Extending Earned Value Management to Firm Fixed Price Contracts Through a Multi-Perspective Analytical Framework for Mixed Contract Portfolios [1]

A framework developed and validated through real-life CAPEX applications across multiple industries

By Alexandre Rodrigues

Foreword by Wayne Abba

Foreword

I am pleased to endorse this timely paper on a subject that deserves serious attention: how to apply Earned Value Management (EVM) in a practical, disciplined way to Firm Fixed Price (FFP) contracts. I have long believed that EVM is first and foremost a management discipline, not a contractual compliance or reporting ritual. That distinction is especially important now, as the United States Government places renewed emphasis on fixed-price contracting.

The question is not whether FFP contracts should be managed with objective performance information; they must be. The more useful question is how to do so when the government does not receive the contractor's actual cost data. This paper addresses that question directly. It shows how EVM concepts can be extended using the information that is available, including the effects of change orders, baseline maintenance, and the need to distinguish true performance variance from owner-directed scope and cost growth.

What I find most valuable is the paper's emphasis on practice. The author uses case studies to show how sound program control principles can be adapted to the realities of fixed-price work while still providing decision makers with meaningful visibility into progress, risk, and emerging cost consequences.

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For government portfolio managers, the value of that visibility depends on consistency. They need management data that can be compared across programs and contract types, so that performance trends, resource demands, and emerging risks can be understood at the portfolio level, not merely contract by contract. EVM is uniquely suited to that purpose because, properly applied, it integrates cost, schedule, and technical performance management into a single disciplined framework. Those elements are necessary for effective management under any contract type, including FFP.

That is why this paper is both timely and useful. As agencies and contractors seek better outcomes under FFP arrangements, they should not abandon the lessons EVM has taught about planning, measuring work accomplished, maintaining a credible baseline, and acting on early warning information. This paper offers a constructive way to carry those lessons forward. I commend it to acquisition executives, program managers, contracting officers, project controls professionals, and policy leaders who want fixed-price contracting to be not only fiscally disciplined, but effectively managed.

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0. Overview

This paper presents a framework for extending Earned Value Management (EVM) to Firm Fixed Price (FFP) contracts. Traditional EVM was developed for environments in which the project owner has visibility into contractor actual costs. In FFP contracts, however, the Owner has no visibility into the contractor's actual costs, and approved change orders become part of the Performance Measurement Baseline (PMB), leading conventional EVM to report Cost Variance (CV) equal to zero and a Cost Performance Index (CPI) of one. Consequently, traditional EVM cannot provide meaningful insight into the owner's actual cost performance.

This paper demonstrates that this limitation arises not from the principles of EVM, but from the way cost performance has traditionally been measured in FFP environments. It presents an analytical framework that preserves the fundamental principles of EVM while enabling meaningful measurement of owner cost performance without requiring visibility into contractor actual costs.

The proposed framework was developed and refined through practical implementation in Capital Expenditure (CAPEX) projects across multiple industries and is illustrated through three real-life case studies drawn from major infrastructure programs. It introduces complementary analytical perspectives for measuring performance at the contractor, contract, owner, and investor levels while preserving a single EVM methodology across mixed contract portfolios. Although this approach introduces additional analytical complexity, modern project information systems and AI-assisted project control make its implementation increasingly practical. The result is a unified performance management approach that extends the applicability of EVM across both Cost-Reimbursable (CR) and FFP environments.

1. Context and motivation

EVM was originally developed for environments in which the owner has visibility into contractor actual costs, such as CR and Fixed Price Incentive Fee (FPIF) contracts. In FFP contracts, however, the owner has no visibility into the contractor's actual costs, making traditional EVM cost-performance analysis ineffective.

Although FFP contracts transfer most execution cost risk to the contractor, they do not eliminate cost variance from the owner's perspective. Throughout CAPEX projects, owners frequently incur additional costs arising from design deficiencies, scope clarifications, contractual obligations, and other owner-responsible changes. These costs are typically incorporated into the contract through change orders.

Because such change orders become part of the updated contract budget, traditional EVM incorporates them into the PMB. Consequently, Actual Cost (AC) and Earned Value (EV) evolve together, resulting in CV = 0 and CPI = 1. While this accurately reflects contract administration from the contractor's perspective, it fails to distinguish between budget growth that creates additional business value and budget growth that merely compensates for undesired cost increases. As a result, traditional EVM provides little insight into the owner's actual cost performance in FFP environments.

Given that the EVM model was not originally developed to address the realities of FFP contracts, why not consider a different performance management model? Why is extending EVM to this type of contract the better approach?

Modern organizations increasingly manage portfolios comprising a mixture of CR, incentive-based, and FFP contracts. Applying different performance management methodologies across contract types fragments governance, reporting, performance metrics, executive dashboards, historical databases, organizational learning, and professional training. Extending EVM to FFP contracts preserves a single enterprise-wide performance management framework across the entire portfolio, regardless of the underlying contracting strategy.

This need for a common performance management framework across mixed contract portfolios has also been recognized by experienced EVM practitioners. Barbara Phillips, who served for more than 25 years as a NASA EVM Subject Matter Expert, observes that organizations increasingly rely on FFP contracts while still requiring a disciplined and standardized approach to measure owner cost performance. She notes that extending EVM to FFP environments preserves a common methodology across mixed contract portfolios while strengthening governance, decision-making, and portfolio performance management.

This not only strengthens organizational consistency and comparability but also enables decision-makers at all organizational levels to evaluate project and program performance using a common language and a unified analytical framework.

2. Conceptual framework

2.1 Core principle

The principles of cost performance apply regardless of the contractual arrangement, whether under a single all-inclusive FFP contract, a CR contract, or a portfolio comprising different contract types.

Implementing EVM in FFP environments differs from its traditional implementation in CR environments in several respects. The central question addressed by this paper is: *how can the universal principles of cost performance be preserved when the Owner Team has no visibility into the contractor's actual costs?*

To address this challenge, it is not necessary to redefine the concept of cost variance, but only to reconsider how it is determined in an FFP environment. Traditional cost variance remains defined as the difference between budgeted and actual cost required to achieve current production. In FFP contracts, the concept does not change; only the observable information used to determine actual cost, earned value, and cost variance changes. Rather than deriving actual cost from contractor resource consumption, owner cost variance is identified through change orders that increase project cost without increasing approved product functionality — referred to as CV Change Orders (CO-CV). This preserves the conceptual definition of CV while adapting its measurement to the information available in FFP environments. (For a summary of the traditional EVM interpretation of cost performance, see Annex B; Annex C provides a simple illustrative example comparing CR and FFP contracts).

