

Reevaluating Earned Value Formulas Across Project Types: A Critical Cross-Case Analysis

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ABSTRACT

Traditionally, Earned Value Management (EVM) has generally been applied as a standard methodology for project cost and/ or schedule performance dimension. Though with expansive institutionalization as a standard with the help of morals in project performance dimension as it concerns transnational project operation, are there project enterprises where, under the traditional Earned Value fashion, one couldn't calculate and/ or understand? The extensively applied Earned Value formula, which relies on specific probability of completion, has proven to affect in the severe conception of project performance, thereby distorting the Earned Value approach in project schedule performance dimension. This is because this paper seeks to offer a critical analysis of the conventional traditional Earned Value approach through the operation of the comparison of different kinds of project types: Software development, Professional Consulting Services, and Construction Projects. [1].[2] Once the criteria for performance confines have been linked, the applicable performance pointers similar as EV, PV, AC, CPI, SPI, and EAC can be assessed and compared. The viability of the effectiveness of these important EVM performance pointers can be estimated for the connection of EVM for fiscal performance; still, it cannot be relied upon for project performance. A marked difference has been noted between indicated performance indices and the real project execution realities, especially in those projects that show prominent schedule interdependencies and critical path sensitivity. In this regard, this study builds upon the area of project management theory by highlighting the structural short comings of traditional EV usage as well as the overall importance of the integration of schedules, predicated performance extension, risks, shaped activity weights, as well as critical path sense into the traditional systems of performance measurement.[3] [4] From the managerial position, the research results provide useful perceptivity to layout directors and associations on enhancing performance dimension delicacy and battling undesirable control signals. This work provides a practical engineering-oriented perspective for improving project control reliability in real execution environments. The proposed comparative analysis supports decision-making in engineering project management applications by highlighting actionable performance diagnosis mechanisms.[5]

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1. INTRODUCTION

As one of the most vastly used performance dimension approaches within the operation of project, EV has traditionally been recognized as one of the most widely adopted performance measurement systems within the application of Project Management. By integrating scope, schedule, and cost into a unified quantitative framework, EVM provides managers with standardized indicators such as Cost Performance Index (CPI), Schedule Performance Index (SPI), and Estimate at Completion (EAC), enabling systematic monitoring and forecasting of project performance. thus, the institutionalization of EVM has entered through multitudinous encyclopedically accepted morals, analogous as major international standards, including the Project Management Institute's PMBOK Guide

and as well as the government procurement. While EVM has been considerably executed by multitudinous associations, a cornucopia of empirical and professional obedience has indicated that the traditional EVM measures aren't inevitably suitable of reflecting the true status of actual project conditions. Specifically, the current generality of schedule performance measures has been challenged by the reliance on fiscal delegates rather of factual time, predicated pointers. This structural inadequacy of schedule measures results in unrealistic reflections of schedules performance for projects with intricate interdependent activity, lights, out critical path, and resources constraints. In addition, EVM measures all earned value units the same, irrespective of their position of strategic significance in the project network. Consequently, progress on non, critical activity can beget an overdue index on schedule performance, while the impact on schedule diversions on critical path isn't fully represented. [3],[4],[8] This issue is aggravated by the contiguity to the project end, where the functional tendency of SPI to approach 1.0 can provides description of schedule recovery when significant time overruns are ongoing. Some of these excrescencies have recently been dived with new disquisition, analogous as Earned Schedule (ES), time, acquainted performance pointers and cold- thoroughbred control mechanisms. nevertheless, the operation of these ways in the real world is still sporadic, and cross, sector empirical evidence is far from being a settled issue. [5],[6] However, the practical integration of these approaches remains inconsistent across industries, and empirical cross-sector validation is still limited. In addition, existing studies often focus on single project types or isolated methodological extensions, leaving a gap in comparative understanding across different project environments. [1],[2] Accordingly, this study seeks to reexamine the theoretical foundations and practical performance of Earned Value formulas through a cross-project analytical perspective. By comparing the behavior and reliability of EVM indicators across software development projects, consulting engagements, and construction projects, this research attempts to estimate the consistence, connection, and contextual significance of conventional performance dimension sense. This research contributes to engineering project control practice by evaluating EVM behavior across real-world project environments including software, consulting, and construction domains.[7]

1.1 Research Question

This study is guided by the following central disquisition question:

How reliable and decision applicable are conventional traditional Earned Value Management calculations for all project types, and do their limitations differ for software/ consulting systems compared with construction projects?

