3	8,92	1.362.797,50	
A.4	Masonry with mortar type PC:PP (1m3)	M3	108,20	105.677.888,00	
A.5	Installation of Stucco 1 SP : 2 PP Thickness 15 mm	M2	319,60	29.663.610,08	
A.6	Acian Installation	M2	319,60	11.685.073,65	
A.7	Flush with spec 1 PC : 2 PS (Mortar Type:M)	M2	48,00	8.257.920,00	
A.8	1 m¹ Flute pipe pairs	M¹	220,80	-	
	Total Job Price			**169.910.529,88**	
	TOTAL NUMBER OF SUBS			**169.910.529,88**	
	TOTAL AMOUNT OF WORK PRICE + 11% VAT			**188.600.688,17**	

Source: Processed Researcher, 2024

1. **MS Project 2016 Analysis**

In the MS Project Project program, the RAB data that is input is also in the form of WBS (*Work Breakdown Structure*) or arranged according to the stages of work or implementation method. In the analysis, one of the Plan RABs, namely the **Sukosewu Embung** RAB, will be used as data to carry *out step by step analysis*.

2. **Components of Earned *Value***

There are three components that make up *the Earned Value* method ; BCWS, BCWP, ACWP. To get this value in the MS Project 2016, several variables must be inputted, namely the budget plan, budget realization, and baseline set that the author has done before.