This view is consistent with the experience of Gary Humphreys, an international EVM practitioner with several decades of experience implementing and assessing EVMS across government and commercial programs. He argues that EVM is at least as important on FFP contracts because, although execution cost risk is largely transferred to the contractor, effective management still depends on disciplined planning, budgeting, scheduling, and performance measurement against a robust PMB.

The framework proposed in this paper implements this principle through a simple adjustment to the earned value that excludes the EV of all CO-CV work:

- Adjusted EV = Conventional EV (or AC) minus the EV of all CO-CV work

This concept establishes that cost variance can be identified and quantified in FFP contracts, providing the conceptual foundation for the analytical framework proposed in this paper.

2.2 Impact on baseline management

This principle requires reconciliation with how the PMB is managed. While CO-CVs result from emergent, unforeseen, and undesired additional costs incurred by the Owner, COs may also arise from other causes, namely:

- **CO-SQ**: to implement *desired changes* to enhance quality or expand scope. The total budget at completion (BAC) and PMB are adjusted accordingly.
- **CO-RK**: to respond to risks that have been identified (they are *not a surprise*) and taken into consideration when a risk contingency reserve was established. A budget is transferred from this reserve (which is already integral to the PMB) into the risk response, with the total budget (BAC) remaining constant.

When an unfavorable CO-CV occurs (e.g., to address rework), what happens to the baseline? On the one hand, this is an extra cost that adds no value to what is being produced by the project; therefore, while it contributes to AC, it must not contribute to EV. This would suggest not incorporating it into the PMB: all scope and cost incorporated into the PMB will contribute to measuring EV and progress. On the other hand, the scope generated by the change order must be measured and controlled, as it is an integral part of what the contractor should accomplish. From the contractor's perspective, it is in fact a scope increase, not a cost overrun. From the Owner's perspective, it is a cost overrun, but it is also a scope that needs to be accomplished on time and contribute to measuring progress of contract execution. Incorporating the CO-CV scope and agreed price into the PMB will make it contribute to EV calculation, thus canceling out the increase in AC, leading to EV = AC, CV = 0, and CPI = 1.

The apparent contradiction arises because traditional EV treats CO-CV work, which adds no approved product functionality or business value, in the same manner as value-adding work.

Rather than removing CO-CV work from the PMB, the proposed framework retains it for planning, scheduling, and progress measurement, but excludes its Earned Value from cost performance measurement.

The following simple example illustrates how the proposed adjustment restores meaningful cost performance measurement while leaving baseline management unchanged:

- Original contract price (BAC) = $1,000
- CO-CV issued for rework = $200
- Current contract price (BAC) = $1,200 (PMB incorporates the CO-CV)
- Work performed in the original baseline = $500 (i.e., 50% of the original work)
- Rework performed (via CO-CV) = $150 (i.e., 75% of the rework in the PMB)
- Actual Cost (AC) = $650
- Conventional EV = $650
- Adjusted EV = $650 - $150 = $500
- Adjusted CV = Adjusted EV - AC = $500 - $650 = -$150
- Adjusted CPI = Adjusted EV / AC = $500 / $650 = 0.77

Under the proposed framework, the work performed to date had a planned cost of $500. However, due to the rework, the Owner incurred an actual cost of $650. The resulting cost variance is −$150, yielding an adjusted CPI of 0.77. We define this indicator as the CPI-Owner, representing cost performance from the Owner's perspective rather than the contractor's.

The proposed adjustment allows CO-CV work to continue contributing to project progress measurement while preventing it from generating Earned Value, thereby restoring meaningful cost performance measurement without affecting complete and consistent baseline management. It also has implications for other aspects of EVM implementation, which are discussed next.

2.3 Impact on progress measurement

This proposed principle also has impacts on how progress is measured. Two managerial perspectives emerge:

- **Perspective 1**: managing execution of the full contractual scope – this is an operational perspective on contract execution. Out of the full adjudicated work under contract, how much has been accomplished? What is the progress?
  - The total work adjudicated stands at (BAC-Contract) = $1,200
  - Total adjudicated work accomplished to date: $650
  - % Progress-Contract = $650 / $1,200 = 54.17%
- **Perspective 2**: reporting progress to the investor – this is a business perspective focused on producing value for the investor. The investor must know what the total cost incurred to date (AC) is, but they do not see or are not interested in counting rework as progress, since that type of work accomplishment adds no value; it is undesired, and ideally it would not have occurred. Therefore, from the investor's perspective, the value-producing scope is the scope that delivers approved product functionality:
  - Total scope (BAC-Owner) = $1,000
  - Scope accomplished (EV-Owner) = $500
  - % Progress-Owner = 50%.

The existence of two different progress measures does not represent an inconsistency. Rather, they coexist because they answer two different management questions: one supports operational management of contract execution, while the other measures the delivery of approved product functionality and business value.

3. Real-life examples

The conceptual framework has been successfully implemented in a variety of projects executed under FFP contracts. Three representative case studies are presented below.

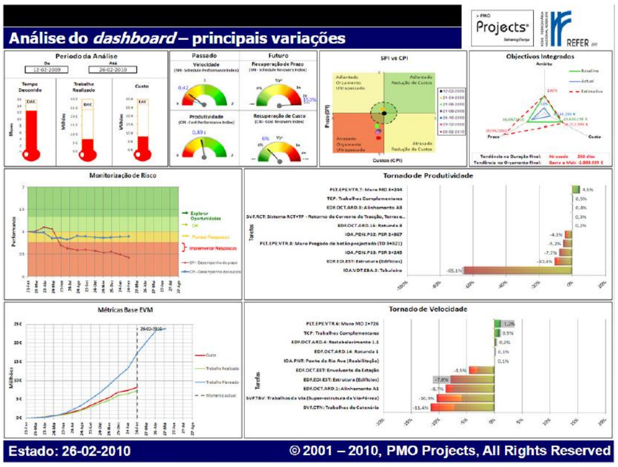
3.1 The "Variante da Trofa (Linha do Minho)" Railway Station, Portugal

The Trofa Railway Station formed part of the *Variante da Trofa* project promoted by the state-owned company REFER, E.P. (the Owner), as part of the modernization of the Minho Line in northern Portugal. The project comprised the construction of a new 3.6 km railway bypass around the town of Trofa, including a new railway station to replace the existing one, together with railway infrastructure, road accesses, track, catenary, and associated civil works. Construction was carried out between approximately 2008 and 2010. The station was delivered as part of the General Civil Works, Track and Catenary Contract executed by a contractor, while separate contracts covered the design-build tunnel and the railway systems.