The question to be answered is: how and to which extent traditional performance indicators for EV are considered reliable and decision-relevant on the different project types, change within SW (Software), consulting (professional) and building projects and where/why their shortcomings differ? [1],[2]

In doing so, this paper can contribute to the question at hand as well as to project management theory and practice by defining the limits of what EVMs can do and where an integrated control of performance could be improved.

1.2 Problem Statement

Although Earned Value Management (EVM) has been generally used as a standardized as a project performance measurement system, the most practical and abstract problems need to be addressed moment are associated with how reliable of its traditional indicators. The being EVM information is primarily concentrated on bone performance measures and chance, complete estimates, which have limited capability of reflecting current schedule behavior, perceptivity to schedule criticality, and functional realities. In the reality, project manager constantly uses Schedule Performance index (SPI) and Cost Performance index (CPI) as leading pointers for decision making. nonetheless the performance reflections attained from analogous parameters are constantly deceiving especially in sophisticated project circumstances, in which non, critical activities largely contribute to progress reporting yet the impact on critical path timeline isn't conceded enough. [3],[4] This may beget time, consuming corrective measures, infelicitous allocation of resources and ineffective prognostications of final project performances. Another insufficiency is related to the fact that this measure is erected on a fine behavior of the traditional SPI, that converges to 1 in the critical finishing phase, whatever the schedule overrun will be. This means that the book of this measure will show a symptom of schedule recovery, while the project won't be fully in schedule control decisions during critical project phases. Actually, associations could be in the situation of taking schedule control opinions, predicated on performance signals that do not fully reflect project execution realities. further, although evolved models, analogous as, Earned Schedule (ES), and cold- thoroughbred approaches of performance control have been introduced; their decision-making decision support systems haven't been slightly embraced or incorporated as swish practices from nascent stages into the mainstream project performance dimension paradigm for all different project types. [5],[6] Consequently, a disconnect persists between theoretical performance measurement models and the operational realities faced by project managers across industries.

1.3 Research Gap

Existing academic literature on Earned Value Management has centered on methodological advancements, single sedulity operations, or measuring individual performance criteria and with fairly numerous empirical studies

performing comprehensive cross, project comparison studies of EVM 's prospects, or how gets changes across different project environments. While numerous studies examine the mathematical properties of CPI and SPI or propose alternative scheduling metrics, limited empirical research has conducted systematic cross-project comparative evaluations that assess how EVM behavior varies across fundamentally different project environments. In particular, there is no holistic comparison of comprehensive comparative studies that simultaneously analyze software development projects, professional consulting projects, and construction projects using a unified performance evaluation framework. This absence and limits the capability to draw generalized conclusions and the capability to propose adaptive performance dimension model predicated on the characteristics of these types of projects. Moreover, current research rarely integrates schedule logic, critical path dependency, resource leveling effects, and risk-weighted activity importance into Earned Value performance interpretation. [3],[4] As a result, without analogous comprehensive incorporation, several models from being disquisition still can't be effectively operated under practical execution constraints affecting project performance. This paper fills these gaps by furnishing a regular cross, project performance analysis that empirically assesses the credibility, stability and decision, making mileage of conventional traditional EVM indicators across multiple project domains. This study thus makes a step toward the advancement of performance dimension proposition while beginning to grease the project of farther sensitive and execution-aware project control frameworks.