Table 10. BCWS Chart

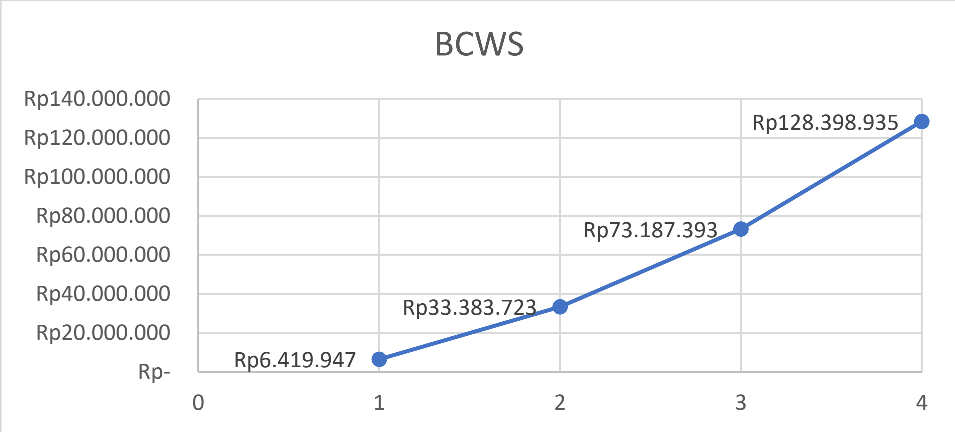

Figure 1. BCWP Chart
Source: Processed Researcher, 2024

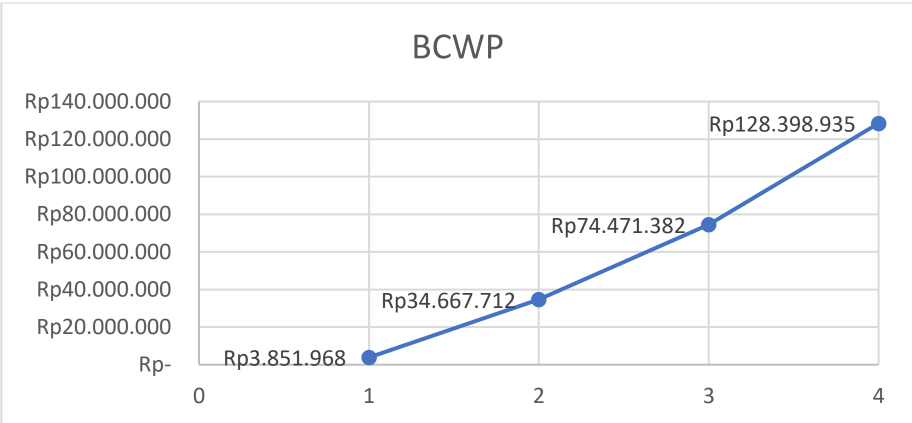

Figure 2. BCWP Chart
Source: Processed Researcher, 2024

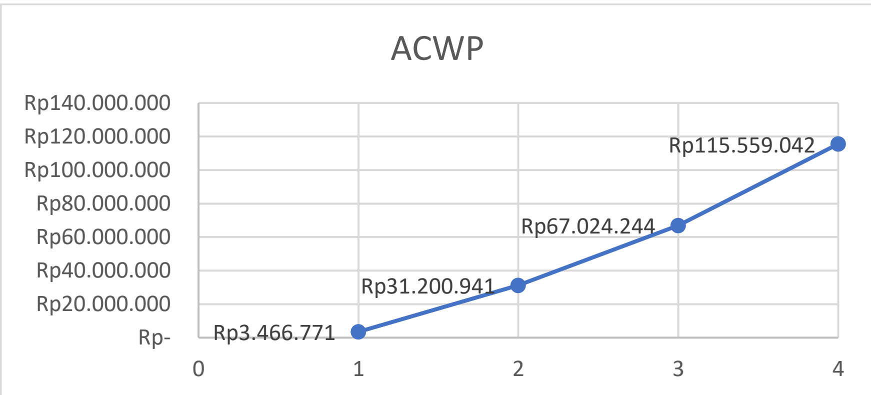

Figure 3. ACWP Chart
Source: Processed Researcher, 2024

3. **Application of *Earned Value* in 9 Embung Projects**

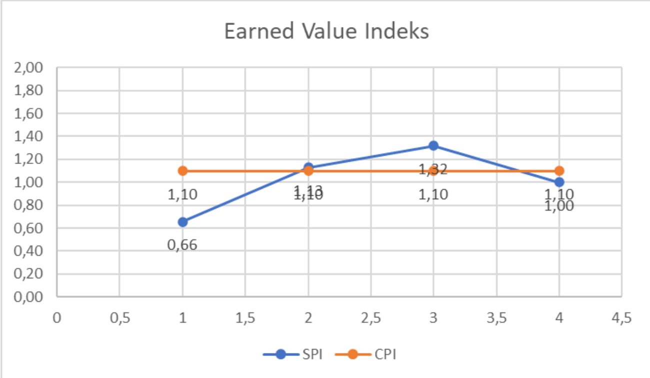

Figure 4. EVM Embung Kerjen Index Chart
Source: Processed Researcher, 2024

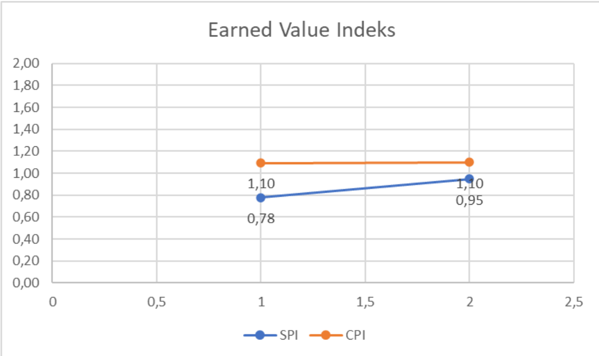

Figure 5. Embung Ngrobyong EVM Index Chart (inlet)
Source: Processed Researcher, 2024

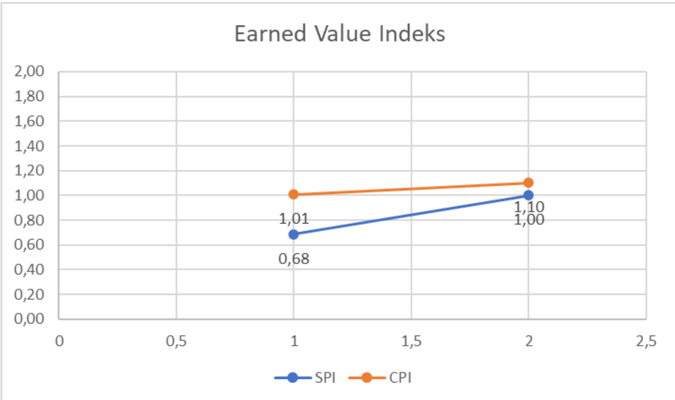

Figure 6. EVM Embung Ngrobyong Index Chart (Outlet)
Source: Processed Researcher, 2024

