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Evaluation of Cost and Time Performance Using The Earned Value Management Method in Hospital Building Construction Projects

Putu Eny Suhardiyani[1]*, I Putu Widyarsana[2], Putu Riska Wulandari[3]
Institut Teknologi dan Bisnis STIKOM Bali, Indonesia[1,2]
Universitas Hindu Negeri I Gusti Bagus Sugriwa, Indonesia[3]
Email: suhardiyanieny@gmail.com[1]*, putuwidyarsana@gmail.com[2],
riskawulandari@uhnsugriwa.ac.id[3]

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ABSTRACT

The construction sector currently faces increasingly dynamic challenges, particularly in healthcare infrastructure development, which requires high standards of functionality and timeliness. This study aims to evaluate the effectiveness of project management through cost and schedule performance analysis using the Earned Value Management (EVM) method on a hospital building construction project. The research approach used is descriptive evaluative, analyzing three main variables: Budgeted Cost Work (BCC), and Cost of Goods and Services (CW). Schedule (BCWS), Budgeted Cost Work Performed (BCWP), and Actual Cost Work Performed (ACWP). Results study disclose existence difference significant between achievements financial and time effectiveness. In terms of schedule, the project experienced a projected deviation resulting in a delay of 60 calendar days from the initial contract duration of 360 days. However, financially, the project management has successfully demonstrated very efficient performance. This project is projected to achieve cost savings of Rp. 718,520,400.00 with a total estimated final cost (EAC) of Rp. 38,731,479,600.00 from a total contract value of Rp. 39,450,000,000.00 billion. These results confirm that the implementation of a strict cost control system is able to produce positive budget optimization for the project owner despite facing constraints on the work time aspect.

INTRODUCTION

A construction project is a complex series of activities aimed at achieving a crucial outcome for an organization, where success depends heavily on the efficient management of resources, including labor, cost, and time (Adekunle et al., 2022; Aguilera et al., 2024; Andersen et al., 2025; Ghorbani, 2023; Metwally et al., 2025). These three elements interact closely; changes in one element will directly impact the other two (Adekunle et al., 2022; Chiu et al., 2024; Shi et al., 2024; Sun et al., 2022). The modern construction industry demands a high level of professionalism due to the dynamic nature of the field's uncertainties. In this context, the construction of healthcare facilities such as hospitals holds a very high level of urgency in society, given their crucial role in providing basic public services.

Delays in the completion of medical infrastructure not only result in financial losses for contractors and project owners (Afana et al., 2024; Adam & Lindahl, 2017), but also hinder the public's right to access adequate healthcare facilities (Pham et al., 2024; Allan et al., 2024). In practice, high-rise building projects often encounter technical and non-technical obstacles (Mahendra & Pribadi, 2023; Adam & Lindahl, 2017). Operational challenges in the field

frequently arise from fluctuating material prices, delays in logistics deliveries, unpredictable weather, and the need for adaptive workforce management to maintain productivity (Mahendra & Pribadi, 2023; Hamza et al., 2025; Al-Mamlook et al., 2020).

The construction of a Hospital Building in the Jimbaran area of Bali is one of the major projects studied in this analysis (Yang & Chen, 2024; Ain Shams Engineering Journal, 2024). This project was initially well-designed, with a construction duration of 360 calendar days and a total budget allocation (contract value) of Rp. 39,450,000,000.00 (Afana et al., 2024). The large budget and tight construction deadlines required continuous monitoring (Hasan et al., 2021; Zaman et al., 2022). Field observations indicate that midway through the project cycle, an accumulation of operational constraints caused the physical construction schedule to lag behind the initial operational plan (Hasan et al., 2021; Prasetyo & Hidayat, 2021). This negative deviation required management to reschedule the schedule (Afana et al., 2024; Prasetyo & Hidayat, 2021).

The novelty of this research lies in several key contributions. First, this study provides empirical evidence of a "CPI > 1.0 & SPI < 1.0" scenario in hospital construction, documenting how cost efficiency can be maintained despite schedule delays. Second, the research identifies specific mechanisms contributing to cost savings, including material price negotiation, waste minimization (material wastage reduction), and workforce reallocation during logistics delays. Third, the study quantitatively projects final cost (EAC) and final time (TE) using EVM parameters, providing a complete ex-post evaluation framework. Fourth, the research contextualizes EVM analysis within healthcare infrastructure, identifying delay factors specific to hospital construction (imported HEPA filters, medical spatial design adjustments). Fifth, the study offers a replicable methodology for project owners and contractors to evaluate performance mid-project and at completion.