2. Literature Review

2.1 Evolution of Earned Value Management as a Performance Measurement System

Earned Value Management (EVM) has been widely recognized as one of the most structured and standardized performance measurement systems in project management. Originating from cost control practices in large defense and aerospace programs, EVM was later formalized by the Project Management Institute (PMI) as an integrated framework combining scope, schedule, and cost dimensions into a unified control system [9] EVM's most important point is the capability to quantify physical work progress in fiscal terms to decide into monetary indicators such as Earned Value (EV), Planned Value (PV), and Actual Cost (AC), enabling the calculation of key performance indices including Cost Performance Index (CPI) and Schedule Performance Index (SPI). [3],[8] These metrics have been considerably accepted by any associations furnishing a common reporting tool for project performance monitoring (Fleming & Koppelman, 2016). [10] This reliance on several EVM pointers, still, has attracted considerable review from scholars on their capability to directly and effectively measure the functional and time performance in managing projects especially for the recently complex and dynamic projects environments.

2.2 Limitations of Traditional EVM Indicators

Traditional EVM frame has been proved to have a number of structural weak points in being disquisition. Significant among the limitations was the issue of schedule performance dimension on a fiscal base. The SPI indicator measure time schedule effectiveness predicated on progress measured in cost, weighted terms rather than factual time performance, thus leading to incorrect conclusions when high budget burdened activity are completed at a rate exceeding that of the critical path activity . [11],[3] Secondly, the nature of SPI fine characteristics makes it tend to the value of 1.0 as projects are near to end, regardless of the magnitude of schedule delays. therefore, phenomenon reduces the reliability of SPI as a late-stage control indicator and weakens its usefulness for proactive schedule management [12] also, conventional EVM doesn't directly regard for resource constraints, risk exposure, or activity criticality into its performance calculations. As a result, two projects with the same earned value performance pointers (CPI, SPI) could, in fact, bear fairly differently in terms of functional terrain and may experience fundamentally different operational conditions and managerial risk profiles

2.3 Earned Schedule and Time-Based Performance Extensions

To overcome the problem of time in classical EVM, illustration the use of other units piecemeal from capitalist for measuring the schedule performance; the fixed "date" dimension volition called the Earned Schedule (ES) was proposed as a time, predicated extension of schedule performance dimension. Also, instead of measuring schedule variance in monetary units, the earned schedule ES translates earned value progress into equivalent planned time units, enabling the calculation of time-based indices such as SPI(t). Empirical studies shown that Earned Schedule delivers further reliable and harmonious schedule performance measures for late project stages. The paraphrase into units of time rather of cost units makes ES more accessible and, as result, more useful for schedule forecasting estimating. Though proven benefits, the Earned Schedule handover in sedulity is still limited in practice and regarded as a voluntary analysis improvement, rather than a set of integral performance management component. [5],[6]

2.4 Integration of EVM with Critical Path and Scheduling Logic

Yet another area of disquisition is the integration of EVM pointers with traditional scheduling techniques such as Critical Path Method (CPM). While EVM measures the quantity of work performed, CPM evaluates the logical sequencing and dependency structure of project activities. exploration predicated on large project trials, had set up that good EVM results don't always correspond to schedule performance, if those activity can be classified on the critical

path were fairly late, but non, critical activity tend to produce positive EVM reports without any impact on schedule performance, and without contributing to actual project completion progress. This disparity demonstrates the importance of integrating cost, based performance measures with network-based schedule analysis in developing more robust project control systems. [3],[4]

2.5 Performance Measurement Beyond the Triple Constraint

Recent project management disquisition has evolved from the traditional triple constraint model of scope, cost, and time. [13]. Contemporary project success should include other confines of issues analogous as stakeholder satisfaction, risk rigidity, organizational knowledge and delivery quality [14]. In this broader perspective, the performance dimension system should measure far more multidimensional project health but hardly concentrate on financial and schedule measures. Consequently, there is a rising demand for integrated performance frame which incorporates quantitative measures and qualitative functional measures for operational indicators. [16],[17] Nonetheless, there are still no common models that completely combine the EVM pointers with the general dimension of the project life., and still lacks standardized models that systematically integrate EVM metrics with broader project health constructs. [18]

2.6 Research Gap Summary

While extensive disquisition has contributed to perfecting individual factors of EVM and schedule dimension ways, being studies remain shattered and sector-specific. There is limited empirical validation comparing EVM performance behavior across different project types using a unified analytical and logical framework. [1],[2] also, current literature doesn't sufficiently address the combined impact of critical path sensitivity, resource leveling, and risk exposure on earned value performance interpretation. [3],[4] As a result, project managers continue to rely on partial indicators that may not accurately represent real project conditions. addresses these problems by an across, project relative analysis and an intertwined interpretation approach which improve its practicality and utility.