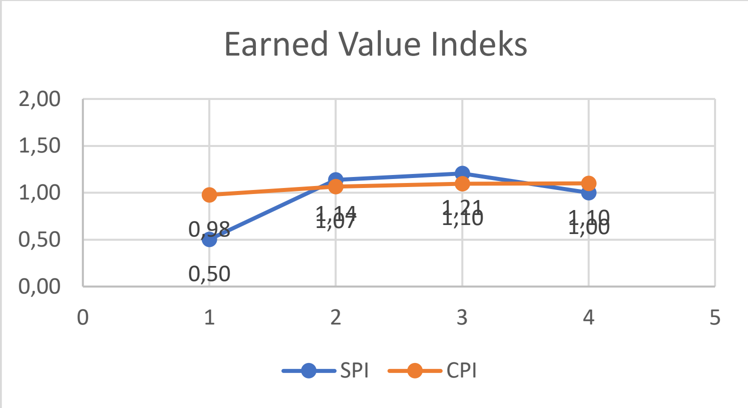

Figure 7. Graph of EVM Index Embung Sukosewu
Source: Processed Researcher, 2024

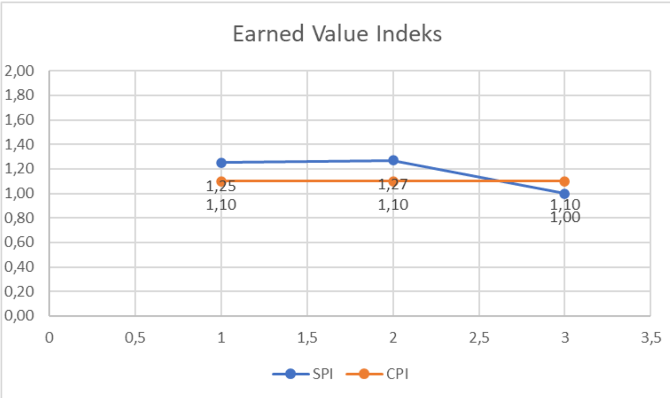

Figure 8. EVM Index Chart Not Mangunan
Source: Processed Researcher, 2024

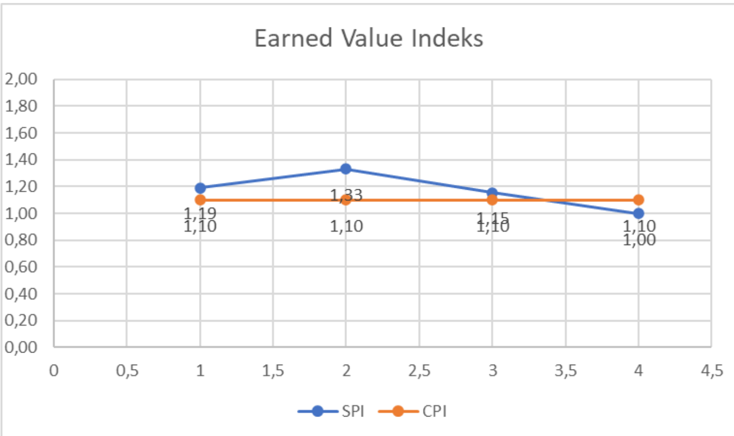

Figure 9. EVM Embung Madenan Index Chart
Source: Processed Researcher, 2024

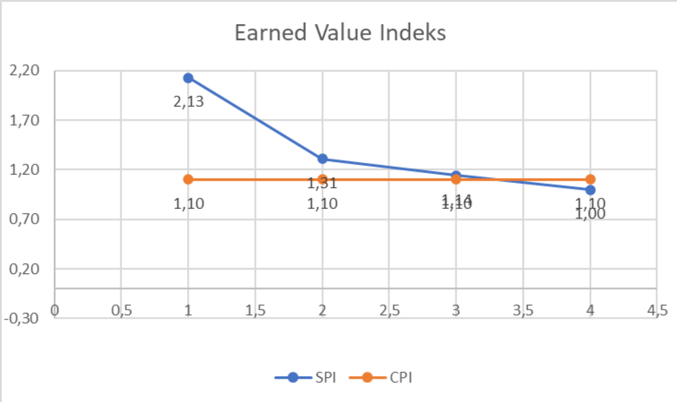

Figure 10. Sumbergondang Embung EVM Index Chart
Source: Processed Researcher, 2024

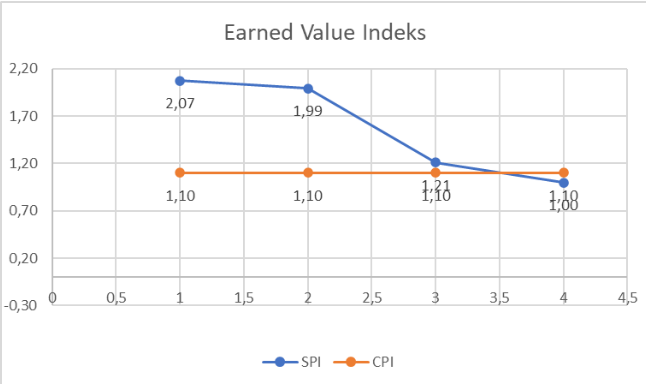

Figure 11. Blendis Embung EVM Index Chart
Source: Processed Researcher, 2024

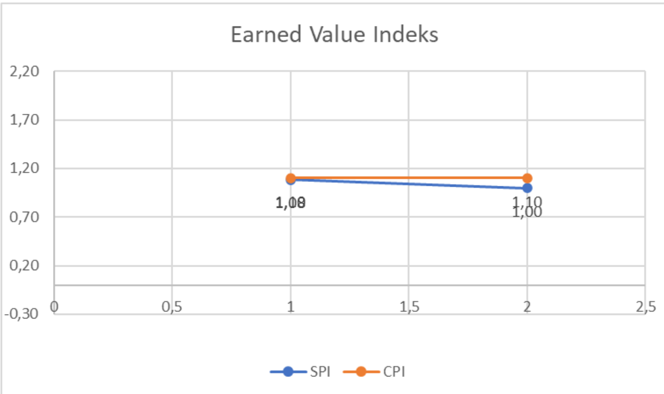

Figure 12. EVM Embung Branjang Index Chart
Source: Processed Researcher, 2024

Research Findings
Project Performance Evaluation

Based on the results of the analysis, the performance of the projects at WS Brantas varies. Locations such as Embung Kerjen and Ngrobyong were recorded to have SPI values below 0. 9, which indicates a significant delay in schedule. On the other hand, Embung Branjang and Madenan showed better performance with SPI values above 0. 95, reflecting more efficient schedule management. In terms of costs, almost all locations show a CPI close to 1, except for Embung Kerjen which recorded a CPI of 0. 91, indicating an overrun of costs.

Effectiveness of the Earned Value Method

The Earned Value method has proven to be effective in quantitatively identifying project deviations. By analyzing using MS Project 2016, we can get a clear picture of the relationship between costs and project schedules. For example, the Embung Branjang project, which has an SPI and CPI value close to 1, shows that this method can improve the efficiency of project management by providing accurate data to support decision-making.

Standardization Recommendations

This study recommends the consistent application of the Earned Value method in reservoir rehabilitation projects. Additionally, integration with software such as MS Project can improve the effectiveness of project supervision. It is hoped that this method can be used as a standard in the management of construction projects, especially those involving public funds. As an illustration, in the Embung Branjang rehabilitation project, the application of the Earned Value method resulted in an SPI value of 0. 96 and CPI 0. 98, which reflects significant efficiencies in both time and cost management. These findings support 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 to optimize the use of public budgets, minimize waste, and increase public trust in infrastructure projects.