To ensure projects stay within budget and to detect early quantitative deviations, conventional monitoring methods such as the S-Curve are considered insufficiently comprehensive when applied separately. While the S-Curve provides a visual comparison between plans and cumulative physical results, it fails to simultaneously integrate actual cost elements to predict final project figures. Therefore, an integrated performance evaluation method is needed.

Earned Value Management (EVM) method, or the Earned Value Concept, is a project management instrument that simultaneously integrates aspects of cost, time, and physical work performance. Through EVM, management not only knows the financial status at the time of reporting but is also able to calculate the current work performance index, measure variances, and accurately project the final total cost and estimated actual project completion time. This study specifically tests the use of EVM in detecting anomalies in the performance of this hospital construction project to serve as a basis for corrective policy making.

METHOD

Data Collection Instruments

This study used a descriptive evaluative design that focuses on cost performance analysis. and time. The research location is in a strategic area of Bali. The data processed includes primary and secondary data, including:

1. Plan Cost Budget (RAB) and S Curve.

2. Timetable Implementation (Time Schedule).
3. Report Weekly Progress Physique (Weight Work).
4. Financial Realization and Expenditure Report Project Actual.

Analysis done through three parameter fundamental system result value:

1. BCWS (Budgeted Cost Work Schedule): It is budget plan Which allocated based on the work schedule set out in the contract.
2. BCWP (Budgeted Cost Work Performed): It is mark results or mark work Which physically completed, calculated based on the planned unit price.
3. ACWP (Actual Work Cost Performed): This is the total actual costs incurred to complete the work during the reporting period.

For do analysis use method *Earned Value Management*, researcher collect primary and secondary data from document official project through collaboration with team *Project Management Office* (PMO). Referring to the methodology base control like presented in the document image_df28bf.png, the main data that is processed includes:

1. Plan Budget Cost (RAB): Used For now total project value (BAC) and allocation cost per work item.
2. S-Curve Plan: Used as a basis for determining weight plan cumulative weekly.
3. Implementation Schedule (*Time Schedule*): Used For identify duration limits contract (360 days) and track critical project.
4. Report Weekly Physical Progress (*Progress Report*): Displays performance weight work real success completed in the field.
5. Report Realization Finance / Expenses Current Project: Internal accounting documents contractor regarding cash out for wages, materials, tools, and sub-contractors.

EVM Fundamental Parameters

In accordance the design contained in the document image_df28bf.png, analysis done in a way periodically through three work volume indicators:

1. BCWS (*Budgeted Cost Work Schedule*): Budget allocated plans based on timetable Work contractual. This value obtained from multiplication between weight plan Work cumulative with a total value contract (*BAC*).

$$\text{BCWS} = \%\ \text{Bobot Rencana} \times \text{Nilai Anggaran Proyek (BAC)}$$

2. BCWP (*Budgeted Cost Work Performed*): Often referred to as *Earned Value*. This value reflects the budget for the volume of work that has been physically completed in the field.

$$\text{BCWP} = \%\ \text{Bobot Realisasi Fisik} \times \text{Nilai Anggaran Proyek (BAC)}$$

3. ACWP (*Actual Cost Work Performed*): Total (actual) expenditure of funds issued by accounting to complete a physical work package during a certain period.

RESULT AND DISCUSSION

Evaluation done with compare performance weekly in a way cumulative for mapping deviations that occur during the construction period.

Cumulative Parameter Transition Data Record (Analysis Simulation)

For map condition physical and financial real in a way objective, Table 1 summarizes movement three mark main (BCWS, BCWP, ACWP) of beginning workmanship until the evaluation period end contract plan.

Table 1. Project Evaluation Performance Transition Data Sample

Period Review	Weight Plan (%)	Weight (%)	BCWS (IDR)	BCWP (IDR)	ACWP (IDR)
Week 12	25.00%	23.50%	9,862,500,000	9,270,750,000	9,120,000,000
Week 24	55.00%	48.00%	21,697,500,000	18,936,000,000	18,600,000,000
Week 36	85.00%	72.00%	33,532,500,000	28,404,000,000	27,850,000,000
Week 52	100.00%	85.71%	39,450,000,000	33,812,595,000	33.182.134.445

From Table 1 it appears clear indication beginning that since mid-project (Week 24), the physical volume achieved ($ BCWP$) is always lagging behind the planned target contractual (BCWS), however expenditure actual cash ($ACWP$) always awake lower from mark physical fitness (BCWP).