3. Theoretical Framework

The theoretical basis of this study is an integrated performance operation paradigm that synthesizes classical Earned Value Management (EVM) theory with time-based performance extensions, scheduling logic, listing sense, and multi, dimensional project health concepts. performance cannot be separated with fiscal sectors in perceptual world. It need to be graded through a wider functional and structural context. [18]

3.1 Earned Value Management as a Control Theory Mechanism

EVM is theoretically deposited as a control proposition Medium EVM can theoretically deployed as a control system which can provide feedback - predicated project monitoring. By comparing planned performance (PV), factual execution (AC), and realized progress (EV), EVM creates an open circle control structure which support directorial decision, swings. Within this context, CPI means cost effectiveness while SPI index indicates schedule efficiency in monetary terms. However, the control proposition suggest that feedback indicators should directly response on a system 's gestural system in order to enable a viable corrective action. When performance indicators are distorted by structural or fine limitations, control effectiveness deteriorates. This limitation stimulates need to improve traditional EVM interpretations.[20],[21],[22]

3.2 Time-Based Performance Theory and Earned Schedule Integration

The time, grounded Version of Performance proposition rephrases the earned value into time, oriented performance index, which provide a deep understanding of time, accuracy schedule status. Its project is consistent with time, oriented control proposition that prefer on, time performance instead of fiscal variables. SPI(t) is deposited as a corrective index in this context that reflect actual schedule divagation in time unit. By using the sense of time, grounded problems, the frame enhances the foretelling capability and the early, warning capacity, especially for late project stages when traditional SPI indexes are having on significance. [5],[6]

3.3 Critical Path Theory and Structural Dependency Alignment

Critical Path theory add the structural, oriented context to EVM performance analysis, while EVM focus on the semantic of work, amounts, CPM emphasize the semantic of work, sequencing system and rely on constrains. Based upon this process, the real time performance can only be interpreted when EVM index was aligned with the critical path time line. [3],[4] As a consequence, the time, grounded frames embedded the critical exertion weighting into performance level, which indicates not all the progress on non, critical path was meaningful.

3.4 Resource Constraint Theory and Performance Distortion Effects

Resource Constraint theory and Performance distortion goods Resource proposition suggests that resource underage, resource levelling and resource flow have influence on performance state. Traditional EVM computations assume ideal situation of resource population that little in the reality of actual projects. This study integrated resource levelling and resource smoothing goods as moderating variable that influence earned value reliability on the basis of actual resource application trend rather than hypothetical scenario.

3.5 Risk Theory and Performance Variability Interaction

Risk management proposition and Performance Variability degrees Interaction Based upon the research finding that performance variances result from query, this paper integrated threat intensity as predictor variable of performance variation, considering that project threats affect work unit speed, work effort length and cost efficiency. However, conventional EVM indicators treated threat influence implicit as implicit rather than explicit variables. The proposed frame integrates risk exposure as an explicatory subcaste to connect the observed performance diversions to buttressing query motorists. As a result, negative interpretation is corroborated and cerebral provision can be laterally expressed.

3.6 Integrated Project Health Perspective

The final layer of the theoretical framework places EVM at the project health broader paradigm project health is considered as a multi, confines conception comprising fiscal performance, schedule stability, platoon performance, governance quality, attestation controls and risk responsiveness. [16],[17] Within this perspective, EVM indicators this perspective as a stage, alone dispatches that needs to be blended with functional and organizational angles to the establish description of project performance. [14],[15]

3.7 Conceptual Framework Summary

After the discussion of those theoretical views displayed above; has made a model naming as 'Integrated performance interpretation model' where:

EVM indicators are signals of the baseline financial performance.

Earned Schedule captures time 'by the clock'.

