Cost and Time Variance by Development of Software: Streamlining Workflow, Visual and Centralized management

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***Abstract*—The construction industry often grapples with significant cost and time variances that can undermine project success. This study aims to streamline workflow and enhance visual management in construction projects by developing specialized software. The primary objective is to facilitate accurate tracking and reporting of cost and time variances through a systematic approach. Software is designed to capture detailed information about activities and sub-activities within construction projects by inputting essential project data; the software generates comprehensive reports highlighting total cost and time variances. These reports enable project managers to identify the occurrence and causes of variances promptly, thereby allowing for more informed decision-making and effective corrective actions through the application of this software in construction projects, we observed a marked improvement in the accuracy and efficiency of variance reporting. The software's ability to provide real-time insights into project performance proves to be a valuable tool in mitigating risks associated with cost overruns and schedule delays. This research underscores the potential of integrating advanced software solutions into project and construction management practices to achieve more streamlined and visually manageable workflows.**

***Index Terms*— Streamlining workflow, Cost Variance, Time Variance, Construction Management Software, Construction Work breakdown.**

I. INTRODUCTION.

Monitoring cost variances and delays on construction sites is crucial for effective project management. By keeping an eye on these factors, project managers can ensure projects stay within budget and on schedule. This proactive approach helps to avoid financial strain, maintain contract compliance, and keep clients happy by addressing issues promptly. Creating specialized software for tracking these variances provides a significant advantage. This software allows for real-time monitoring of project progress, helping to quickly identify and fix delays and cost overruns. By automating data collection and analysis, the software makes project information more accurate, supporting better decision-making. It also centralizes data, improving communication and collaboration among team members and stakeholders, reducing misunderstandings.

The software's analytical tools can spot trends and pinpoint the causes of delays and cost issues, allowing for proactive risk management. It can be customized to fit the specific needs of any construction project, from small developments to large multi-storey buildings. Though there's an initial investment, the long-term benefits include smoother processes, increased efficiency, and significant cost and time savings.

In complex projects, especially with tall buildings like those in Mumbai, precise planning and monitoring become even more important. For instance, wall painting can't start until plastering and brickwork are finished and dried. Any delays in these steps can cascade, affecting the entire project schedule. Additionally, government regulations might impose fines for delays, making it critical to manage timelines carefully. Encouraging a culture of transparency, teamwork, and flexibility helps construction teams handle delays more effectively. Tools for tracking cost and time variances enhance accuracy, inform decisions, and improve communication. They also streamline operations, cut down on errors, and ensure regulatory compliance, helping to avoid fines and legal issues. Developing tools for tracking cost and time variances is essential for modern construction

project management. These tools help manage the complexities of projects, ensuring success and profitability in a competitive industry.

Day To Day Cost Updating: The day-to-day updating of costs on a construction site is crucial for maintaining budget control and ensuring financial viability. By tracking expenses daily, project managers can quickly identify and address deviations from the budget, preventing cost overruns. This real-time financial monitoring enhances decision-making, allowing for efficient resource allocation and optimized productivity. Regular cost updates also improve transparency and accountability among stakeholders, fostering trust and reducing disputes. Additionally, daily cost monitoring aids in the early detection of financial risks, enabling swift mitigation strategies. It supports accurate forecasting and financial planning, ensuring sufficient funds are available and preventing cash flow shortages. Moreover, maintaining daily cost records ensures compliance with financial regulations and contractual obligations, facilitating verifiable documentation for audits. Implementing robust daily cost tracking is essential for successful and profitable construction projects

II. PROCEDURE FOR PAPER SUBMISSION

The research began with identifying a common issue in construction projects — frequent cost overruns and delays in project completion. It was observed that existing systems do not provide centralized daily monitoring and generally allow access to only one project at a time. This creates difficulties in tracking multiple projects efficiently. Recognizing this gap, the objective of the study was defined: to develop software capable of monitoring cost and time variance in a centralized and visually manageable manner.

After defining the problem, a detailed literature review was conducted. Previous studies related to earned value management, cost monitoring techniques, and risk management were analyzed to understand existing solutions and their limitations. This helped in establishing the research gap and confirming the need for a more integrated and multi-project-based system.

Next, system requirements were identified. The proposed software needed features such as secure user login, project registration, activity and sub-activity entry, multi-user access, and automated report generation. Based on these requirements, the system was designed and developed in modular form.

Once development was completed, real project data from the “Shraddha Heights” construction project was entered into the system for validation cost and time variance paper. Estimated and actual cost and time details were recorded. The software automatically generated cost and time variance reports at project, activity, and sub-activity levels.

Finally, the generated results were analyzed to determine financial loss, efficiency, and workflow improvement. Conclusions were drawn regarding the effectiveness of centralized management and automated variance tracking in improving construction project performance.

III. MATH

The system calculates:

Cost Variance (CV) = Estimated Cost – Actual Cost

Schedule Variance (SV) = Estimated Time – Actual Time

If the value is negative, it indicates loss or delay. If positive, it indicates savings or early completion.