(https://www.infraestruturasdeportugal.pt/sites/default/files/inline-files/rc_rf_2009_en_1.pdf)

EVM was implemented for the construction of the new Trofa Railway Station, one of the principal components of the *Variante da Trofa project*. The works were procured under a FFP contract with an initial contract value of approximately €26 million. The figures below present examples of EVM performance reports used to monitor the project's cost and schedule performance (these EVM reports shown are drawn from the author's original implementation).

Indicator	Value	Interpretation
BAC (total budget – total budgeted cost for the scope activities, usually new work and planned work)	€25,880,197.50	The total budget for the works is €25,880,197.50.
AC – cost of work performed	€8,148,236.92	Actual cost incurred.
EV – budgeted cost of work performed	€7,128,673.95	Value of the work actually completed.
PV – budgeted cost of work planned	€17,263,603.91	Value of the work that should have been completed (planned).
SPI (Index = EV / PV) Schedule Performance Index Measures the percentage of planned work actually accomplished.	0.42 (0.42 m/m)	Only 42% of the planned work has been achieved. At this rate, the project will take much longer than planned.
CPI (Index = EV / AC) Cost Performance Index Measures cost efficiency in relation to budgeted cost.	0.89	Every €1.00 spent produces only €0.89 of planned value.
TSPI (Schedule Critical Index) = (BAC – EV) / (BAC – PV) The schedule recovery index indicates the productivity required to complete the remaining work on time.	2.53	To recover the schedule, every remaining month would need to achieve 2.53 times the originally planned productivity.
TCPI (Cost Critical Index) = (BAC – EV) / (BAC – AC) The cost recovery index indicates the budget efficiency required to complete the remaining work within the budget.	1.06	To recover the budget, every remaining €1.00 of expenditure must produce €1.06 of planned value.
SV (Schedule Variance = EV – PV) Difference between the value of work performed and the value of work planned.	-€10,134,930.25	The project is behind schedule by approximately €10,134,930.25 worth of planned work.



The EVM system was implemented on behalf of the Owner and provided rigorous cost and schedule control throughout project execution. As a pilot implementation within REFER E. P., it introduced management information that had not previously been available, significantly enhancing project visibility, decision-making, and overall project control.

One of the most insightful discussions arising from the implementation concerned the treatment of a change order to increase the number of lampposts. During construction, it was discovered that the original design did not satisfy the required operating standard for adequate platform illumination. Initially, the Owner's project team regarded this as a scope enhancement. However, from the Owner's perspective, the approved investment budget had always been intended to deliver a *properly illuminated railway station*, rather than merely a station containing a specified number of lampposts. Since the additional lampposts were required to achieve the originally intended functional performance, the change was classified as cost variance (i.e., as CO-CV) — that is, a cost overrun rather than a scope increase. This example illustrates the importance of establishing clear, objective, and internally consistent criteria for classifying change orders, particularly in FFP contracts where the distinction between correcting deficiencies in the original scope and introducing genuinely new scope can significantly affect project performance assessment.

3.2 The "Parque Escolar" Program, Portugal

The Parque Escolar Program was a nationwide initiative promoted by the Portuguese Government through the state-owned company Parque Escolar, E.P.E., with the objective of modernizing Portugal's public secondary school infrastructure. Launched in 2007, the program initially planned the refurbishment, expansion, and modernization of 332 secondary schools throughout the country by 2015, representing one of the largest public infrastructure programs ever undertaken in Portugal. With an estimated investment exceeding EUR 2.4 billion, the program comprised a large portfolio of concurrent construction projects delivered through hundreds of individual public works, design, supervision, and consultancy contracts involving numerous contractors, consultants, and suppliers. This created a particularly demanding environment for program and portfolio management, requiring rigorous planning, coordination, performance measurement, and executive reporting across multiple projects executed simultaneously. Following the 2008 global financial crisis and the subsequent fiscal constraints in Portugal, the original program scope was scaled back, and approximately 173 schools were ultimately completed under the initiative.

(https://www.oecd.org/content/dam/oecd/en/publications/reports/2012/04/modernising-secondary-school-buildings-in-portugal_g1g15a8c/9789264128774-en.pdf)
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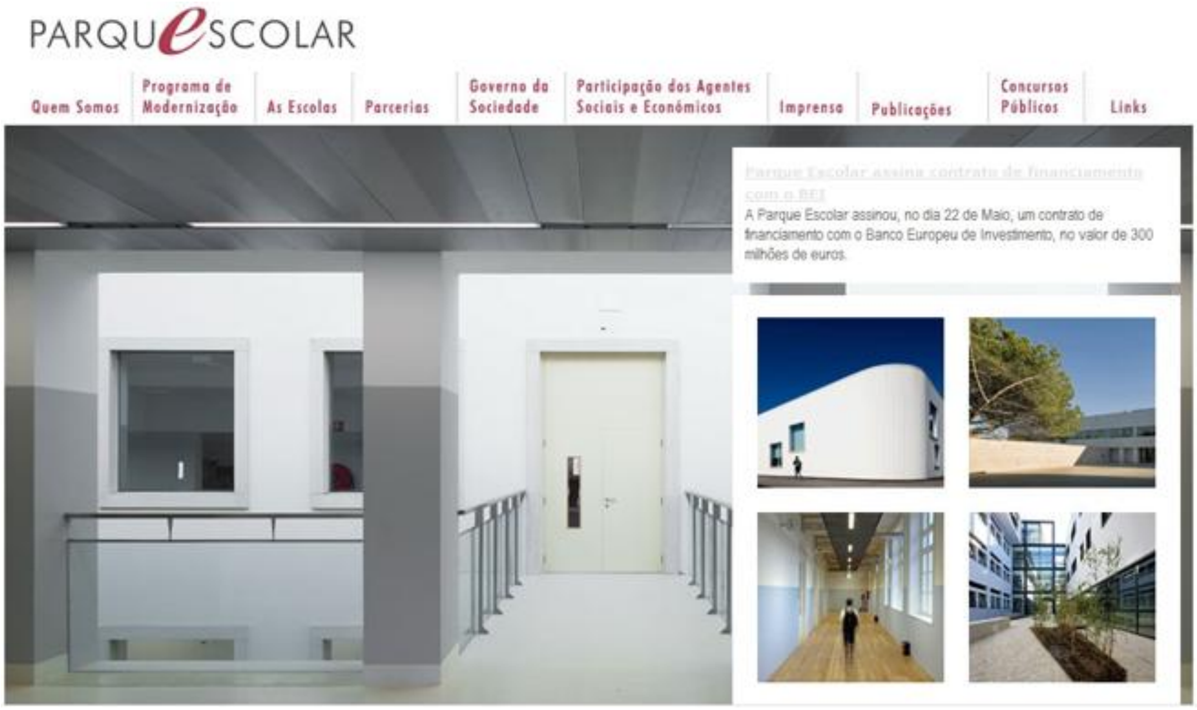