Critical Path consistency ensures structural identification.

Resource constraints, influence index trust ability.

Variation in performance is explained by risk exposure.

Health constructs of each project provide complete decision context

The multiple, subcaste frame constitutes the logical base of a cross, project relative analysis in this exploration.

4. METHOD

4.1 Research Project

This study utilizes the relative cross, case logical project to probe the limitations of traditional EVM indicators in a variety of project settings. The disquisition project espoused is a relative cross, case analysis. The reason for espousing a multiple case disquisition project is because of the generality capacity of logical conclusion and the capability to take the variety among project types. [1],[2]

Three project categories were analyzed:

Software development project

Professional consulting project

Construction project

slice was grounded on trying to include a wide range of idiosyncratic functional conduct, types of inquiry, and features of execution.

4.2 Unit of Analysis

The primary focus of the analysis basically is project execution activities that have the EVM metrics, and their ineffectiveness relational affinity with schedule composition, resource limitation, and peril constraint. All the systems are dissected at the reporting, phase location by the EVM standards, as follows

Earned Value (EV)

Planned Value (PV)

Actual Cost (AC)

Cost Performance Index (CPI)

Schedule Performance Index (SPI)

Earned Schedule indicators (SPI (time)) with appropriate respect Were

The definition of generalities, upon which computation of Earned Schedule is based, has already been used in the and are illustrated by way of examples where appropriate. This format for analysis enables definitive comparison of distortion trends generated by different scheduling parcels. [5],[6]

4.3 Data Structure and Measurement Variables

The disquisition utilizes structured data sets of project performance, grounded on factual project reporting formats and valid project operation practices. The major variable groups used for disquisition are

Financial Performance Variables

BAC (Budget at Completion)

AC (Actual Cost)

EV (Earned Value)

CPI (Cost Performance Index)

Schedule Performance Variables

PV (Planned Value)
SPI (Schedule Performance Index)
SPI (t) (Time based Schedule Performance Index)
Structural and Operational Variables
Critical path activity donation
Resource leveling and smoothing status
Activity risk exposure bracket

4.4 Analytical Procedure

The disquisition follows a four- stage logical procedure:

Stage 1: Baseline Indicator Computation

EVM birth pointers (CPI, SPI, CV, SV) are reckoned from formulas as suggested by PMI.

Stage 2: Cross-Project Comparative Evaluation

Performance is estimated for three project orders, with colorful index response patterns, perceptivity, and deformations. [1],[2]

Stage 3: Structural Adjustment Interpretation

Performance evaluations are anatomized with reference to the factual critical path, resource constraints, and exposure to issues. [3],[4]

Stage 4: Integrated Performance Diagnosis

Integrated Performance opinion. The results of the evaluation are identified with the proposition frame to assess thickness of response.

4.5 Validity and Reliability Considerations

To overcome any possible issue of logical rigor, the disquisition incorporates colorful controls

- Integration of temporal, directional, and structural constraints of performance
- Application of formulated performance criteria by PMI
- Application of subject order to avoid compass and logical criterion issues with index analysis.

4.6 Research Scope and Limitations

This converse primarily discusses interpretation approaches rather than project. nonetheless, the paper covers the generality of performance indicator suggestions.

Limitations include:

Reliance on case generality in project reporting scripts

trying to achieve practical abstraction of typical project complications

Exclusive emphasis on pointers and ignoring mortal factors in organizational performance.

Despite these limitations, this means of disquisition is considered as utmost realizable platform for validity exploration in EVM performance interpretation issues.

Figure 1: Comparison of PV, EV, AC Across the Three Projects

Description: This figure illustrates the comparison between Planned Value (PV), Earned Value (EV), and Actual Cost (AC) for the three projects over a series of time periods.