Through visualization and automated reporting, project managers can quickly identify which activity is causing deviation and take corrective action immediately.

The developed system presented in this study is specifically engineered to monitor cost variance and time variance at the construction site level through a structured Work Breakdown Structure (WBS) and activity–sub-activity tracking mechanism. Unlike generic project management software, this tool is purpose-built for variance identification and operational decision-making in real construction environments.

Commercial software and large construction ERP systems are highly comprehensive platforms. They are designed for macro-level project planning, critical path scheduling, and resource leveling. While these systems are powerful, they require baseline configurations, advanced training, licensing costs, and technical expertise for earned value management calculations. Scientifically, they operate on complex

scheduling algorithms and multi-layered data models, which may not always be necessary for medium-scale projects where daily cost and time control is the primary requirement.

In contrast, the developed system applies a more focused analytical approach. It directly compares estimated cost versus actual cost and estimated time versus actual time at multiple hierarchical levels (project, activity, sub-activity). From a scientific project management perspective, this reduces data abstraction and shortens the feedback loop between data entry and managerial decision-making. Faster feedback loops are known to enhance control efficiency and reduce error propagation in dynamic systems such as construction projects.

Another important benefit is usability. Many enterprise systems introduce cognitive overload because of their complexity. The developed software minimizes this by using structured and simplified data input models aligned with real site activities. Scientifically, reducing interface complexity increases user compliance and improves data accuracy, which directly enhances the reliability of variance analysis.

Strategically, the system offers:

i. Faster Corrective Action: By detecting variance at sub-activity level, root causes can be identified early. Early intervention reduces cumulative cost escalation, which in financial modeling is referred to as minimizing compounding loss.
ii. Improved Resource Optimization: Continuous monitoring allows dynamic reallocation of labor and machinery. This aligns with lean construction principles that emphasize waste reduction and workflow stabilization.
iii. Cost-Effectiveness: Unlike enterprise tools, this system requires lower implementation and training costs, increasing return on investment (ROI) for small and medium contractors.
iv. Enhanced Risk Control: Scientifically, variance tracking functions as an early-warning indicator. Predictive risk mitigation becomes possible when deviations are identified in early project stages.
v. Scalability Potential: The current system provides a structured database foundation that can be integrated with AI-based predictive analytics in the future.

In summary, while commercial software focuses on broad scheduling and enterprise-level integration, the developed system strategically emphasizes practical, variance-centered control. It offers scientifically sound, data-driven decision support with lower complexity, making it particularly suitable for construction firms seeking efficient and affordable project performance management.

IV. CONCLUSION

i. The study successfully developed and implemented a specialized software system for monitoring cost variance and time variance in construction projects
ii. The system applies a structured Work Breakdown Structure (WBS) approach, enabling monitoring at project, activity, and sub-activity levels for accurate performance tracking.
iii. Direct comparison of estimated and actual cost and time provides a clear and measurable variance analysis framework.
iv. Early identification of negative variance supports faster corrective actions, reducing cumulative financial losses and schedule delays.
v. The centralized database system improves transparency, accountability, and coordination among managers, supervisors, and contractors.

APPENDIX

Appendix A – Project Details

Constructible Area: 9500 ft²

Plot Area: 300 m²

The project data was collected from site records and implemented into the developed cost and time variance monitoring software.

Appendix B – Definitions of Key Terms

1. Cost Variance (CV)

Difference between Estimated Cost and Actual Cost.

CV = Estimated Cost – Actual Cost

2. Time Variance (TV)

Difference between Planned Completion Time and Actual Completion Time.

TV = Estimated Time – Actual Time

3.Work Breakdown Structure (WBS)

A hierarchical decomposition of the construction project into manageable activities and sub-activities.

4.Estimated Cost

Budgeted amount planned for completing an activity.

5. Actual Cost

Real expense incurred in completing the activity.

Appendix C – Software Modules Developed

1. User Login and Authentication

2. Master Registration

3. Project Registration

4. Activity Registration

5. Sub-Activity Registration

6. Role-Based User Management

7. Report Generation Module

8. Variance Analysis Dashboard

Appendix D – Data Fields Used in Software

For Each Activity:

i. Activity Name
ii. Start Date
iii. Estimated Completion Date
iv. Actual Completion Date
v. Estimated Cost
vi. Actual Cost
vii. Assigned Person

For Each Sub-Activity:

i. Sub-Activity Name
ii. Project Reference
iii. Activity Reference
iv. Estimated Time
v. Actual Time
vi. Estimated Cost
vii. Actual Cost

Appendix E – Sample Variance Observation

Example Activity: Footing Work

i. Estimated Cost: ₹375060
ii. Actual Cost: ₹381760
iii. Cost Variance: -₹6700
iv. Negative variance indicates cost overrun.

Appendix F – Preventive Measures Suggested

1. Resource reallocation
2. Additional manpower deployment
3. Schedule adjustment
4. Cost optimization strategies
5. Real-time monitoring implementation

Appendix G – System Limitations

1. Manual data entry dependency
2. Limited to cost and time variance only
3. No AI-based prediction currently
4. Requires accurate field data

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