EVM was implemented across the Parque Escolar Program during 2009 to provide rigorous budget control, integrated cost and schedule performance measurement, early warning of potential delays, improved resource planning, enhanced transparency, and real-time performance reporting across one of Portugal's largest public infrastructure programs. The implementation addressed the challenges of managing a geographically dispersed portfolio of hundreds of concurrent contracts involving numerous contractors, consultants, and stakeholders, while introducing EVM to an organization with limited prior experience in performance-based project management.

A phased implementation strategy was adopted, beginning with a three-month "quick win" focused on projects already under construction, followed by the extension of the methodology to the design and procurement phases, portfolio-wide deployment across the school modernization program, and the transfer of the EVM system and processes to Parque Escolar as the organization's standard project performance management methodology. The figures below present examples of EVM performance reports used to monitor the program’s cost and schedule performance (these EVM reports shown are drawn from the author's original implementation).

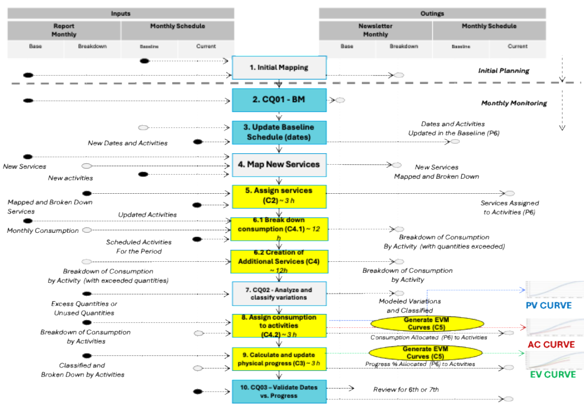
The EVM implementation was completed rapidly and became the primary performance reporting system for key stakeholders, including Parque Escolar's senior management. Following the successful initial deployment, the methodology was progressively extended to the design and procurement phases and rolled out across additional schools. A key element of the implementation was the transfer of the EVM system and supporting processes to the organization through structured project management and EVM training, workshops, and institutionalization activities. Senior management recognized EVM as an essential management tool, while early resistance—primarily driven by the perception that EVM represented an additional, optional reporting requirement—was overcome by embedding the methodology into the organization's mandatory planning, controlling, and reporting processes. This institutionalization, together with continuous knowledge transfer, proved to be a critical success factor for the long-term adoption of EVM across the program.

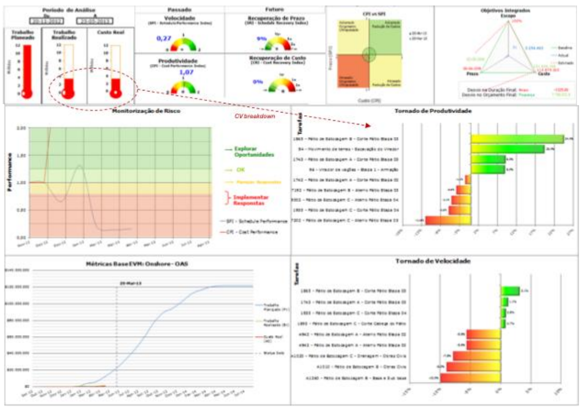
3.3 The "Nacala Corridor" Program, Mozambique and Malawi

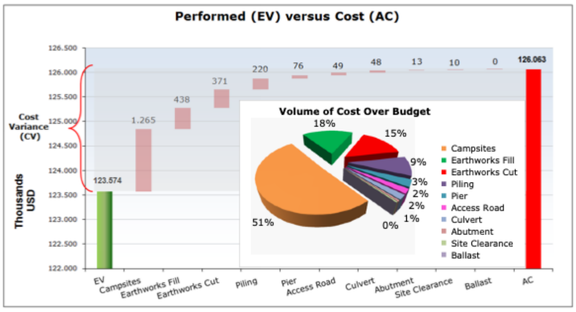
The Nacala Corridor Program was a multinational transport infrastructure initiative undertaken by Vale, in partnership with CFM and the Governments of Mozambique and Malawi, with Mitsui subsequently joining the project as an equity partner, and other public and private stakeholders, to establish an integrated logistics corridor linking the Moatize coal basin in western Mozambique to the deep-water Port of Nacala on the Indian Ocean. Executed between approximately 2011 and 2017, the program comprised the construction of approximately 230 km of new railway, the rehabilitation of 682 km of existing railway across Mozambique and Malawi, the development of a new coal export terminal at Nacala, and associated port and logistics infrastructure. With a total investment of approximately US$4.4 billion, it represented one of the largest private infrastructure programs ever undertaken in Africa. The EVM implementation was applied to railway and port construction projects, comprising a complex portfolio of concurrent engineering and construction contracts involving numerous owners, joint-venture partners, designers, contractors, consultants, suppliers, and subcontractors from multiple countries. The international nature, technical complexity, and contractual diversity of these projects created a highly demanding environment for integrated program performance measurement and control.

