

## Time and Cost Performance Evaluation Using Earned Value Management in Residential Construction Projects: A Case Study of the Hanglekir Housing Development

Riris Setiyowati<sup>1</sup>, Jalaludin<sup>2\*</sup>

<sup>1,2</sup> Civil Engineering, Universitas Dian Nusantara, Indonesia

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### Corresponding author\*:

[jalaludin@dosen.undira.ac.id](mailto:jalaludin@dosen.undira.ac.id)

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**Abstract:** Construction projects frequently experience discrepancies between planned schedules and actual implementation, resulting in delays and cost inefficiencies. Therefore, effective monitoring is needed to evaluate project performance and maintain alignment with planned time and budget targets. **Objective:** This study evaluates the time and cost performance of the Hanglekir Residential Housing Development Project using the Earned Value Management (EVM) approach. **Methodology:** This research employed a mixed-method case study design. Quantitative data were obtained from project documents, including cost budget plans, schedules, and progress reports, while qualitative data were collected through field observations and interviews. Project performance was analyzed using EVM indicators, namely Schedule Variance (SV), Cost Variance (CV), Schedule Performance Index (SPI), Cost Performance Index (CPI), and forecasting indicators such as Estimate at Completion (EAC) and Estimate at Schedule (EAS). **Findings:** The results indicate that the project experienced schedule delays, as shown by SPI values consistently below 1. However, cost performance was relatively efficient in several periods, reflected by CPI values above 1. Forecasting results show that the final project cost is likely to remain below the initial budget, while the completion time is expected to slightly exceed the planned schedule. **Implications:** These findings demonstrate the importance of integrated project monitoring to improve time and cost control. **Originality:** This study provides empirical evidence of the practical application of EVM for evaluating both schedule and cost performance in a residential construction project.

**Keywords:** Earned Value Management; construction project performance; schedule performance index; cost performance index; construction project management.

## INTRODUCTION

The construction sector plays a strategic role in supporting national economic growth and infrastructure development. In Indonesia, the construction industry contributes significantly to the national economy and urban development, particularly through the development of residential buildings, commercial facilities, and public infrastructure. According to the Central Statistics Agency the construction sector consistently contributes more than 10 percent of Indonesia's Gross Domestic Product (GDP), making it one of the key drivers of economic growth (BPS, 2024). However, despite its economic importance,

many construction projects still face challenges related to project delays and cost overruns. Reports from infrastructure monitoring institutions indicate that deviations in project schedule and budget remain common problems in construction projects, particularly in projects involving complex coordination among multiple stakeholders (Flyvbjerg, 2014).

In practice, construction project delays and cost overruns are frequently reported in various infrastructure and building projects. Media reports highlight that delays in construction projects are often caused by factors such as design changes, material price increases, and coordination problems between contractors and project owners. For example, reports in national media indicate that several building and infrastructure projects in Indonesia experienced schedule delays due to fluctuations in construction material prices and administrative approval processes (Indonesia, 2024; Kompas.com, 2023). Such conditions demonstrate that effective project monitoring and control mechanisms are essential to ensure that construction projects can be completed within planned schedules and budgets. Therefore, the development and application of systematic project performance evaluation methods have become increasingly important in improving construction project management practices.

Previous studies have addressed this issue first from the perspective of construction project management and cost–schedule integration. In this stream, project control is understood as a managerial effort to align work execution with predefined targets of time, cost, and scope. Fleming and Koppelman emphasize that effective project control requires integrating physical progress, time consumption, and cost expenditure into a unified performance framework (Fleming & Koppelman, 2016). Similarly, Kim and Reinschmidt show that forecasting and control become more meaningful when cost and schedule information are analytically connected rather than treated as separate reporting domains (Kim & Reinschmidt, 2010). Lipke also demonstrates that schedule performance cannot always be interpreted adequately through conventional cost-based measures alone, which implies that project control needs more refined integration between cost and time indicators (Lipke, 2003). Together, these studies establish that integrated project control is central to performance evaluation, but they also reveal that many projects still struggle to operationalize such integration in actual implementation settings.

A second stream of literature examines delay factors and cost overruns in construction projects. This body of research consistently identifies weak planning, unrealistic scheduling, ineffective site coordination, unclear scope, and communication problems as

major causes of project delays. Doloi, Sawhney, Iyer, and Rentala, for example, identify lack of commitment, poor site management, weak coordination, improper planning, and poor communication as critical causes of delay in construction projects (Doloi et al., 2012). Studies on cost overruns likewise highlight that design modifications, rework, optimism bias, and managerial inefficiencies can substantially increase project cost and disrupt implementation continuity. Love, Edwards, and Irani argue that cost overruns in infrastructure projects cannot be explained solely by optimism bias, but are also shaped by deeper organizational and managerial conditions (Love et al., 2012). This stream is therefore valuable in identifying what disrupts project performance, yet it tends to concentrate on causal factors rather than on measuring the magnitude of project performance deviation through a unified quantitative framework.