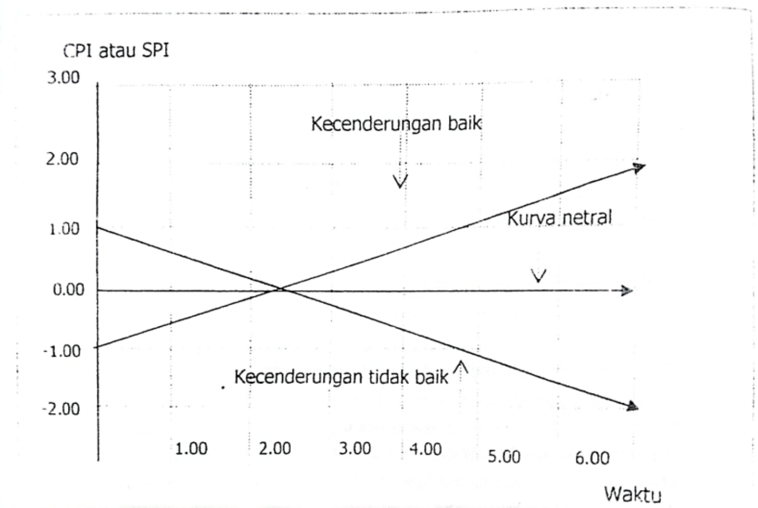

Figure 13. SPI and CPI Comparison Graph at Each Location
Source: Processed Researcher, 2024

The graph above shows the comparison of SPI and CPI values at each project site. Locations with an SPI value below 0.9 require special attention to improve the implementation schedule.

CONCLUSION

This study evaluates the cost and schedule performance of the WS Brantas reservoir rehabilitation projects using the Earned Value Method (EVM) integrated with MS Project 2016, revealing significant variation across locations—some like Embung Branjang and Madenan demonstrate optimal efficiency, while others such as Embung Kerjen and Ngrobyong face challenges related to material delays, difficult terrain, and fluctuating work volumes. The application of EVM proved effective for systematically measuring progress in costs and schedules, enhancing data-driven decision-making and accountability in managing public infrastructure budgets. Focusing on medium-scale projects, this research expands understanding of EVM’s utility beyond previous contexts. However, limitations include restricted site coverage and lack of consideration for external factors such as government policies and weather conditions. Future research should broaden the scope to include more diverse project sites and integrate advanced monitoring technologies like drones for real-time field data, as well as analyze the influence of policies and regulations on project outcomes, thereby providing a more comprehensive framework to improve construction project management efficiency and effectiveness.

REFERENCES

Acebes, F., Pajares, J., Galán, J. M., & López-Paredes, A. (2015). Beyond earned value management: A graphical framework for integrated cost, schedule and risk monitoring. *Procedia - Social and Behavioral Sciences, 194*, 181–189. https://doi.org/10.1016/j.sbspro.2015.06.134

Acebes, F., Pereda, M., Poza, D., Pajares, J., & Galán, J. M. (2019). Stochastic earned value analysis using Monte Carlo simulation and statistical learning techniques. *International Journal of Project Management, 37*(7), 1048–1061. https://doi.org/10.1016/j.ijproman.2019.09.001

Agitiya Wahyu, A., Gunasti, A., & Cahya Dewi, I. (2024). Standardize time and cost performance with the earned value method at the project structure work stage. *Sustainable Civil Building Management and Engineering Journal, 1*(1), 31–40. https://doi.org/10.47134/scbmej.v1i1.2138

Asmoro, M. R., Witjaksana, B., & Tjendani, H. T. (2024). Cost and time analysis using earned value method building construction of distance learning program units of Surabaya Open University phase II. *International Journal on Advanced Technology, 3*(1). https://ojs.transpublika.com/index.php/IJATEIS/

Batselier, J. (2017). *Empirical evaluation of earned value management methodologies* [Doctoral dissertation, KU Leuven]. https://lirias.kuleuven.be/handle/123456789/571234

Fleming, Q. W., & Koppelman, J. M. (2016). *Earned value project management* (4th ed.). Project Management Institute.