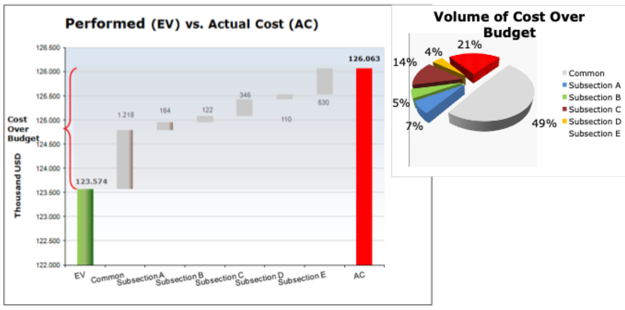
(https://vale.com/documents/44618/2699492/Newsroom_-_Logistics_-_Vale_inaugurates_the_Nacala_Corridor_in_Southeast_Africa_ID%3D1006.pdf/93f05870-43d3-7474-575c-2de6cfcacec3?download=true&t=1672692681049&version=1.0)

An EVM system was developed for the Owner and implemented during the early years of construction (2013–2014) to support the management of the major railway (Malawi section) and port (Nacala) construction contracts. The figures below illustrate examples of the EVM processes and performance reports used to monitor project performance, with particular emphasis on cost variance analysis decomposed by scope components and work type (these EVM reports shown are drawn from the author's original implementation).









The implementation of EVM delivered significant benefits to the Owner, particularly by providing early warning of emerging cost and schedule deviations, enabling timely management intervention. The program was executed under exceptionally challenging conditions, including a vast geographical area, limited availability of qualified local labor and suppliers, and demanding climatic conditions. Early identification of unrealistic cost and schedule targets enabled the Owner to reprogram investment plans and revise revenue forecasts, thereby minimizing the overall business impact. In addition, EVM established a common performance measurement language across a highly diverse project environment involving multidisciplinary teams from multiple countries, including Mozambique, Portugal, Brazil, South Africa, and Malawi.

In this implementation, another important requirement addressed by the proposed framework arose from the governance model commonly adopted in large CAPEX programs, where the CAPEX baseline is established before detailed engineering, procurement, and construction activities commence, while project execution is delegated to an Owner's Team. From the investor's perspective, project performance is continuously measured against the CAPEX baseline, whereas the Owner's Team measures contractor performance against the respective contractual baselines. The proposed framework supports these complementary performance measurement perspectives through the introduction of the CPI-CAPEX and CPI-Owner metrics. A more detailed discussion of this multi-level performance measurement approach is provided in Annex A.

4. Benefits of extending EVM to FFP Contracts.

Extending the EVM model to address the realities of FFP contracts provides several benefits, which can be grouped into four areas: project management, organization, management decision-making, and portfolio & executive management.

4.1 Project Management: Preserves the Full Benefits of EVM in FFP Contracts

Traditional EVM is generally regarded as having limited applicability in FFP contracts because owners lack visibility into contractor actual costs. The proposed framework overcomes this limitation while preserving the conceptual foundations of EVM. FFP contracts do not require a different EVM model—they require a different way of measuring owner cost performance within the original EVM framework. Organizations can therefore continue to benefit from integrated scope–schedule–cost management, objective performance measurement, forecasting capability, management by exception, and standardized EVM metrics in projects executed through FFP contracts.

Gary Humphreys also observes that maintaining a common EVM methodology across different contract types preserves standardized management processes and historical performance information, improving future estimating, planning, and organizational learning.

4.2 Organization: Simplifies Governance Across Mixed Contract Portfolios

Organizations frequently manage portfolios comprising CR, FPIF, and FFP contracts. Using different performance management approaches for different contract types fragments governance, reporting, training, and management processes. The framework to extend EVM to FFP enables organizations to maintain a single standardized EVM methodology across mixed portfolios, providing a common analytical language, common processes, and consistent decision-making regardless of contracting strategy.

Daniel Goldsmith, an experienced EVM practitioner with extensive commercial and government implementation experience, similarly argues that applying EVM across different contract types enables objective performance measurement and standardized comparisons among projects, regardless of their contracting strategy. Based on his experience, organizations successfully use EVM on commercial FFP contracts to manage cost, schedule, and profitability while preserving a common management methodology.

4.3 Management Decision-Making: Enhanced Management Information and Early Warning Capability

By distinguishing among contractor, contract, owner, and, where applicable, CAPEX performance perspectives, the proposed framework generates management information that traditional EVM cannot provide in FFP environments. This includes:

- Owner-level cost performance metrics (CPI-Owner and CV-Owner) that reflect actual owner cost performance rather than merely contract administration.
- Two complementary measures of progress, distinguishing operational contract execution from value-producing progress delivered to the investor.
- An early-warning indicator (IEAC-Owner trend) that highlights when deteriorating contract cost performance is likely to consume a favorable procurement ("buyout") variance and eventually threaten the approved CAPEX budget.
- Complementary CAPEX perspective for organizations that employ structured CAPEX investment governance and maintain a separate investment baseline, enabling investor-oriented performance measurement.
- Complementary schedule performance perspectives, including complementary schedule performance indices (SPI): SPI-Contract, SPI-Owner, and, where applicable, SPI-CAPEX, extending the same analytical principles to schedule performance.

Collectively, these analytical perspectives provide a richer understanding of project performance by separating operational execution from business value, improving forecasting, and supporting earlier and better-informed management decisions.

Where organizations employ structured CAPEX investment governance, the framework also provides an additional investor-oriented view of project performance.