A third stream of research focuses on Earned Value Management (EVM) and forecasting through CPI and SPI. In this stream, EVM is widely used to integrate cost, schedule, and progress information into performance indicators such as the Cost Performance Index (CPI) and Schedule Performance Index (SPI). Fleming and Koppelman position EVM as a practical management system for tracking project efficiency (Fleming & Koppelman, 2016), while Kim and Reinschmidt show that earned value data can also be used for probabilistic forecasting of project duration (Kim & Reinschmidt, 2010). However, this literature also points to limitations in traditional EVM forecasting. Lipke argues that schedule assessment based purely on monetary units can distort the understanding of actual time performance (Lipke, 2003), while Khamooshi and Golafshani propose Earned Duration Management to separate schedule measurement from cost-based distortions (Khamooshi & Golafshani, 2014). Vanhoucke further shows that project control efficiency depends not only on the existence of indicators (Vanhoucke, 2012), but also on how those indicators are interpreted and used in dynamic control settings. Thus, although EVM-based forecasting has developed substantially, the literature still leaves open the question of how effectively these indicators explain real project conditions when applied to specific construction cases with identifiable field problems.

Based on these three streams, the main gap in previous research lies in the limited integration between project management control, delay and overrun factors, and empirical EVM-based performance evaluation within one real construction case. Many studies discuss integration models conceptually, identify delay factors descriptively, or improve forecasting techniques methodologically, but relatively few combine these perspectives to

evaluate how actual project progress, actual cost expenditure, and field constraints interact in one ongoing project. Accordingly, this study aims to analyze the schedule and cost performance of the Hanglekir four-story residential project by applying Earned Value Management through the calculation of BCWS, BCWP, ACWP, SV, CV, SPI, and CPI, and by extending the analysis to forecasting indicators such as ETC, EAC, ETS, and EAS. Through this design, the study seeks to answer the empirical gap left by earlier research by showing how integrated project performance measurement can be used to assess actual deviations in a specific construction context.

Based on the identified gap, this study advances the argument that EVM can function not only as a monitoring tool, but also as an empirical decision-support framework for diagnosing project inefficiency and forecasting completion outcomes in real construction practice. The working hypothesis is that if the Hanglekir project is experiencing schedule underperformance, then its SPI will remain below 1, whereas fluctuations in CPI will reveal whether cost utilization is efficient or inefficient at different reporting periods. A further assumption is that deviations in these indicators are not merely numerical symptoms but are linked to practical field factors such as design changes, coordination weaknesses, and implementation constraints. Therefore, by applying EVM indicators to an actual residential construction project, this study expects to demonstrate that integrated performance analysis can reveal both the extent of deviation and the managerial meaning of that deviation for project control.

## RESEARCH METHOD

The unit of analysis in this study is the time and cost performance of a multi-story residential construction project, specifically the Hanglekir four-story residential project located on Jl. Terusan Hanglekir, Kebayoran Lama, South Jakarta. The focus of the study is the conformity between project planning and actual implementation, particularly in relation to schedule achievement and cost efficiency during project execution. This project was selected because it provides relevant empirical data, including project schedules, cost budget plans, weekly progress reports, and actual expenditure records, which are required to measure project performance using Earned Value Management indicators.

This study employs a mixed-method case study design by combining quantitative and qualitative approaches. The quantitative approach was chosen because the study aims to measure project performance using numerical data derived from planned progress, actual

progress, planned costs, and actual costs. These data are then converted into project performance indicators such as Schedule Variance (SV), Cost Variance (CV), Schedule Performance Index (SPI), and Cost Performance Index (CPI), as well as forecasting indicators including Estimate to Complete (ETC), Estimate at Completion (EAC), Estimate to Schedule (ETS), and Estimate at Schedule (EAS). Meanwhile, the qualitative approach was used to explain the actual implementation conditions and identify practical factors causing deviations between project planning and field realization. The case study method was selected because it allows an in-depth investigation of project performance in a real construction setting.

The sources of data in this research consist of primary and secondary data. Primary data were obtained through field observations and interviews with parties directly involved in the project, such as project management personnel and field executors. These data were used to understand the actual conditions of implementation and to identify the factors affecting project performance. Secondary data were obtained from project documents, including the Budget Plan (RAB), project schedules, weekly progress reports, and actual project cost records. These documents were used as the main source of quantitative data for calculating project performance and forecasting project completion.

Data were collected through three techniques, namely documentation study, field observation, and semi-structured interviews. Documentation study was conducted by reviewing project administrative and technical records, such as cost budgets, S-curves, time schedules, and work progress reports. Field observation was carried out to examine actual project conditions, including work progress and operational constraints during implementation. Interviews were conducted using interview guidelines to collect information regarding delays, design changes, coordination issues, weather conditions, and cost control practices. Through these techniques, the study obtained both measurable data and contextual explanations related to project execution.

