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Developing the Application of Earned Value Management (EVM) for Small-Scale Construction Firms

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ABSTRACT: In today's rapidly evolving construction industry, small-scale firms operate under intense budgetary and timeline constraints, often lacking access to formal project control tools. These challenges can significantly compromise project delivery, client satisfaction, and long-term business viability. Earned Value Management (EVM) represents a powerful methodology for integrated cost and schedule control, enabling firms to monitor performance proactively and make informed decisions. Although EVM has demonstrated widespread success in large-scale and institutional projects, its penetration into small-scale construction remains minimal due to perceived complexity and lack of training.

This research aims to bridge that gap by evaluating the feasibility and impact of EVM adoption in small-scale construction enterprises. Through a multi-case study approach across four diverse project types, this study analyzes the implementation process, challenges, and outcomes of EVM. The results show measurable improvements in project predictability, budget oversight, and resource utilization. The study concludes by presenting a simplified and scalable EVM framework tailored to the capacities of small firms, contributing to the broader discourse on democratizing project management tools in the construction industry.

KEYWORDS: Earned Value Management (EVM), Project Cost Control, Construction Project Management, Schedule Performance, Small Construction Firms, Resource Optimization, Risk Mitigation.

I. INTRODUCTION

The construction sector is a critical contributor to national economic development, infrastructure expansion, and employment generation. However, the industry is notoriously characterized by high uncertainty, cost overruns, time delays, and scope changes—especially among small and medium-sized firms. These challenges are often exacerbated by the informal management systems, limited technical expertise, and lack of real-time performance monitoring tools commonly found in small-scale construction enterprises.

In contrast to larger firms that utilize sophisticated software and have access to experienced project managers, small-scale firms tend to rely on manual tracking, intuition, and reactive decision-making. This often results in inefficient resource deployment, escalating budgets, missed deadlines, and dissatisfied clients. As client expectations continue to evolve toward higher accountability and transparency, small firms must upgrade their project management practices to remain competitive.

Earned Value Management (EVM) is an integrated performance measurement methodology that combines scope, schedule, and cost variables to deliver a comprehensive snapshot of project status. Originally developed for the United States Department of Defense in the 1960s, EVM has evolved into a globally accepted standard for project control and forecasting. EVM enables the identification of variances between planned and actual performance, supporting early corrective action. Despite its potential, the uptake of EVM in small construction firms remains negligible.

This paper explores how EVM can be adapted and applied within small-scale construction firms to improve efficiency and reduce risks. The study presents an in-depth analysis of four real-world construction projects, assessing the role of EVM in addressing common performance challenges. It also proposes a streamlined EVM framework that aligns with

the operational capabilities of resource-constrained firms. By doing so, this research contributes to the broader goal of equipping small firms with cost-effective, scalable project control tools that enhance performance and competitiveness.

1.1 BACKGROUND OF RESEARCH WORK

The construction industry, particularly in the small-scale sector, faces challenges in maintaining budget and schedule control due to inadequate project monitoring systems. Traditional tracking methods are often reactive, identifying issues only after they have impacted project performance. Earned Value Management (EVM) presents an opportunity to integrate cost and schedule tracking in a proactive manner. Originally used in large-scale government and industrial projects, EVM has demonstrated its effectiveness in providing accurate, timely insights into project performance.

In small construction firms, limited staffing, financial constraints, and a lack of formal management training hinder the adoption of advanced systems like EVM. Nevertheless, the scalability and adaptability of EVM principles make it feasible for these firms to adopt simplified models. As more small construction projects face delays and overruns due to poor forecasting and insufficient tracking, the need to introduce structured methodologies becomes imperative. This research emerges from the growing recognition that empowering small firms with efficient yet accessible project management tools like EVM could significantly enhance their execution capability and financial sustainability. It aims to demonstrate through practical case studies how EVM can be streamlined and tailored to fit small projects without requiring complex software or extensive resources.