4.4 Portfolio & Executive: Improves Consistency and Comparability of Portfolio Information

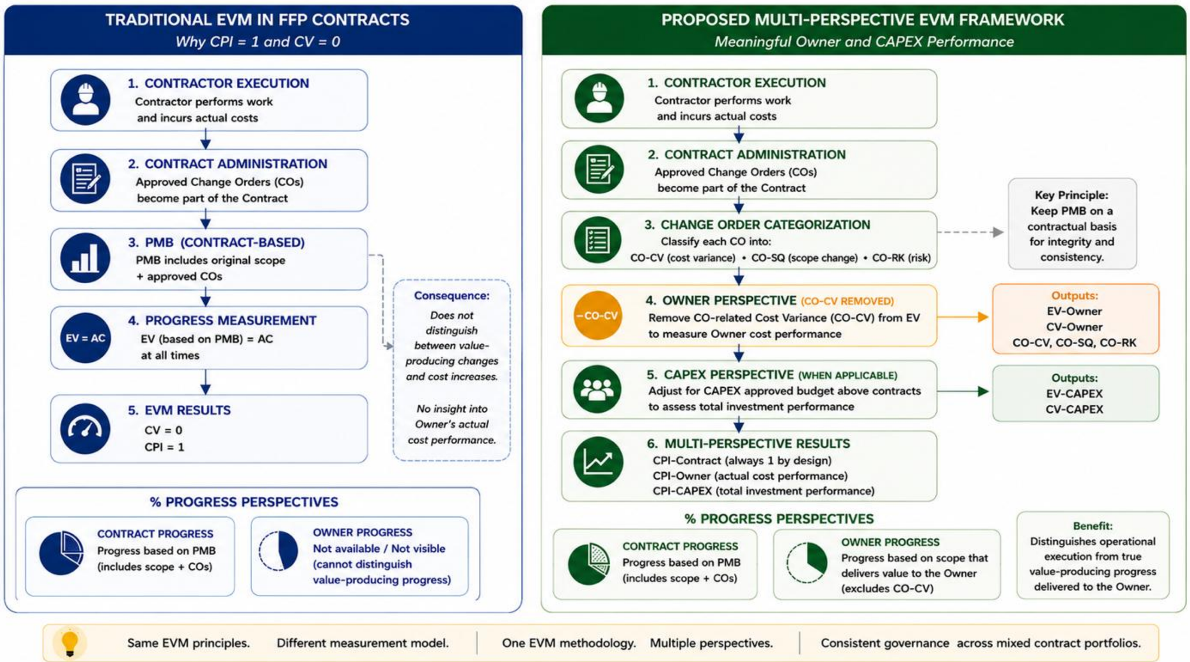
Applying a common analytical framework across all contract types produces consistent performance information throughout projects, programs, and portfolios. Performance metrics become directly comparable, executive dashboards are standardized, historical databases become more coherent, benchmarking improves, and organizational learning strengthens. This consistency also facilitates portfolio-level analysis and supports Artificial Intelligence applications that rely on standardized project performance data.

Daniel Goldsmith further observes that the principles of EVM are present in virtually every successful major organization or capital project, even when they are not explicitly identified as EVM. This suggests that EVM represents not merely a prescribed methodology, but a set of fundamental management principles that effective organizations naturally adopt in pursuit of disciplined project execution.

5. Implementation of the framework

Where traditional cost control systems fall short, EVM offers the flexibility to adapt to the realities of FFP contracts and the governance structures commonly adopted in large CAPEX projects and programs, enabling meaningful cost performance measurement and analysis at multiple levels. This adaptation is achieved primarily through the way budget, baselines, and cost performance are modeled from the Owner's perspective. The following figure summarizes the proposed framework and provides a visual reference for the implementation principles presented in this section.

Traditional EVM vs. Proposed Multi-Perspective EVM Framework for FFP Contracts



The proposed framework is based on the following principles:

- <u>**R1 – Product functionality baseline:** a baseline clearly defining the required product functionality exists.</u>
    - It should define the characteristics of the "product of the project" that grant business value to the owner.
    - For example, "Illumination according to required standards of use".
- <u>**R2 – Performance Measurement Baselines (PMBs):** establish the appropriate baselines for the required performance perspectives.</u>

    - The main PMB, which is mandatory, is the Contract's baseline attached to the FFP contract. It includes the total contract budget/price allocated to the planned work and to the contract's contingency reserve, if it exists.
    - When performance is also to be reported to the investor at a CAPEX level in a governance structure, a PMB-CAPEX is also established (refer to Annex A).
    - If schedule performance is to be measured in a way that differentiates between contractor and owner's accountability, then a PMB-Owner should exist (see Annex A.3)
- **R3 – Contingency reserves:** an owner cost contingency reserve exists to account for known risk over which it bears accountability.
    - This contingency is an integral part of the owner's total investment budget, but not part of the contract price/budget, so the contractor has no visibility into it.
    - In addition, the contract price/budget may also include its own contingency reserve, with visibility to the contractor for known risks for which it is considered beneficial to have visibility and an active involvement of the contractor; this contingency budget can only be used with the owner's approval.
    - Both contingencies are not allocated to the currently planned work and will be used only for planned work to be baselined in the future, related to either responding proactively to risk before materialization, or to accommodating the impacts of risk occurrence.
- **R4 – Change classification:** approved change orders to the contract's price/budget must always be classified in one of the following categories.
    - C1 – Budget increase/decrease related to changes desired by the owner in the product's functionality.
        - This means "pay more/less to have more/less business value". Example: adding a swimming pool, not initially considered for the house under construction.
    - C2 – Transfer (use of) of budget from the contingency reserves to newly planned work to deal with known risk (plan proactive response and/or deal with impact).
        - When the budget comes from the contract's contingency reserve, the total contract price does not change (BAC-Contract); only the amount of budget authorized to be spent will be affected.
        - If the change comes from the owner's contingency reserve, it will change the contract's price/budget (BAC-Contract).

- C3 – Cost variance. Changes to the contract price/budget that do not affect the product's functionality.
  - This means "pay more/less to have the same business value". Example: adding the installation of additional lamps to the scope of work to ensure that illumination standards are met, where the initial engineering specification had a defect (i.e., considered fewer lamps than needed to meet the standard).

- **R5 – Baseline Management:** rules governing changes to the PMBs are defined.
  - For the PMB-Contract:
    - Changes C1 (desired changes) and C3 (cost variance) will change the total value and time-phasing of the PMB. Change C2 (use of risk contingency) will only change the time-phasing of the PMB.
  - For the PMB-CAPEX:
    - Changes C1 (desired changes) will change the total value and time-phasing of the PMB. Change C2 (use of risk contingency) will only change the time-phasing of the PMB. C3 changes generally do not apply.
  - For PMB-Owner (in case schedule performance differentiation is considered)
    - All schedule changes are incorporated into the PMB-Contract, whereas schedule changes of Owner's accountability are not incorporated into the PMB-Owner (they generate schedule variance).
- **R6 – Cost Metrics:** The following cost-related EVM metrics are calculated:
  - EV-Contract = AC-Contract.
    - All work completed, valued at the contract price/budget, is the actual cost for the owner.
  - % Progress-Contract = EV-Contract / BAC-Contract
    - It refers to the full scope adjudicated
  - CV-Owner-Total = total value of type C3 changes
    - Total changes made to the contract price/budget that constitute cost variance (do not affect the product's functionality).
    - This value includes changes already executed, changes underway, and changes planned to be executed in the future.
    - A negative value means a cost overrun. If positive, it is a cost-saving for the owner.
  - CV-Owner = CV-Owner-Total x % Progress (for each work package)