The data were analyzed in several stages using descriptive quantitative and qualitative analysis. First, the study calculated cumulative planned progress and cumulative actual progress based on project reports. The cumulative planned progress was obtained using the following formula:

$$KPR_n = KPR_{n-1} + PR_n$$

where  $KPR_n$  is the cumulative planned progress in period  $n$ ,  $KPR_{n-1}$  is the cumulative planned progress in the previous period, and  $PR_n$  is the planned progress in period  $n$ .

The cumulative actual progress was calculated using:

$$KPA_n = KPA_{n-1} + PA_n$$

where  $KPA_n$  is the cumulative actual progress in period  $n$ ,  $KPA_{n-1}$  is the cumulative actual progress in the previous period, and  $PA_n$  is the actual progress in period  $n$ .

Second, deviation analysis was conducted to identify the difference between planned and actual performance, using:

$$Deviation = KPR - KPA$$

A positive deviation indicates that actual progress is below planned progress, while a smaller or negative deviation indicates better schedule achievement.

Third, project performance was analyzed using the Earned Value Management (EVM) approach. The main variables used in this study are Budgeted Cost of Work Scheduled (BCWS), Budgeted Cost of Work Performed (BCWP), and Actual Cost of Work Performed (ACWP). These were calculated as follows:

$$BCWS = (\text{Planned Progress}) \times (\text{Total Project Budget})$$

$$BCWP = (\text{Actual Progress}) \times (\text{Total Project Budget})$$

$$ACWP = \text{Actual cost incurred during project implementation}$$

Based on these variables, the study calculated schedule and cost variances using:

$$SV = BCWP - BCWS$$

$$CV = BCWP - ACWP$$

where  $SV$  represents Schedule Variance and  $CV$  represents Cost Variance. A negative  $SV$  indicates that the project is behind schedule, while a negative  $CV$  indicates that the project is experiencing cost inefficiency.

Furthermore, the study measured project performance efficiency using the following indices:

$$SPI = \frac{BCWP}{BCWS}$$

$$CPI = \frac{BCWP}{ACWP}$$

where *SPI* is the Schedule Performance Index and *CPI* is the Cost Performance Index. An *SPI* value below 1 indicates schedule delay, while a *CPI* value below 1 indicates cost overrun or inefficiency.

Finally, forecasting analysis was conducted to estimate project completion cost and time. The Estimate to Complete (ETC) was calculated using:

$$ETC = \frac{BAC - BCWP}{CPI}$$

where *BAC* is the Budget at Completion or total contract value. Then, Estimate at Completion (EAC) was calculated as:

$$EAC = ACWP + ETC$$

To estimate the remaining project duration, Estimate to Schedule (ETS) was calculated using:

$$ETS = \frac{\text{Remaining Time}}{SPI}$$

and Estimate at Schedule (EAS) was calculated as:

$$EAS = \text{Reporting Time} + ETS$$

The quantitative results were then interpreted descriptively to assess the level of time and cost efficiency of the project. In addition, qualitative data obtained from field observations and interviews were analyzed descriptively to explain the factors causing deviations in project performance. Through this combination of numerical analysis and contextual interpretation, the study provides a comprehensive evaluation of the project's schedule and cost performance.

## RESULT

This research was conducted on the Residential Housing Development Project in Hanglekir. The estimated cost of this house is Rp. 23,789,000,000 and the implementation period is 18 months. The project site is located in a fairly dense residential area, requiring careful planning, especially in terms of work scheduling and material mobilization.

**Table 1.** Residential Housing Development Project Data

No.	Project Information	Description
1	Project Name	Hanglekir Residential House
2	Project Location	Jl. Terusan Hanglekir, Kebayoran Lama, South Jakarta
3	Project Owner	Mr. X
4	Project Budget (RAB)	IDR 23,789,000,000

No.	Project Information	Description
5	Construction Period	18 Months
6	Architectural Consultant	BS Architects
7	Structural Consultant	PT Graha Oprima Design
8	M&E Consultant	PT Hantaran Prima Mandiri
9	Construction Management	Thomas Wilson
10	Quantity Surveyor	Dian Robiana
11	Main Contractor	EKA Construction

### Cost Budget Plan and Project Schedule

The Cost Budget Plan (RAB) and project implementation schedule were prepared as a basis for controlling the costs and timing of the construction of the Hanglekir House. Details of the work, ranging from preparatory work to plumbing installation, are presented in detail in Figure 1. The S-curve is used to illustrate the weight of weekly work progress during the project implementation period, so that the progress of the project can be monitored and compared with the established plan.