1.2 NEED TO STUDY

The construction industry is characterized by high risk and complexity. Small firms, in particular, are more susceptible to cost overruns, schedule delays, and inefficient resource use due to their limited technical and financial capabilities. Conventional project tracking methods lack the accuracy and depth of integrated tools like EVM. Despite the proven benefits of EVM, small firms remain hesitant to integrate such systems. This reluctance stems from concerns regarding cost, training, and operational complexity. However, simplified EVM models adapted to small firms' capabilities can yield significant performance improvements. There is a critical need for small firms to adopt affordable, efficient, and systematic project management methodologies to enhance execution and delivery. This study aims to demonstrate practical methods for implementing EVM in this context, helping firms improve cost control, scheduling, and risk management without substantial overhead.

1.3 PROBLEM STATEMENT

Despite their critical role in the construction industry, small-scale construction firms continue to face significant challenges in managing time, cost, and scope effectively. The absence of structured project management tools contributes to persistent inefficiencies, resulting in project delays, cost escalations, and diminished client satisfaction. Most small firms operate with minimal planning, limited documentation, and ad-hoc decision-making—an environment where performance issues are often discovered too late to allow meaningful corrective action. Earned Value Management (EVM) has proven effective in managing these performance elements in larger projects, offering quantitative insights into progress and enabling timely interventions. However, its application in the small-firm context is rare, largely due to a lack of awareness, perceived complexity, and the assumption that such tools are only suited for large or institutional projects.

This study poses the central research question: Can Earned Value Management be effectively simplified and applied in small-scale construction projects to improve project performance, and if so, what challenges and opportunities arise during its implementation? By answering this question, the research seeks to fill a significant gap in the literature and provide actionable recommendations for small firms looking to improve project predictability, resource efficiency, and overall performance through structured yet scalable management techniques.

1.4 SCOPE & LIMITATIONS

This study focuses on the practical application of EVM in small-scale construction projects across residential, commercial, and infrastructure sectors. It evaluates EVM's role in improving financial control, risk management, and scheduling. The study is limited to projects in urban and semi-urban contexts, and findings may vary based on regional cost structures and project complexities. External factors such as policy shifts and unforeseen disruptions were not analyzed in depth.

1.5 RESEARCH OBJECTIVES

- To assess the viability of EVM implementation in small construction firms.
- To analyze cost and schedule performance before and after EVM adoption.
- To identify challenges faced by small firms in applying EVM.
- To propose a simplified EVM framework tailored for small-scale applications.
- To examine the impact of EVM on risk and resource management.

II. METHODOLOGY

2.1 RESEARCH DESIGN

A mixed-methods research design was employed, incorporating qualitative interviews and quantitative case study analysis. Four representative construction projects were selected based on predefined criteria.

2.2 DATA COLLECTION

Primary Data :

- Interviews with project managers and firm owners
- On-site project observations
- Budgetary and performance reports

Secondary Data:

- Industry benchmarks
- Literature on EVM applications and construction project management

2.3 INCLUSION/EXCLUSION CRITERIA

Inclusion:

- Projects with budget/schedule overruns
- Projects with active or recently concluded phases

Exclusion:

- Fully-funded and on-schedule projects with minimal managerial oversight

III. CASE STUDIES AND ANALYSIS

Case Study 1: Residential Project – Early Cost Deviation Detection

A 30-unit housing project faced material cost surges mid-project. EVM enabled early cost variance identification, prompting renegotiation with suppliers and better labor scheduling.

Parameter	Planned	Actual
Duration (Days)	540	560
Cost (INR Crores)	15.0	17.2

Outcome: Prevented further budget escalation and improved stakeholder confidence.

Case Study 2: Commercial Building – Schedule Optimization

A commercial complex experienced subcontractor delays. Weekly EVM reports identified lagging areas, enabling strategic contractor reassignment.

Parameter	Planned	Actual
Duration (Days)	720	750
Cost (INR Crores)	20.0	22.0

Outcome: Reduced cascading delays and improved contractor accountability.

