

Implementation of EVM for Performance Analysis Using Primavera P6 in Construction Projects

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Abstract: *Construction projects are often found to be overbudgeted, delayed and not up to the standards. Project management techniques such as CPM and PERT are often deployed to control project cost, execution and timely completion. Projects often suffer from these problems due to poor planning, under-supervised execution and poor monitoring of progress. Various modern techniques are researched to control cost and timely completion of projects, such as Earned Value Management (EVM). Metrics of EVM give insights about the project being below schedule, on schedule or ahead of schedule, and similar insights about the cost incurred. This paper aims to assess construction project progress according to EVM metrics and identify reasons for low implementation of EVM analysis in construction projects. For this purpose, data of a tenement project is assessed using EVM in Primavera P6 software. For the reasons of low implementation, responses from contractors and connected professionals are collected and analysed by RII (Relative Importance Index) method.*

Keywords: *Earned Value Management, Primavera P6, Construction Project Management, Schedule Performance Index, Cost Performance Index, Relative Importance Index.*

I. INTRODUCTION

The construction industry is one of the most dynamic, complex, and economically significant sectors in the world, contributing substantially to national infrastructure development, employment generation, and economic growth. In India, where infrastructure development is progressing at an unprecedented pace, the construction sector plays a pivotal role in shaping the built environment and supporting long-term socioeconomic advancement. However, despite its immense significance, the construction industry has consistently been plagued by two of the most persistent and costly challenges in project management — cost overruns and schedule delays.

Across the globe, a substantial proportion of construction projects fail to be completed within their originally planned budgets and timelines. Studies and industry reports have repeatedly highlighted that projects in both the public and private sectors routinely exceed their estimated costs and planned durations, often by significant margins. These overruns arise from inadequate project planning, poor monitoring and control mechanisms, scope changes, resource mismanagement, communication breakdowns, unforeseen site conditions, and the inherent uncertainty associated with construction activities.

At the heart of these challenges lies a fundamental deficiency in traditional project monitoring and control systems. Conventional approaches typically rely on comparing actual expenditure against planned costs, or tracking physical progress through basic tools such as bar charts, Gantt charts, and S-curves. While these tools provide a foundational level of project visibility, they treat cost and schedule as separate, independent dimensions, fail to objectively quantify the value of work actually accomplished, and offer little or no predictive capability regarding future project outcomes.

It is against this backdrop that Earned Value Management (EVM) has emerged as one of the most powerful and widely recognised methodologies for integrated project performance measurement and control. EVM addresses the fundamental shortcomings of traditional monitoring approaches by combining the three critical dimensions of project management — scope, cost, and schedule — into a single, unified analytical framework. By measuring the budgeted value of work actually completed against both the planned value of work scheduled and the actual cost incurred, EVM



provides project managers with objective, quantifiable, and actionable insights into the true status of a project at any given point in time.

A. Concepts of Earned Value Management

Earned Value Management is a project management methodology that integrates scope, schedule, and cost parameters to provide an objective measure of project performance and progress. EVM is widely used in the defence and production sectors, and numerous research studies affirm its capability in controlling schedule and cost in the construction industry. Based on insights from EVM indices, various corrective measures may be taken to overcome delays in cost and schedule. The fundamental terminologies used in EVM analysis are as follows:

Planned Value (PV): Value of activity cost according to planned work quantity and planned cost of activity.

Actual Cost (AC): Actual cost incurred to complete the activity.

Earned Value (EV): Value of cost according to actual work quantity and actual cost.

Cost Variance (CV): Difference between Earned Value and Actual Cost ($CV = EV - AC$).

Schedule Variance (SV): Difference in Earned Value and Planned Value ($SV = EV - PV$).

Cost Performance Index (CPI): $CPI = EV / AC$. Values >1 indicate cost efficiency; <1 indicate overrun.

Schedule Performance Index (SPI): $SPI = EV / PV$. Values >1 indicate ahead of schedule; <1 indicate delay.

Estimate to Complete (ETC): Amount of planned cost yet to be expended to complete the project.

Budget at Completion (BAC): Total planned cost to complete the project.

II. LITERATURE REVIEW

A comprehensive review of existing literature was carried out to understand the current state of EVM application in the construction industry, identify research gaps, and build a theoretical foundation for the present study.