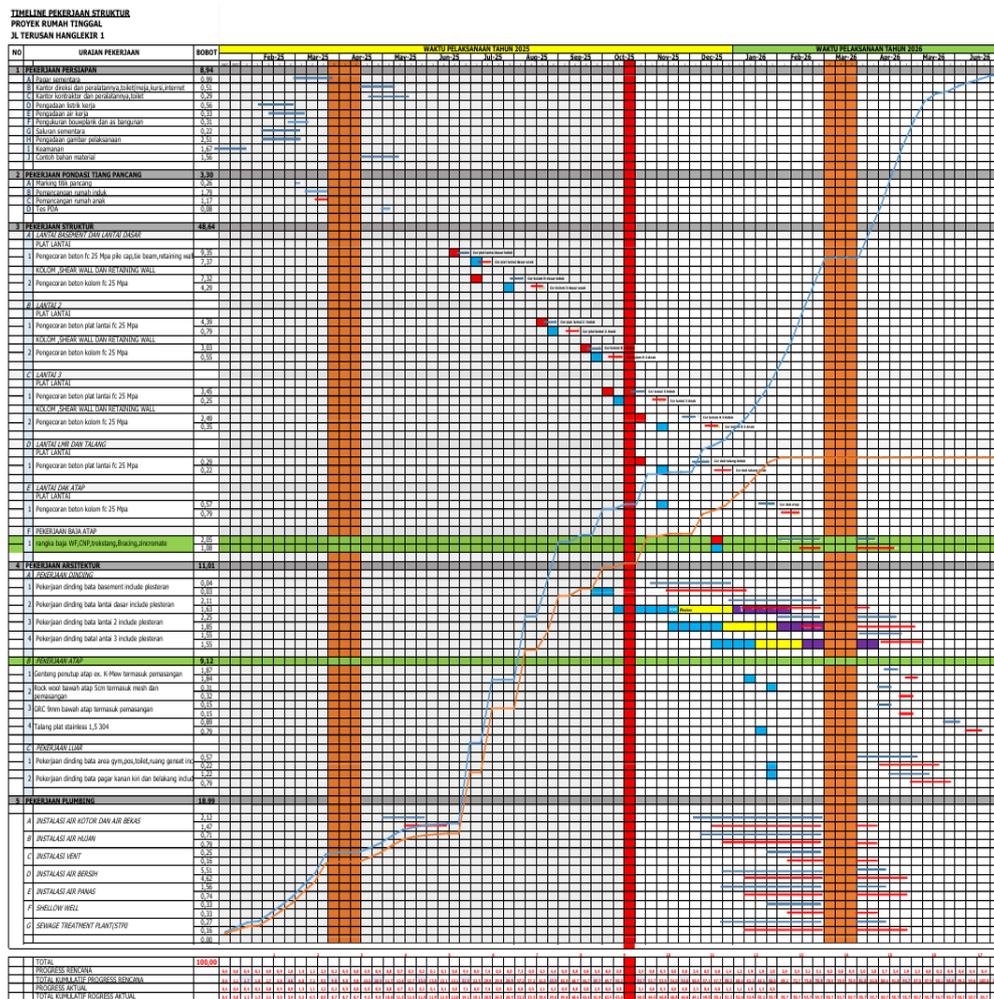


Figure 1. S curve

## Data Analysis

### Cumulative Total Plan Progress

**Table 2.** Cumulative Total Plan Progress

	Planned Weight (%)	Total Planned Weight (%)
1	1,670	1,67
2	2,950	4,62
3	5,180	9,80
4	1,100	10,90
5	2,060	12,96
6	9,530	22,49
7	7,370	29,86
8	16,000	45,86
9	2,760	48,62
10	5,060	53,68
11	0,280	53,96
12	5,210	59,17
13	7,440	66,61
14	12,240	78,85
15	2,960	81,81
16	12,910	94,72
17	4,050	98,77
18	1,230	100,00

(Source : Result analysis 2026)

### Cumulative Actual Progress

**Table 3.** Cumulative Actual Progress

Month	Actual Weight (%)	Total Actual Weight (%)
1	1,200	1,20
2	2,700	3,90
3	4,800	8,70
4	1,100	9,80
5	2,100	11,90
6	7,200	19,10
7	7,400	26,50
8	13,100	39,60
9	3,300	42,90
10	3,600	46,50
11	0,300	46,80
12	4,500	51,30
13	4,400	55,70
14	0,000	55,70
15	0,000	55,70
16	0,000	55,70
17	0,000	55,70
18	0,000	55,70

### Deviation Difference

**Table 4.** Deviation Difference

Month	Plan Weight(%)	Actual Weight (%)	Deviation
1	1,67	1,20	0,47
2	4,62	3,90	0,72
3	9,80	8,70	1,10
4	10,90	9,80	1,10
5	12,96	11,90	1,06
6	22,49	19,10	3,39
7	29,86	26,50	3,36
8	45,86	39,60	6,26
9	48,62	42,90	5,72
10	53,68	46,50	7,18
11	53,96	46,80	7,16
12	59,17	51,30	7,87
13	66,61	55,70	10,91
14	78,85	0,000	78,85
15	81,81	0,000	81,81
16	94,72	0,000	94,72
17	98,77	0,000	98,77
18	100,00	0,000	100,00

**BWCS Calculation**

BCWS = (Planned Progress) x (Total Project Budget)