Case Study 3: Road Construction – Risk-Responsive Resource Allocation

Weather-related delays disrupted a road project. EVM metrics allowed real-time resource reallocation to maintain workflow efficiency.

Parameter	Planned	Actual
Duration (Days)	600	630
Cost (INR Crores)	30.0	32.5

Outcome: EVM supported agile risk management and continuity in project delivery.

Case Study 4: Bridge Repair – Labor and Equipment Efficiency

Bridge maintenance suffered from downtime due to poor equipment scheduling. EVM revealed inefficiencies, resulting in labor redistribution and time recovery.

Parameter	Planned	Actual
Duration (Days)	360	375
Cost (INR Crores)	10.0	11.2

Outcome: Improved productivity through optimized resource planning.

3.2 COMPARATIVE PERFORMANCE ANALYSIS

Project Type	Schedule Variance (Days)	Cost Variance (INR Cr)	Key Improvement
Residential	+20	+2.2	Cost deviation alerts
Commercial	+30	+2.0	Subcontractor tracking
Road	+30	+2.5	Risk-responsive planning
Bridge	+15	+1.2	Resource optimization

Project Type	Planned Budget (₹ Lakhs)	Planned Duration	Planned Value (PV)	Earned Value (EV)	Actual Cost (AC)	Cost Performance Index (CPI)	Schedule Performance Index (SPI)
Residential Building	35	5 months	₹20 L	₹17 L	₹19 L	0.89	0.85
Commercial Complex	65	7 months	₹40 L	₹45 L	₹43 L	1.05	1.13
Institutional Health Clinic	50	6 months	₹30 L	₹27 L	₹35 L	0.77	0.90
Road & Drainage Infrastructure	25	10 weeks	₹18 L	₹19 L	₹20 L	0.95	1.05

IV. FINDINGS AND DISCUSSION

- **Cost Control:** EVM facilitated early financial variance identification, allowing mitigation strategies before escalation.
- **Schedule Management:** Firms improved adherence by tracking and revising timelines based on EVM data.
- **Risk Management:** Dynamic risk response was enabled through EVM-based forecasting.
- **Resource Utilization:** Labor and equipment productivity improved significantly with real-time tracking.
- **Scalability:** Implementation required minimal tech infrastructure, making EVM adaptable to firms with basic digital tools.

V. CONCLUSION

This study has demonstrated that Earned Value Management (EVM) is a viable and impactful project control methodology for small-scale construction firms, despite traditional perceptions of its complexity. The findings from multiple case studies indicate that even simplified EVM models can significantly enhance cost control, improve schedule adherence, and foster more informed decision-making within resource-constrained environments.

Key conclusions include:

- **Improved Financial Oversight:** EVM enables real-time tracking of budgeted versus actual performance, allowing small firms to identify cost overruns early and take corrective actions.
- **Schedule Predictability:** By continuously comparing planned progress with actual work completed, EVM improves transparency in schedule management and reduces the likelihood of delays.
- **Enhanced Decision-Making:** EVM's integrated view of scope, cost, and time facilitates proactive project adjustments and better forecasting.
- **Scalability and Adaptability:** The methodology, when appropriately simplified, fits well within the operational capacity of small firms, eliminating the need for costly software or extensive training.

Despite its clear benefits, the adoption of EVM in small construction firms remains limited due to a lack of awareness, resistance to change, and limited access to training resources. Future work should focus on developing practical toolkits, localized training modules, and simplified digital platforms tailored to this sector.

In conclusion, EVM is not only applicable but also highly beneficial for small-scale construction projects. With minimal investment and strategic implementation, it can transform the way small firms manage projects, leading to more predictable outcomes, greater client satisfaction, and improved profitability.

VI. RECOMMENDATIONS

1. Small firms should invest in basic EVM training for project managers.
2. Digital tracking tools can help firms adopt EVM with minimal costs.
3. Regular performance analysis should be conducted to identify early cost deviations.

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