    - The cost variance that has already materialized in a C3 work package for the owner, with the work executed (it is the EV for the CV-Owner-Total related work packages).
    - The CV-Owner rolls up from the lower-level work packages into higher levels in the WBS, up to CAs and the total contract scope.
  - EV-Owner = EV-Contract + CV-Owner
    - The earned value for the Owner.
    - It is the contract's EV (which is the same as the contract's AC), discounted for the materialized cost variance to the Owner (for unfavorable variance, CV-Owner is negative)
  - BAC-Owner = BAC-Contract + CV-Owner-Total
    - It is the component of the current contract budget that relates to value-producing scope
  - % Progress-Owner = EV-Owner / BAC-Owner
    - It is the progress from the Owner perspective, which refers only to value-producing scope and excludes cost variance
  - CPI-Owner (adjusted) = EV-Owner/EV-Contract = EV-Owner/AC-Contract
    - The CPI for the Owner.
    - Measures cost performance from the Owner's perspective by comparing the budgeted value of the value-producing work accomplished with the actual cost incurred under the contract.
  - CPI-Contract (traditional) = EV-Contract/AC-Contract = 1
    - The contract's CPI.
    - Under an FFP contract, EV-Contract = AC-Contract; therefore, CPI-Contract is always equal to 1 and provides no useful information regarding cost performance.
  - CPI-CAPEX = EV-CAPEX / AC-CAPEX (if applicable)
    - In case performance analysis is implemented at CAPEX level
    - EV-CAPEX = % Progress-Owner x BAC-CAPEX
    - AC-CAPEX = AC-Contract
  - % Progress-CAPEX = EV-CAPEX / BAC-CAPEX (if applicable)
    - It is the progress measure at the CAPEX level
    - It yields the same value as %Progress-Owner
- **R7 – Schedule Metrics:** the following schedule-related EVM metrics are calculated (if applicable):
  - SPI-Contract = EV-Contract / PV-Contract

- Schedule performance that measures variance for which only the contractor is accountable. This is the traditional SPI.
- PV-Contract includes all changes approved to the contract.

- SPI-Owner = EV-Owner / PV-Owner
    - Schedule performance that measures variance for which contractor and Owner are accountable. This variance only incorporates into the PMB-Owner changes that affect the business value (C1 changes), and therefore PV-Owner does not include delays (or time-savings) for which the Owner is accountable, leading to variation in this schedule performance indicator.
- SPI-CAPEX = EV-CAPEX / PV-CAPEX
    - Overall project or program schedule performance perceived and measured by the investor at the CAPEX level.

The following table summarizes the metrics system of the FFP-expanded EVM framework presented in this paper (it does not include the schedule performance metrics).

EVM Metric	4 – Contractor	3 – Contracts	2 – Owner's Team	1 – Investor
BAC	Internal to contractor's system, for which Owner has no visibility	**BAC-Contract:** includes the full scope of work adjudicated to date. The initial BAC plus all the change orders approved (C1 and C3). It may include a Contract's Contingency Reserve for C2s.	**BAC-Owner:** includes the scope of work initially adjudicated, plus change orders that affect product functionality (C1). It does not include CV change orders (C3). It may include a Contract's Contingency Reserve for C2s.	**BAC-CAPEX:** Includes the initially approved investment budget for the baseline functionality, plus change orders that affect product functionality (C1). It includes the Owner's Risk Contingency Reserve for C2s.
EAC	Owner has no visibility	**EAC-Contract:** always = BAC-Contract	**EAC-Owner:** always = BAC-Contract (based on the contracts' budget)	**EAC-CAPEX:** generally, it is not accepted to have an overrun over BAC-CAPEX. Lowest of BAC-CAPEX or EAC-Owner.
IEAC	Owner has no visibility	NA	IEAC-Owner = BAC-Owner / CPI-Owner (trend based on past CPI)	IEAC-CAPEX = BAC-CAPEX / CPI-CAPEX (trend based on past CPI)
VAC	Owner has no visibility	Always = 0 (CV is cost/budget growth)	**VAC-Owner:** total current contracts' budget growth due to approved CV change orders (C3). It is the current expected final CV, or CV-Total.	**VAC-CAPEX:** generally, it is not accepted to have an overrun over BAC-CAPEX. Equals BAC-CAPEX – EAC-CAPEX.
EV	Owner has no visibility	Budget of all adjudicated work accomplished, measured by the RoC (equals AC).	**EV-Owner:** budget of all the performed work in the contract according to the RoC, subtracted by the current CV (i.e, equals EV-Contracts minus CV).	**EV-CAPEX:** value of the total scope accomplished, as per the investor's budget (BAC-CAPEX). Equals % Progress x BAC
AC	Owner has no visibility	All costs incurred for all adjudicated work (equals EV)	All costs incurred for all adjudicated work.	**AC-CAPEX:** all costs incurred for all adjudicated work.
CV-Total	NA	Always = 0 (CV is cost/budget growth)	Total of CV change orders (C3) approved to date. Equals VAC-Owner.	Same as VAC-CAPEX.
CV	Owner has no visibility	Always = 0 (CV is a cost/budget growth)	**CV-Owner:** budget of all adjudicated work/cost that constitutes CV (C3) and has been accomplished as measured by the RoC. (i.e., CV-Total already performed)	**CV-CAPEX:** cost variance as measured by the investor. Equals EV-CAPEX – AC-CAPEX
% Progress	Owner has no visibility	**% Progress-Contract:** progress of all adjudicated work as measured by the RoC (equals EV/BAC).	**% Progress-Owner:** Progress of all adjudicated in the contract, excluding performed CV (C3). Equals EV-Owner/BAC-Owner.	**% Progress-CAPEX:** Same as % Progress-Owner.
CPI	Owner has no visibility	Always = 1 (CV is cost/budget growth)	**CPI-Owner** = EV-Owner / AC	**CPI-CAPEX** = EV-CAPEX/AC-CAPEX
CO-CV (no impact on PF)	NA	Change orders for extra work/cost that have no impact on product functionality		NA
CO-RK (for identified risks)	NA	Change orders for extra work/cost to deal with identified risk (contingencies)		NA
CO-SQ (for changes to PF)	NA	Change orders for extra work/cost that impact product functionality (desired changes).		