BCWS calculation for month 01, period February 8, 2025 – March 8, 2025

BCWS = 1.67% x IDR 23,789,000,000

BCWS = IDR 397,276,300

**Table 5.** BCWS Construction of Hanglekir Residential Houses

Month	Plan Weight(%)	Contract Value	BCWS	Cumulative BCWS
1	1,670	Rp 23.789.000.000	Rp 397.276.300	Rp 397.276.300
2	2,950	Rp 23.789.000.000	Rp 701.775.500	Rp 1.099.051.800
3	5,180	Rp 23.789.000.000	Rp 1.232.270.200	Rp 2.331.322.000
4	1,100	Rp 23.789.000.000	Rp 261.679.000	Rp 2.593.001.000
5	2,060	Rp 23.789.000.000	Rp 490.053.400	Rp 3.083.054.400
6	9,530	Rp 23.789.000.000	Rp 2.267.091.700	Rp 5.350.146.100
7	7,370	Rp 23.789.000.000	Rp 1.753.249.300	Rp 7.103.395.400
8	16,000	Rp 23.789.000.000	Rp 3.806.240.000	Rp 10.909.635.400
9	2,760	Rp 23.789.000.000	Rp 656.576.400	Rp 11.566.211.800
10	5,060	Rp 23.789.000.000	Rp 1.203.723.400	Rp 12.769.935.200
11	0,280	Rp 23.789.000.000	Rp 66.609.200	Rp 12.836.544.400
12	5,210	Rp 23.789.000.000	Rp 1.239.406.900	Rp 14.075.951.300
13	7,440	Rp 23.789.000.000	Rp 1.769.901.600	Rp 15.845.852.900
14	12,240	Rp 23.789.000.000	Rp 2.911.773.600	Rp 18.757.626.500
15	2,960	Rp 23.789.000.000	Rp 704.154.400	Rp 19.461.780.900
16	12,910	Rp 23.789.000.000	Rp 3.071.159.900	Rp 22.532.940.800
17	4,050	Rp 23.789.000.000	Rp 963.454.500	Rp 23.496.395.300
18	1,230	Rp 23.789.000.000	Rp 292.604.700	Rp 23.789.000.000

**BCWP Calculation**

BCWP = (Actual Progress) x (Total project budget)

BCWP calculation for month 01 of the period February 8, 2025 – March 8, 2025

$$BCWP = 1.2\% \times \text{IDR } 23,789,000,000$$

$$BCWP = \text{IDR } 285,468,000$$

**Table 6.** BCWP Construction of Hanglekir Residential Houses

Month	Actual Weight(%)	Contract Value	BCWP	Cumulative BCWP
1	1,200	Rp 23.789.000.000	Rp 285.468.000	Rp 285.468.000
2	2,700	Rp 23.789.000.000	Rp 642.303.000	Rp 927.771.000
3	4,800	Rp 23.789.000.000	Rp 1.141.872.000	Rp 2.069.643.000
4	1,100	Rp 23.789.000.000	Rp 261.679.000	Rp 2.331.322.000
5	2,100	Rp 23.789.000.000	Rp 499.569.000	Rp 2.830.891.000
6	7,200	Rp 23.789.000.000	Rp 1.712.808.000	Rp 4.543.699.000
7	7,400	Rp 23.789.000.000	Rp 1.760.386.000	Rp 6.304.085.000
8	13,100	Rp 23.789.000.000	Rp 3.116.359.000	Rp 9.420.444.000
9	3,300	Rp 23.789.000.000	Rp 785.037.000	Rp 10.205.481.000
10	3,600	Rp 23.789.000.000	Rp 856.404.000	Rp 11.061.885.000
11	0,300	Rp 23.789.000.000	Rp 71.367.000	Rp 11.133.252.000
12	4,500	Rp 23.789.000.000	Rp 1.070.505.000	Rp 12.203.757.000
13	4,400	Rp 23.789.000.000	Rp 1.046.716.000	Rp 13.250.473.000

### ACWP Calculation

Actual Cost is the total actual cost incurred in the implementation of the project, which consists of direct and indirect costs. Direct costs include expenditures for materials, labor, equipment, and subcontracted work, while indirect costs include office operating costs and field operating costs.

**Table 7.** ACWP Construction of Hanglekir Residential Houses

Month	Direct and Indirect Costs	
	ACWP	Cumulative ACWP
1	Rp 703.318.452	Rp 703.318.452
2	Rp 207.909.352	Rp 911.227.804
3	Rp 1.070.074.753	Rp 1.981.302.557
4	Rp 1.944.814.433	Rp 3.926.116.990
5	Rp 815.004.806	Rp 4.741.121.796
6	Rp 1.208.125.527	Rp 5.949.247.323
7	Rp 1.054.496.936	Rp 7.003.744.259
8	Rp 1.102.002.924	Rp 8.105.747.183
9	Rp 942.428.320	Rp 9.048.175.503
10	Rp 798.792.758	Rp 9.846.968.261
11	Rp 812.510.947	Rp 10.659.479.208
12	Rp 712.914.762	Rp 11.372.393.970
13	Rp 283.403.809	Rp 11.655.797.779
14	Rp -	Rp -
15	Rp -	Rp -