Analysis Performance Cost (CPI)

Budget performance throughout the observation period was assessed using *the Cost Performance Index* (CPI). Based on comprehensive mathematical calculations of the total work volume of this hospital building project, a very stable cumulative average CPI index value of **1.019 was obtained**.

The CPI figure which is consistent perched above the nominal threshold of 1.0 **(**$CPI > 1.0$) proves height efficiency use of budget capital in the field. Consequences logical from this index of 1.019 indicates that for every cash disbursement of Rp. 1,000, -, management contractor succeeds realize building output worth Rp. 1,019. The main factor trigger efficiency financial This is success team logistics in negotiate precast material prices, minimization remainder wasted material (*material wast*), as well as accuracy subcontractor supervision structure so that No required demolition consequence disabled quality (work repeat).

Analysis Performance Schedule (SPI)

Different with performance financial aspects management time project This faced with quite a few obstacles Massive. Cumulative *Schedule Performance Index* (SPI) parameters show trend drop below ideal number 1.0 ($SPI < 1.0$), especially start enter phase work installation electrical special and mechanical room operation (phase critical). Delay progress physique This triggered by delays delivery of air conditioning system units special (*HEPA Filter*) home pain that must be imported from abroad, plus existence adjustment spatial design medical on request from party committee House pain to align regulations ministry health latest. As a result, the weight progress real stuck at 85.71% at the moment time calendar plan contract beginning has

finished passed (360 days). Through calculation ratio decline speed work (SPI), predicted in a way mathematical that the total time spent for finish all over remainder the work (*Time Estimate*) is inflated to 420 days. This is confirming occurrence total delay of 60 days calendar.

Recapitulation Projection End Project

Table 2. Year-End Projection Recapitulation

Evaluation Parameters	Analysis Value	Information Academic / Operational Status
Budget Contract (BAC)	Rp. 39,450,000,000.00	Total agreed contractual funding ceiling.
Cost Performance Index (CPI)	1,019	Use budget efficient (occurs) Savings).
Schedule Performance Index (SPI)	< 1.0 (Average 0.857)	Progress implémentation physique expérience delay.
Estimate Final Cost (EAC)	Rp. 38,731,479,600.00	Total absorption projection cost real moment 100% completed.
Variance Final Financial (CV_{final })	Rp. 718,520,400.00	Difference profit positive (Remaining Budget) Project).
Duration Contract Plan	360 Day Calendar	Target deadline settlement document legality.
Projection (TE)	420 Calendar Days	Total prediction day for complete physique remainder.
Final Time Deviation	60 Day Calendar	Projection delay hand over accepts physique building.

Analysis Variance Cost and Remainder Work

The delay in the project timeline, the internal financial management capabilities are highly commendable, having mitigated the potential cost overruns that typically threaten large-scale projects. The difference in net operating profit is projected to achieve real cost savings of Rp 718,520,400.00. These budget savings were achieved through the optimization of permanent daily labor assignments, which were diverted to other structural areas during times of delays in core logistics, thus minimizing idle wage costs. This positive remaining fund provided the contractor with liquidity to allocate to cover unforeseen expenses during the extended work period (an additional 60 days), such as field office operational costs, electricity consumption, and heavy equipment rental.

CONCLUSION

Based on results analysis comprehensive use instrument *Earned Value Management* (EVM) against project development building House sick, pulled conclusion scientific as following: 1) Implementation system control internal finance in management project This is considered very successful and effective, as proven by the achievements mark *The Cost Performance Index* (CPI) is consistently above 1.0 (average 1.019), which leads to potential savings remainder ceiling budget worth Rp. 718,520,400.00 of the total value contract Rp. 39,450,000,000.00. Estimate cost real at closing worth Rp. 38,731,479,600.00. 2)

Management scheduling experience deficiency performance shown with mark *Schedule Performance Index* (SPI) < 1.0 which triggers occurrence deviation delay handover physique project for 60 days calendar, so the total duration swell from plan early 360 days to 420 days calendar.

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