[1] *A Review on Earned Value Management Analysis in Construction* — Ippakayal & Kumthekar

This study evaluates the conceptual framework and practical application of EVM's foundational parameters — PV, AC, EV, CPI, SPI, EAC, and ETC. The review affirms that EVM offers a superior approach to project monitoring by integrating scope, cost, and schedule within a single analytical model, functioning as an early warning system. The study concludes that management commitment, robust baseline planning, continuous training, and system integration are critical success factors.

[2] *A Generic Framework for Managing Schedule and Cost Risks Using PERT and EV Technique* — Zanelidin & Ahmed (2024)

This study develops a dynamic, spreadsheet-based risk management framework integrating PERT and EV techniques. Using a questionnaire survey among 68 construction professionals in the UAE, experts identified 15 critical risk events. RII rankings revealed that 'errors in estimation of task durations' and 'poorly defined scope' were ranked highest. The framework effectively assists practitioners in assessing risks in a practical manner.

[3] *Application of Earned Value Management System in Infrastructure Projects – A Review* — Jadhav & Shinde (2018)

Through an extensive literature survey, the study confirms that EVM serves two fundamental purposes — providing an accurate real-time picture of project status and supplying arithmetic necessary to forecast final cost and schedule outcomes at completion. A precise Work Breakdown Structure (WBS) is identified as the key to successful EVM implementation.

[4] *Application of Earned Value Management in Indian Construction Projects* — Barikder & Paul (2020)

The study validates EVM's effectiveness in the Indian construction context by applying it to 8 live projects. CPI was found to stabilise at the 20% project completion point in 7 out of 8 case studies. However, EVM schedule performance measures (SPI and SV) are established to be fundamentally unreliable for construction projects, converging to 1 and 0 respectively at project completion regardless of actual delays.



[5] *Applying Earned Value to Construction Projects* — Al-Fadhli & Al-Bazaz (2020)

EVM was applied to a real administrative building project using Microsoft Project software. The application revealed a positive CV and SV at the status date, though both CPI and SPI were slightly below 1, indicating mild inefficiencies. The study confirms that EVM is an effective and practically applicable method for tracking work progress, identifying deviations, and predicting future performance.

[6] *Factors Affecting Implementation of EVM in Construction Projects* — Naizghi, Kazan & Usmen (2025)

Using 354 valid responses from 631 construction professionals, the study finds that the decision to implement EVM is most strongly influenced by management commitment, followed by project budget range and availability of resources. Logistic regression confirms that high management commitment increases the odds of EVM implementation by over 400%. Nearly 50% of all implementation barriers are attributed to just two factors — lack of EVM knowledge and tedious data collection procedures.

[7] *Comparative Analysis of Earned Value Management Techniques in Construction Projects* — Elsaid, Nassar, Alqahtani & Abotaleb (2025)

Analysing 30 diverse construction projects in Egypt, the study finds that Earned Schedule (ES) provides the most accurate predictions during early project stages, while Earned Duration (ED) proves more reliable in later phases. The research advances EVM application by presenting a context-specific framework that enhances forecasting accuracy and strengthens project control.

Research Gap

Despite the contributions of the above literature, several important gaps exist. There is a lack of region-specific empirical studies on EVM adoption in the Indian construction context, where project practices and data infrastructure differ significantly from Western settings. The literature predominantly addresses large-scale projects, leaving EVM's applicability to small and medium-sized projects underexplored. Integration of EVM with emerging technologies such as BIM, IoT, and machine learning remains insufficiently evaluated in real project environments. Additionally, no construction-specific EVM implementation guidelines are proposed for the Gujarat region, and behavioural and organisational factors influencing local adoption remain underexplored.

III. OBJECTIVES & SCOPE

The study aims to achieve the following objectives:

- Implementation of Earned Value Management (EVM) in the Saurashtra construction region in Gujarat.
- Analyse the cost and schedule performance of a construction project using EVM metrics.
- Study the reasons for low implementation of EVM in the region.
- Explore the capabilities of Primavera P6 software for EVM analysis.

The scope of the study is confined as follows:

- Small-scale residential projects in the Rajkot region.
- G+2 tenement projects — scheduling, resource allocation, management, and EVM analysis using Primavera P6.
- Cost and schedule projection using EVM metrics.
- A completed G+2 tenement project (Vasudha Prime, Rajkot) was selected for EVM analysis.

IV. RESEARCH METHODOLOGY

Primavera P6 is a project management software from Oracle designed for planning, managing, and evaluating projects. It provides comprehensive controls over project scheduling, resource management, progress tracking, EVM analysis, and reporting. For this study, the inbuilt EVM provisions of Primavera P6 software were utilised to analyse the data of a completed G+2 tenement project named 'Vasudha Prime' in Rajkot, Gujarat.