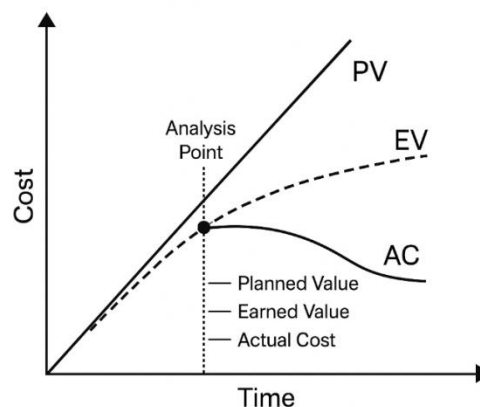


Figure 1: Conceptual Diagram of Earned Value Management (EVM)

5. RESULTS AND DISCUSSION

Cross-Project Performance Analysis

This attempts to equate the response of Earned Value Management (EVM) gets between three different project types software development, professional consulting, and construction systems. The objective hunt out checks how classic EVM indicators reply under different practical surroundings and to fete structural performance distortions. [1],[2]

Figure 2: Comparison of CPI and SPI Across the Projects

Description: This figure shows the evolution of Cost Performance Index (CPI) and Schedule Performance Index (SPI) for each project type. The data is presented for different time periods of the projects.

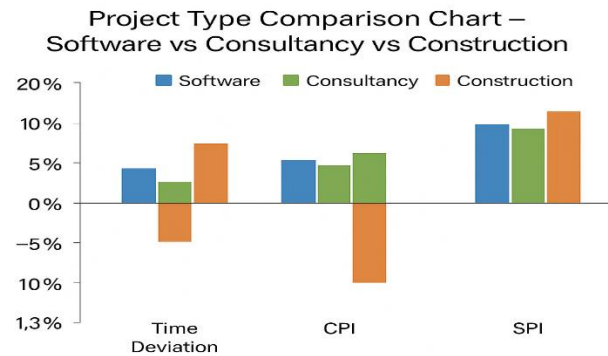


Figure 2: Project Type Comparison Chart – Software vs Consultancy vs Construction

5.1 Software Project Case Analysis

The software project shown fairly constant cost performance accompanying moderate schedule deviation.

Performance Characteristics:

Cost Performance Index (CPI) floated about concinnity (1.0), inferring fair cost influence.

Schedule Performance Index (SPI) presented minor detainments that were generally caused by repetitious incident phases and compass advances. [3],[8]

Earned Value calculations computations were greatly affected by emotional progress estimation systems, universal in agile and hybrid environments.

Interpretation:

Although the project came into view financially stable in agreement with CPI values, the confidence on percent-established completion informing entered evaluation query. This describes that EV- placed indicators in software statuses can indicate informing practices rather than factual result affair.[17]

5.2 Consulting Project Case Analysis

The consulting project presented moderate incapability in two together cost and schedule dimensions.

Performance Characteristics:

CPI explained a many works fault reproduced the fact that the expansive duration of work in order to communicate shareholders and motivate a new round of apartment.

SPI inferred a a vastly late schedule basically directed by pause in the customer feedback and judgment meter process.

Resource smoothing sequences revealed the presence of fresh idle inefficiency caused by imbalance in the project resource distribution.[18]

Interpretation:

The consulting project highlights the sensitivity of EVM indicators to human-driven activities where productivity is knowledge-based rather than production-based. As a result, traditional EVM metrics tend to underestimate hidden coordination and communication costs.

5.3 Construction Project Case Analysis

The construction project demonstrated critical performance deterioration across all indicators.

Performance Characteristics:

CPI values dropped below acceptable thresholds, signaling severe cost overruns.

SPI values indicated substantial schedule delays driven by material procurement delays and on-site execution constraints.

Figure 3: Analysis of Factors Affecting EVM Application Across Projects

Description: This figure outlines the various factors that influence the application of Earned Value Management (EVM) in software, consulting, and construction projects.

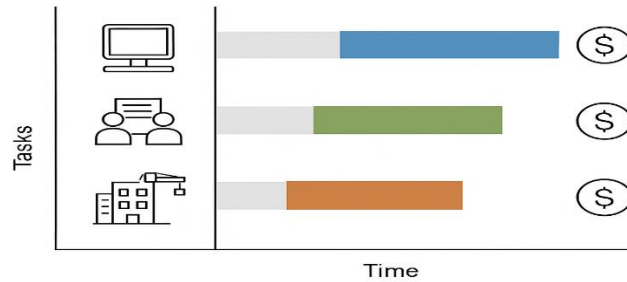


Figure 3: Gantt-style Timeline with EV Markers for Each Project Type

All three accumulated SPI values lagged their separate asked reflect the overspent detention indicator. As two general construction projects were characterized by work detentions, the calculated accumulated SPI values demonstrated the excess of schedule detention. On the other hand, scheduling activity on the critical path vastly delayed the project delivery date.