### SV Value

SV is obtained by subtracting BCWP from BCWS:

SV calculation for month 01 of the period February 8, 2025 – March 8, 2025:

$$SV = BCWP - BCWS$$

$$SV = IDR 397,276,300 - IDR 285,468,000$$

$$SV = - IDR 111,808,300$$

**Table 8.** SV Construction of Hanglekir Residential Houses

Month	Cumulative BCWP	Cumulative BCWS	SV
1	Rp 285.468.000	Rp 397.276.300	-Rp 111.808.300
2	Rp 927.771.000	Rp 1.099.051.800	-Rp 171.280.800
3	Rp 2.069.643.000	Rp 2.331.322.000	-Rp 261.679.000
4	Rp 2.331.322.000	Rp 2.593.001.000	-Rp 261.679.000
5	Rp 2.830.891.000	Rp 3.083.054.400	-Rp 252.163.400
6	Rp 4.543.699.000	Rp 5.350.146.100	-Rp 806.447.100
7	Rp 6.304.085.000	Rp 7.103.395.400	-Rp 799.310.400
8	Rp 9.420.444.000	Rp 10.909.635.400	-Rp 1.489.191.400
9	Rp 10.205.481.000	Rp 11.566.211.800	-Rp 1.360.730.800
10	Rp 11.061.885.000	Rp 12.769.935.200	-Rp 1.708.050.200
11	Rp 11.133.252.000	Rp 12.836.544.400	-Rp 1.703.292.400
12	Rp 12.203.757.000	Rp 14.075.951.300	-Rp 1.872.194.300
13	Rp 13.250.473.000	Rp 15.845.852.900	-Rp 2.595.379.900
14	Rp -	Rp 18.757.626.500	-Rp 18.757.626.500
15	Rp -	Rp 19.461.780.900	-Rp 19.461.780.900
16	Rp -	Rp 22.532.940.800	-Rp 22.532.940.800
17	Rp -	Rp 23.496.395.300	-Rp 23.496.395.300
18	Rp -	Rp 23.789.000.000	-Rp 23.789.000.000

CV Value

CV is obtained by subtracting ACWP from BCWP.

SV calculation for month 01 of the period February 8, 2025 – March 8, 2025:

$$CV = BCWP - ACWP$$

$$CV = IDR 285,468,000 - IDR 703,318,452$$

$$CV = - IDR 417,850,452$$

**Table 9.** SV Construction of Hanglekir Residential Houses

Month	Cumulative BCWP	Cumulative ACWP	CV
1	Rp 285.468.000	Rp 703.318.452	-Rp 417.850.452
2	Rp 927.771.000	Rp 911.227.804	Rp 16.543.197
3	Rp 2.069.643.000	Rp 1.981.302.557	Rp 88.340.443
4	Rp 2.331.322.000	Rp 3.926.116.990	-Rp 1.594.794.990
5	Rp 2.830.891.000	Rp 4.741.121.796	-Rp 1.910.230.796
6	Rp 4.543.699.000	Rp 5.949.247.323	-Rp 1.405.548.323
7	Rp 6.304.085.000	Rp 7.003.744.259	-Rp 699.659.259
8	Rp 9.420.444.000	Rp 8.105.747.183	Rp 1.314.696.817
9	Rp 10.205.481.000	Rp 9.048.175.503	Rp 1.157.305.497
10	Rp 11.061.885.000	Rp 9.846.968.261	Rp 1.214.916.739
11	Rp 11.133.252.000	Rp 10.659.479.208	Rp 473.772.792
12	Rp 12.203.757.000	Rp 11.372.393.970	Rp 831.363.030
13	Rp 13.250.473.000	Rp 11.655.797.779	Rp 1.594.675.221

14	Rp-	Rp-	Rp-
15	Rp-	Rp-	Rp-
16	Rp-	Rp-	Rp-
17	Rp-	Rp-	Rp-
18	Rp-	Rp-	Rp-

**SPI Value**

SPI is obtained from BCWP divided by BCWS:

SPI calculation for month 01 of the period February 8, 2025 – March 8, 2025:

$$SPI = BCWP / BCWS$$

$$SPI = IDR 397.276.300 / IDR 397.276.300$$

$$SPI = 0,719$$

**Table 10.** SPI Construction of Hanglekir Residential Houses

Month	Cumulative BCWP	Cumulative BCWS	SPI
1	Rp 285.468.000	Rp 397.276.300	0,719
2	Rp 927.771.000	Rp 1.099.051.800	0,844
3	Rp 2.069.643.000	Rp 2.331.322.000	0,888
4	Rp 2.331.322.000	Rp 2.593.001.000	0,899
5	Rp 2.830.891.000	Rp 3.083.054.400	0,918
6	Rp 4.543.699.000	Rp 5.350.146.100	0,849
7	Rp 6.304.085.000	Rp 7.103.395.400	0,887
8	Rp 9.420.444.000	Rp 10.909.635.400	0,863
9	Rp 10.205.481.000	Rp 11.566.211.800	0,882
10	Rp 11.061.885.000	Rp 12.769.935.200	0,866
11	Rp 11.133.252.000	Rp 12.836.544.400	0,867
12	Rp 12.203.757.000	Rp 14.075.951.300	0,867
13	Rp 13.250.473.000	Rp 15.845.852.900	0,836