Flyvbjerg, B., Ansar, A., Budzier, A., Buhl, S., Cantarelli, C., Garbuio, M., Glenting, C., Holm, M. S., Lovallo, D., Lunn, D., Molin, E., Rønnest, A., Stewart, A., & van Wee, B. (2018). Five things you should know about cost overrun. *Transportation Research Part A: Policy and Practice, 118*, 174–190. https://doi.org/10.1016/j.tra.2018.07.013

Gebrehiwet, T., & Luo, H. (2025). Performance evaluation of construction project by earned value management system in Amhara waterworks construction enterprise. *Discover Civil Engineering, 2*(1), Article 193. https://doi.org/10.1007/s44290-025-00193-0

Irniawan, D., Oetomo, W., & Marleno, R. (2023). Cost and time analysis using earned value method in administration building construction project at Polije campus. *International Journal on Advanced Technology, 2*(4). https://ojs.transpublika.com/index.php/IJATEIS/

Kerzner, H. (2017). *Project management: A systems approach to planning, scheduling, and* *controlling* (12th ed.). John Wiley & Sons.

Larsen, J. K., Shen, G. Q., Lindhard, S. M., & Brunoe, T. D. (2016). Factors affecting schedule delay, cost overrun, and quality level in public construction projects. *Journal of Management in Engineering, 32*(1), Article 04015032. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000391

Mahamid, I. (2020). Schedule delay in Saudi Arabia road construction projects: Size, estimate, determinants and effects. *International Journal of Architecture, Engineering and Construction, 9*(3), 51–58. https://doi.org/10.7492/IJAEC.2020.013

Naderpour, A., & Mofid, S. (2020). Performance measurement of schedule and cost analysis by using earned value management for a residential building. *Materials Today: Proceedings, 33*(7), 4994–4999. https://doi.org/10.1016/j.matpr.2020.12.718

Narbaev, T., & De Marco, A. (2017). An earned schedule-based regression model to improve cost estimate at completion. *International Journal of Project Management, 35*(6), 1056–1066. https://doi.org/10.1016/j.ijproman.2017.04.012

Pinto, J. K., Patanakul, P., & Pinto, M. B. (2021). The aura of capability: Gender bias in selection for a project manager position. *International Journal of Project Management, 39*(4), 420–431. https://doi.org/10.1016/j.ijproman.2021.02.001

Reski Meliya, K., Purnama Sari, D., Arrie Rafshanjani, M., & Artikel, H. (n.d.). Evaluation techniques for the implementation of project development using the earned value method. *ETHNIK: Journal of Economics*.

Scientific Reports. (2025). Comparative analysis of earned value management techniques in construction projects. *Scientific Reports, 15*, Article 5834. https://doi.org/10.1038/s41598-025-05834-z

Thoha, P., Balido, S., Tjendani, H. T., & Witjaksana, B. (2024). Analysis of implementation delays using the earned value method (on the Purwosari-SekarMojo road works, Pasuruan District). *International Journal on Advanced Technology, 3*(1). https://ojs.transpublika.com/index.php/IJATEIS/

Utomo, B. S., Wibowo, K., & S, S. (2022). Earned value concept as a method to analyze cost and time control. *Journal of Advanced Civil and Environmental Engineering, 5*(2), 103–112. https://doi.org/10.30659/jacee.5.2.103-112

Willems, L. L., & Vanhoucke, M. (2015). Classification of articles and journals on project control and earned value management. *International Journal of Project Management, 33*(7), 1610–1634. https://doi.org/10.1016/j.ijproman.2015.06.003

Zhang, L., Zhao, Q., & Xia, Q. (2018). An integrated cost, schedule, and risk control framework for construction projects under uncertainty. *Automation in Construction, 95*, 54–66. https://doi.org/10.1016/j.autcon.2018.07.026