Data of the completed project was collected and processed through Primavera P6 at starting and completion stages to carry out cost and schedule variance analysis, based on recorded data at suitable time intervals provided by the builder. The workflow steps implemented in Primavera P6 are described below.

A. Enterprise Project Structure (EPS)

The EPS defines the set of various departments associated with the company, establishing responsibility and task hierarchy. This breakdown is important for maintaining transparency where multiple heads operate under one authority. The EPS was configured to reflect the organisational structure of the project.

B. Workdays and Currency Settings

Under workday settings, the working calendar was configured with all days as working days, with working hours from 9 AM to 6 PM and a break from 1 PM to 2 PM. Currency was set to INR (Indian Rupee) to reflect actual project costs.

C. Work Breakdown Structure (WBS)

The Work Breakdown Structure implies manageable chunks of activities that are easier to plan and manage. The project was divided into 5 major segments — substructure, superstructure, finishing, plumbing, and electrical — making resource planning and progress tracking more efficient.

D. Activity Details

Activities were added with logical sequencing and planned durations, which serve as the comparison benchmark for schedule variance in EVM analysis. The project was estimated to be completed in approximately 250 days, starting from excavation till final finishing. At the time of actual execution, actual durations were entered to compute variation against planned values.

E. Project Resources

Project resources including materials, equipment, and human resources were added to the software. Cost of various resources was configured to compute the planned/budgeted cost of each activity and the overall project.

F. Scheduling and Control

As data of a completed project was available, scheduling was done activity-wise — whenever an activity was completed, it was marked as complete along with the actual money spent on that activity. This approach enabled computation of actual duration and actual cost for each work item.

G. EVM Analysis Using Primavera P6

After sufficient data was scheduled into the software, EVM indices were calculated to assess project status. The built-in capability of Primavera P6 was utilised to calculate the EVM parameters. A graph of Budgeted vs. Actual Cost Comparison and a plot of Planned Value and Earned Value were generated to visualise project performance.

The EV plot indicated that the project performed adequately at the starting stage, but showed lagging performance in the middle and finishing stages. In the later stages, actual cost was estimated to increase compared to planned cost, confirming cost overrun tendencies. This early prediction enables the project manager to take corrective action before significant damage is incurred.

TABLE I: ACTUAL COST OF VASUDHA PRIME PROJECT, RAJKOT

Category	Cost (₹)
Cement	7,90,340
Steel	5,69,034
Aggregates	5,68,250
Centring	3,92,800
Concrete Labour	59,900
General Labour	8,35,350



Plumbing	5,98,037
Electrical	3,56,605
Tile Work	12,37,625
Miscellaneous	3,02,059
Total Project Cost	₹57,10,000

V. REASONS FOR LOW IMPLEMENTATION OF EVM

To investigate the probable reasons for the near-absence of EVM implementation in the Gujarat construction region, a structured questionnaire was prepared and circulated among construction professionals including contractors, project managers, and consultants. The questionnaire covered details about probable benefits, current use and practice, and likely reasons for low implementation of EVM.

Collected responses were analysed using the Relative Importance Index (RII) method to rank the most prevalent barriers to EVM implementation in the construction industry in the Gujarat region.

A. Relative Importance Index (RII)

RII is a statistical method used to find the relative importance of a variable out of the data set. It is commonly used for Likert scale data. The RII is computed using the following equation:

$$RII = \frac{\sum W}{A \times N}$$

Where: W = weight of response for a particular statement; A = highest weight (5); N = total number of responses. The questionnaire addressed the following categories of barriers:

- Organizational & Management Barriers — higher management being unaware or not assuring EVM integration in projects.
- Technical & Systems Barriers — lack of availability of suitable tools and infrastructure to effectively utilise EVM.
- People & Skills Barriers — lack of trained professionals, normalisation of progress data from actual site, and progress perception errors.
- Financial & Commercial Barriers — monetary burden of using EVM is higher compared to conventional practice.
- Project Characteristics & Local Context — small duration projects do not justify EVM use; frequent design changes; use of local traditional cost control methods.
- Cultural & Perception Barriers — EVM will expose poor performance; paperwork-heavy work; lack of awareness among clients about EVM benefits.