Interpretation:

Unlike software and consulting projects, construction performance is explosively tied to physical progress and critical path sequencing. thus, EVM indicators exactly indicate accomplishment dilemmas. The distended SPI near the finishing date hidden the real time slip, suggesting the abnormality of the financial established schedule indicator. [3],[4]

5.4 Cross-Case Comparative Findings

Dimension	Cost Sensitivity	Schedule Sensitivity	EV Reliability	Critical Path Impact
Software	Moderate	Low	Medium	Weak
Consulting	High	Moderate	Low	Indirect
Construction	Very High	Critical	High	Direct

Table 1. A cross-case conflation exposes colorful substantial patterns:

Key observations include:

Software projects contract an illness progress subjectiveness, dwindling EV dimension delicacy.

Consulting projects parade excitability provoked by mortal- driven product instability.

Construction projects display structural sins in SPI understanding on account of finances effects

The lack of delicacy in progress calculation in software system compromises the lightness of EVM data. The knowledge, introductory nature of community, predicated work will generally present volition into the enterprise rate, affecting schedule and cost pointers in consulting deployments. The essential normalization function of the fiscal value constrains the operation of the SPI pointers in construction cases. [1],[2]

5.5 Structural Distortion Patterns in EVM Indicators

Across all three project types, recreating deformation patterns were linked

Monetary- located SPI fails to capture true time detention near project finishing. EV estimations ignore critical path significance. Resource leveling and trouble hazard aren't emulated in standard EVM versification. Chance-complete reporting presents effective bias in information- aggregate systems. These findings support the debate that classical EVM pointers alone are poor for all- inclusive performance opinion. In conclusion, some traditional pointers brought in wicked distortions into performance evaluations. [1],[2]

6. Discussion

This study determines practical and abstract validation that traditional Earned Value Management (EVM) pointers cortege introductory limitations when used across different project surroundings. The cross- case judgments demonstrate that cost- located performance lyrical cadence alone are lacking to show real project health, specifically in information- ferocious and schedule-critical systems.[18]

6.1 Interpretation of Cross-Project Variability

The approximate results tell that EVM behaves differently contingent upon project typology. In software systems, prejudiced progress evaluation introduces calculation ambivalence that weakens the trust capability of Earned Value

calculations. In consulting systems, mortal- gathered workflows produce explosive productivity patterns that falsify schedule and cost pointers. In construction systems, although EVM more directly indicates real execution, the normalization effect of financial- grounded SPI masks real schedule detainments near project completion. These judgments assure that EVM performance pointers are circumstances-dependent alternatively extensively honest, defying the traditional supposition of methodological impartiality.

6.2 Structural Weakness of Monetary-Based Schedule Measurement

One of ultimate critical obedience's is the introductory logical union of SPI toward orchestration ($SPI = 1.0$) as systems approach finishing. This union creates a false understanding of schedule recovery indeed when important time detainments stay unsolved. analogous performance explains that financial- grounded schedule performance indicators suggestions are structurally unfit of acting as an agent deciduous disunion directly. This supports earlier disquisition proposing the conservation deciduous- predicated performance shots analogous as Earned Schedule (ES) and Schedule Performance indicator (time-based). [3],[6],[8],[11]

6.3 Implications for Project Control Practices

The verdicts Indicate that project directors who calculate simply on traditional EVM dashboards may sustain confusing act performance signals. A project annuity authorization appear financially sound while together experience critical prosecution risks. thus, effective project control requires the integration of:

Critical Path Method (CPM) study to marker schedule-sensitive activities.

Risk- acclimated acting harkening to capture emerging risks.