**CPI Value**

CPI is obtained from BCWP divided by ACWP:

CPI calculation for month 01 of the period February 8, 2025 – March 8, 2025:

$$CPI = BCWP / ACWP$$

$$CPI = IDR 285,468,000 / IDR 703,318,452$$

$$CPI = 0.406$$

**Table 11.** CPI Construction of Hanglekir Residential Houses

Month	Cumulative BCWP	Cumulative ACWP	CPI
1	Rp 285.468.000	Rp 703.318.452	0,406
2	Rp 927.771.000	Rp 911.227.804	1,018
3	Rp 2.069.643.000	Rp 1.981.302.557	1,045
4	Rp 2.331.322.000	Rp 3.926.116.990	0,594
5	Rp 2.830.891.000	Rp 4.741.121.796	0,597
6	Rp 4.543.699.000	Rp 5.949.247.323	0,764
7	Rp 6.304.085.000	Rp 7.003.744.259	0,900
8	Rp 9.420.444.000	Rp 8.105.747.183	1,162

Month	Cumulative BCWP	Cumulative ACWP	CPI
9	Rp 10.205.481.000	Rp 9.048.175.503	1,128
10	Rp 11.061.885.000	Rp 9.846.968.261	1,123
11	Rp 11.133.252.000	Rp 10.659.479.208	1,044
12	Rp 12.203.757.000	Rp 11.372.393.970	1,073
13	Rp 13.250.473.000	Rp 11.655.797.779	1,137

### Project Performance Projection

ETC (Estimate To Complete) Calculation

$$ETC = (\text{Contra Value} - \text{BWCP}) / \text{CPI}$$

$$ETC = (\text{Rp.}23,789,000,000 - \text{Rp.}13,250,473,000) / 1.137$$

$$ETC = \text{Rp. } 9,270,230,549$$

EAC (Estimate at Completion) Calculation

$$EAC = \text{ACWP} + \text{ETC}$$

$$EAC = \text{Rp. } 11,655,797,779 + \text{Rp. } 9,270,230,549$$

$$EAC = \text{Rp. } 20,926,028,328$$

### ETS (Estimate to Schedule) and EAS (Estimate at Schedule) Calculation

$$ETS = (\text{Remaining Time}) / \text{SPI}$$

$$ETS = (18 - 13) / 0.836$$

$$ETS = 5.98 \text{ Months} \approx 6 \text{ Months}$$

$$EAS = \text{Reporting Time} + \text{ETS}$$

$$EAS = 13 + 5.98$$

$$EAS = 18.98 \text{ Months} \approx 19 \text{ Months}$$

### DISCUSSION

The results of this study indicate that the Hanglekir Residential Housing Development Project experienced deviations between planned and actual project performance, particularly in terms of schedule achievement. The comparison between cumulative planned progress and cumulative actual progress shows that the actual project progress was consistently lower than the planned progress during the first thirteen months of implementation. This condition resulted in increasing deviation values over time, indicating that the project experienced delays relative to the initial schedule. The Schedule Variance (SV) values obtained during the observation period were consistently negative, and the Schedule Performance Index (SPI) values remained below 1. For example, the SPI

value in the first month was 0.719 and reached 0.836 in the thirteenth month, indicating that the project only achieved around 71.9%–83.6% of the planned work progress.

In contrast, the project showed relatively better performance in terms of cost efficiency. Although negative Cost Variance (CV) occurred in several early months, positive CV values began to appear after the eighth month of implementation. This trend is supported by the Cost Performance Index (CPI), which increased and remained above 1 after the eighth month, reaching 1.137 in the thirteenth month. These results indicate that the project was able to produce work value greater than the actual cost incurred. Forecasting analysis further indicates that the estimated project completion cost (EAC) is IDR 20,926,028,328, which is lower than the initial contract value of IDR 23,789,000,000. Meanwhile, the estimated project completion time (EAS) is approximately 19 months, which is slightly longer than the planned duration of 18 months.

The difference between schedule performance and cost performance can be explained by several project implementation factors. The negative SV values and SPI values below 1 indicate that the progress of construction work was slower than planned. This condition may be influenced by operational constraints at the project site, such as limited site accessibility, coordination challenges in dense residential areas, delays in material mobilization, or changes in work priorities during project execution. In projects located in urban residential environments, logistical limitations and site management challenges often affect the speed of construction activities.