TABLE II: RII VALUES OF SURVEYED PARAMETERS (RANKED HIGHEST TO LOWEST)

Parameter	RII
Detect cost overruns	0.846
Detect schedule lag	0.835
Improve cost forecasting	0.830
Support decision-making	0.819
Clients don't demand EVM	0.797
Unreliable site data	0.762
Lack of dedicated officials	0.759



Frequent design changes	0.759
Small projects don't justify EVM	0.751
Lack of trained staff	0.749
Poor progress records	0.749
No immediate ROI	0.727
Increase accountability	0.719
Preference for traditional methods	0.719
Familiarity with EVM	0.716
Used only for large projects	0.716
Difficulty in EV measurement	0.714
Fragmented systems	0.708
High initial cost	0.708
Poor integration	0.705
Lack of client awareness	0.703
Contract discourages EVM	0.700
Lack software	0.697
No regulatory requirement	0.697
EVM reports include metrics	0.695
Staff overburdened	0.692
Documented procedures	0.689
Resistance to change	0.686
Know CPI/SPI	0.676
Lack top management support	0.676
Lack management priority	0.670
EVM discussed in meetings	0.665
Formal training available	0.659
EVM seen as bureaucratic	0.657
Cost-schedule integration	0.646
Fear of exposure	0.646
EVM used in most projects	0.632



B. Key Findings from Survey

Analysis of the survey data revealed the following key implications:

- Respondents strongly agreed on the benefits of EVM, especially in cost/schedule control and forecasting, as evidenced by the top-ranked RII values.
- Clients and owners do not demand EVM reports — this was the highest-ranked barrier (RII: 0.797), indicating that external demand is a critical driver of adoption.
- Lack of trained professionals for EVM analysis (RII: ~0.749) — there is a significant shortage of personnel trained in EVM methodologies and software.
- Poor integration of systems to utilise the core concepts of EVM (RII: ~0.708) — digital infrastructure gaps prevent effective implementation.
- Reliability of progress data gathered (RII: 0.762) — data collected during actual site execution may vary due to subjective progress judgements, resulting in errors in EVM index computation.

These findings suggest that external demand and technical/system issues are the dominant barriers responsible for the low usage of EVM in Gujarat's construction sector. The low RII values for parameters such as 'EVM used in most projects' (0.632) and 'formal training available' (0.659) confirm that actual implementation maturity is low and training and integration gaps are significant.

VI. RESULTS & CONCLUSION

TABLE III: TOP RANKED PARAMETERS — BENEFITS OF EVM

Rank	Parameter	RII
1	EVM improves early detection of cost overruns	0.846
2	EVM improves early detection of schedule lag	0.835
3	EVM improves forecasting for completion costs	0.830
4	EVM supports better decision-making	0.819
5	Clients/owners do not demand EVM reports	0.797

TABLE IV: PRIMARY BARRIERS TO EVM IMPLEMENTATION

Parameter	RII
Clients/owners do not demand EVM reports	0.797
Unreliable site data	0.762
Lack of trained staff	~0.749
Poor integration of systems	~0.708

The EVM analysis of the Vasudha Prime tenement project in Rajkot using Primavera P6 demonstrated that one can effectively arrive at the status of a project through cost-based performance indices. The EV plot revealed that while the project performed adequately at the starting stage, it showed lagging performance in the middle and finishing stages, with actual costs increasing beyond planned values in the later stages. This is consistent with the findings of Barikder and Paul (2020), who confirmed that EVM provides reliable cost performance prediction from the 20% project completion point.

Early detection of schedule and cost deviations through EVM provides project managers with the opportunity to apply corrective measures before significant damage occurs. Comparison of EVM-predicted costs with actual cost of the



project is most effective when the project is in the execution stage. This study confirms the practical utility of Primavera P6 as a platform for EVM analysis in small-scale residential construction.

Questionnaire results strongly affirm that EVM is highly beneficial in predicting cost and schedule variance. However, EVM is not externally demanded by clients or builders in the Gujarat region, and there is a shortage of trained staff and digital infrastructure to carry out EVM analysis. The cost of implementing EVM in small-scale projects may also be perceived as high relative to its benefits — a topic warranting further detailed investigation.

In conclusion, EVM is an effective, powerful, and practically applicable project performance measurement tool for the construction industry. For wider adoption in the Gujarat region, efforts must focus on building client and owner awareness, developing trained EVM professionals, improving digital integration infrastructure, and potentially establishing mandated use of EVM on projects above a certain size threshold.

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