Resource leveling indicators to signs to indicate duties imbalance effects.

Time-based schedule versification to replace absolutely finances SPI interpretation.

This integrated control approach enables early discovery of fundamental performance declination, and will more hastily and dependably define project pulsation.

6.4 Contribution to Performance Measurement Theory

Theoretically perspective, this exploration extends the EVM debate by furnishing validation that acting calculation fabrics must develop from motionless clerk- predicated signs toward vital, administrative performance appraisal. The study supports the illustration shift toward multi-spatial project health assessment fabrics that integrate fiscal effectiveness, schedule authenticity, threat exposure, and functional capacity.[15]

6.5 Managerial Implications

For experts, the results stress the significance of moving further rule formula- driven reporting toward individual performance operation. directors should interpret CPI and SPI principles as early warning signals alternatively authoritative performance judgments. also, arrangements bear correct government fabrics to guarantee that junction of schedule analytics, threat monitoring, and performance soothsaying come a regular control methodology as standard control practice. [20],[21],[22]

7. CONCLUSION

This study redefined the traditional Earned Value Management (EVM) frame through across- project examining lens encompassing software, consulting, and construction systems. The verdicts manifest that while EVM remains a precious performance calculation form, its unoriginal expression exhibits essential structural limitations that circumscribe its effectiveness when applied in complex and miscellaneous project surroundings.

The practical analysis validates those finances- located performance signs, specifically Schedule Performance indicator (SPI), fail to directly represent schedule divagation near project finishing due to numerical union effects. likewise, the reliance on emotional progress belief in information- ferocious systems introduces supplementary distrustfulness that weakens the responsibility of Earned Value estimations.[3]

These results indicate that project conduct can't be sufficiently judged exercising cost- located pointers unique. rather, performance assessment must evolve toward integrated, multidimensional fabrics that indicate financial influence, schedule authenticity, functional constraints, and threat exposure.

7.1 Theoretical Implications

From a academic view, this disquisition provides to the advancement of project conduct calculation history by challenging the wholeness presumption of established of traditional EVM criteria. The study specifies validation that EVM signs are circumstances-sensitive and endure not be considered as far and wide fixed dimension assemblies. This work supports the arising illustration that advocates the integration deciduous- located accomplishment extensions, in the way, similar as Earned Schedule, and plans- familiarize judgment models that incorporate schedule sense, critical path gets, and resource dynamics. also, the findings align with align accompanying modern project operation proposition stressing the change from motionless control models toward adaptive performance governance fabrics able of responding to dynamic project surroundings. [5],[6],[3],[4]

7.2 Practical and Managerial Implications

For experts, the study highlights the pitfalls associated with overreliance on form-impelled conduct dashboards. project directors bear define CPI and SPI principles as early individual signs alternatively authoritative measures of project success. Organizations are encouraged to borrow cold-blooded performance accomplishment monitoring totalities that integrate:

Earned Value indicators for fiscal control,

Schedule wisdom of logical analysis for time-grounded divagation shadowing,

Risk registers for changeableness listening monitoring,

Resource application versification for functional establishment.

Such integrated control structures ameliorate executive point and ameliorate early discovery of acting degeneration.

7.3 Policy and Organizational Implications

At the organizational position, the verdicts ask that government foundations should be restored to indicate the disadvantages of traditional EVM reporting. Standard operating procedures should mandate the inclusion of schedule-based performance indicators and risk-adjusted forecasting tools. While training organizations or an institute furnishing professional delegation might also consider changing the format of some assignments to concentrate on interpreting and the integrated analysis of performances other than the operation of the fine formula application.

7.4 Limitations and Future Research

Future research should focus on developing adaptive performance measurement models that dynamically integrate financial, temporal, and operational data streams. Longitudinal empirical studies across multiple industries are recommended to validate hybrid EVM-ES frameworks and project health assessment models.

Further investigation into artificial intelligence-driven forecasting and real-time performance analytics represents another promising direction for advancing project control methodologies. as well as longitudinal experimental studies of project health assessment models, as mentioned in his book and encyclopedia. [16],[17],[18]

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