On the other hand, the improvement in cost performance reflected by CPI values greater than 1 suggests that the project management team was able to control project expenditures effectively. Efficient resource utilization, careful material procurement, and controlled labor costs may have contributed to maintaining cost efficiency even though the project experienced schedule delays. This indicates that time performance and cost performance do not always move in the same direction in construction projects, and effective financial management can still maintain cost efficiency despite delays in work progress.

The findings of this study are consistent with previous research in construction project management that highlights the frequent occurrence of schedule delays in construction projects. Studies by Doloi identify poor planning, coordination problems, and operational constraints as major factors causing project delays (Doloi et al., 2012). Similarly, Flyvbjerg

notes that many construction and infrastructure projects experience schedule deviations due to complexity and uncertainty in project implementation (Flyvbjerg, 2014).

However, the findings of this study also demonstrate that schedule delays do not necessarily lead to cost overruns. This result supports the argument presented by Fleming and Koppelman that Earned Value Management can reveal differences between schedule performance and cost performance in construction projects (Fleming & Koppelman, 2016). In some cases, project managers are able to maintain cost efficiency even when the project experiences schedule delays. The novelty of this study lies in its empirical application of Earned Value Management indicators in a residential building project context, demonstrating how SPI, CPI, EAC, and EAS can be used simultaneously to evaluate both current project performance and future project projections.

From a broader perspective, the results of this study highlight the importance of integrated project performance monitoring in construction management. The use of Earned Value Management indicators enables project managers to identify deviations in both schedule and cost performance early during project implementation. The results also demonstrate that schedule delays and cost efficiency can coexist within the same project, depending on how project resources are managed and controlled.

These findings contribute to the understanding that construction project performance should not be evaluated solely based on schedule achievement, but should also consider cost efficiency and overall project productivity. The integration of time and cost performance indicators provides a more comprehensive framework for evaluating project success and supports better decision-making in construction project management.

The results of this study show both functional and dysfunctional aspects of project performance. On the positive side, the project demonstrates strong cost efficiency, as indicated by CPI values above 1 and a projected final cost lower than the original project budget. This suggests that the project management team was able to manage financial resources effectively. However, the negative schedule performance indicates that project planning and implementation coordination may need improvement. Delays in construction projects can potentially affect stakeholder satisfaction, contractual commitments, and project delivery timelines.

These results indicate that achieving cost efficiency alone is not sufficient to ensure overall project success. Effective project management must balance both schedule performance and cost performance in order to achieve optimal project outcomes.

Based on the findings of this study, several actions can be recommended to improve project performance in future construction projects. First, project planning and scheduling processes should be strengthened to ensure that the planned schedule reflects realistic project conditions. Second, project managers should implement continuous monitoring systems using project performance indicators such as SPI and CPI to detect deviations early. Third, coordination among project stakeholders, including contractors, consultants, and suppliers, should be improved to minimize delays caused by communication or logistical problems.

Furthermore, the implementation of Earned Value Management should be integrated into routine project monitoring practices in order to improve transparency and decision-making in construction project management. By using performance indicators and forecasting tools systematically, project managers can better anticipate potential project deviations and implement corrective actions to maintain both schedule and cost efficiency.

## CONCLUSION

The findings of this study show that the implementation of the Hanglekir Residential Housing Development Project experienced deviations between planned and actual project performance, particularly in terms of schedule achievement. The analysis using the Earned Value Management (EVM) approach indicates that the project experienced schedule delays, as reflected by negative Schedule Variance (SV) values and Schedule Performance Index (SPI) values consistently below 1 during the observed period. However, the project demonstrated relatively efficient cost performance, as indicated by Cost Performance Index (CPI) values greater than 1 in several periods of implementation. Forecasting analysis also indicates that the estimated final project cost (EAC) is lower than the initial project budget, while the estimated completion time (EAS) suggests a slight delay compared to the original project schedule. These results indicate that although the project experienced delays in work progress, effective cost control strategies were able to maintain overall cost efficiency.

The main contribution of this research lies in the empirical application of Earned Value Management indicators to evaluate both schedule and cost performance in a real residential construction project. By integrating indicators such as SV, CV, SPI, CPI, EAC, and EAS, this study provides a comprehensive framework for assessing project performance and forecasting project completion outcomes. The findings contribute to the development of

construction project management studies by demonstrating how EVM can be used not only as a monitoring tool but also as a decision-support mechanism for evaluating project efficiency and identifying potential deviations during project implementation.

Despite these contributions, this study has several limitations. The analysis is based on a single case study of a residential construction project, which may limit the generalization of the findings to other types of construction projects with different levels of complexity or scale. In addition, the study focuses primarily on quantitative performance indicators and does not deeply explore organizational or managerial factors that may influence project performance. Future research is therefore recommended to examine multiple construction projects with different characteristics and to incorporate additional variables such as risk management, project coordination, and resource management in order to obtain a more comprehensive understanding of factors influencing construction project performance.

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