Although the proposed framework introduces additional measures and metrics, its implementation does not fundamentally increase project control effort. It primarily requires:

- revised metric definitions;

- governance of multiple baselines;
- consistent classification of change orders.

Modern AI-assisted project control systems make these requirements increasingly practical by automating change classification, baseline management, and metric calculation, thereby substantially reducing the administrative effort traditionally associated with EVM implementation.

6. Conclusions

For decades, EVM has been regarded as having limited applicability in FFP contracts because owners lack visibility into contractors' actual costs. As a consequence, it is generally assumed that meaningful cost performance measurement is not possible in such environments and that the CPI will invariably remain equal to one.

This paper demonstrates that this limitation does not arise from the principles of EVM themselves, but rather from the way actual cost and earned value have traditionally been interpreted in FFP environments. By distinguishing between work that creates approved product functionality and work that merely compensates for non-value-adding cost growth, meaningful owner cost performance can be measured while preserving the conceptual foundations of EVM and maintaining consistent baseline management.

The proposed framework further shows that performance in CAPEX projects executed through FFP contracts should be interpreted from multiple complementary analytical perspectives—including contractor, contract, owner, and investor (CAPEX)—each answering a different management question while remaining part of a single coherent EVM framework. Rather than requiring different performance management approaches for different contract types, organizations can preserve a common analytical language, standardized metrics, common management processes, and consistent reporting across mixed contract portfolios.

The framework presented in this paper was developed and refined through practical implementation in real CAPEX projects across multiple industries. It demonstrates that extending EVM to FFP environments is both conceptually sound and operationally achievable. Although the proposed approach introduces additional analytical complexity, modern project information systems and AI-assisted project control make its implementation increasingly practical.

Ultimately, the contribution of this work extends beyond FFP contracting. It demonstrates that the fundamental principles of EVM are independent of the contractual mechanism used to procure project work. By adapting the measurement model rather than replacing the management framework, EVM can remain a universal analytical language for measuring and managing project, program, and portfolio performance across mixed contract environments.

Annexes

The main body of this paper presents the conceptual framework and its implications for Earned Value Management (EVM) in Firm Fixed Price (FFP) contracts. The annexes provide supporting conceptual discussion, implementation guidance, and illustrative examples that complement—but are not required to understand—the proposed analytical framework. Readers interested primarily in the conceptual contribution may therefore read the paper without consulting the annexes, whereas practitioners and researchers seeking additional explanation or implementation detail may use them as reference material.

Annex A – A multi-level performance analysis framework

The proposed framework extends traditional EVM by recognizing that performance in FFP environments must be interpreted from different analytical perspectives, each serving a distinct management purpose. Rather than replacing one another, these perspectives complement one another by answering different management questions.

A.1 - The CAPEX vs. Owner's Team Perspectives

In organizations undertaking large CAPEX investments, such as those in the mining and energy sectors, the investor establishes their Performance Measurement Baseline (PMB) before the procurement process begins. This PMB-CAPEX becomes the governing investment baseline against which the investor continuously measures project or program performance throughout the project life cycle.

Once the PMB-CAPEX is approved, responsibility for procurement and contract administration is delegated to the local Owner's Team, which is established to deliver the project or program. From the investor's perspective, procurement is a tactical activity intended to secure project delivery within the constraints of the approved CAPEX investment.

This governance structure creates two complementary EVM perspectives. At the investment level, the investor continuously measures project or program performance against the PMB-CAPEX. At the contract level, the Owner's Team measures contractor performance against each contract's PMB. The proposed framework integrates these perspectives into a coherent performance measurement framework, preserving visibility of both investment performance and contractual performance throughout project execution.

Consider a simple illustrative example: the investor approves a CAPEX budget of $1,400 before procurement. The Owner's Team subsequently awards the work to a contractor for $1,000, resulting in a buyout variance of $400. The current status is as follows:

- BAC-Owner = $1,000
- EV-Owner = $500
- % Progress-Owner = 50%
- AC (same for both perspectives) = $650
- CPI-Owner = $500 / $650 = 0.77

Now, for the investor, the total value-producing work approved in their baseline (PMB-CAPEX) has a budget value of $1,400 instead of $1,000. Therefore, a question arises: f*or the investor, what is the cost performance of the project to date?* The following analysis shows how the investor perceives and measures performance:

- EV-CAPEX = BAC-CAPEX × %Progress = $1,400 × 50% = $700
- AC-CAPEX = $650 (AC is the same whatever the perspective).
- CV-CAPEX = $700 - $650 = +$50
- CPI-CAPEX = $700 / $650 = 1.08

Therefore, although the work performed is costing more than originally planned in the contract, the favorable "buyout" variance obtained in contracting is still balancing out the cost overrun of the contract and thus the project is still showing a favorable cost performance from the investor's perspective: they expected a cost of $700 for the progress to date, but only had to sustain $650 of cost for what was achieved.

Both perspectives matter and should be monitored simultaneously. While the Owner's Team is, overall, managing project performance effectively by delivering progress on budget to the investor, there is a cost trend at the contract level that requires attention:

- The total budget of the value-producing work is $1,000 (BAC-Owner)
- The current cost performance is unfavorable: CPI-Owner is 0.77
- The current trend in the cost at completion for the FFP contract is:
  - IEAC-Owner = $1,000 / 0.77 = $1,298

The current forecast cost at completion (IEAC-Owner = $1,298) remains below the approved CAPEX budget of $1,400. However, continued deterioration in contractual cost performance could eventually consume the available buyout variance and place the approved CAPEX budget at risk. Consequently, the projected contract overrun should be managed as an emerging project risk, with IEAC-Owner monitored as a leading key risk indicator (KRI). Tracking the trend of IEAC-Owner over time provides early warning of the point at which the contractual overrun may begin to threaten the investor's approved CAPEX budget, allowing timely management intervention.

A.2 - The four different levels/perspectives of cost efficiency

Overall, applying the proposed framework in FFP contracts creates a scenario in which four complementary levels of cost efficiency should be distinguished and understood:

- **Contractor efficiency (CPI-Contractor)** – measures the contractor's internal cost efficiency against its own baseline and is normally not visible to the owner.
- **Contract efficiency (CPI-Contract)** – measures performance against the contractual baseline managed by the owner. Because all approved contract costs are incorporated into that baseline, CPI-Contract remains equal to 1 and therefore provides limited managerial insight.
- **Owner efficiency (CPI-Owner)** – this is measured based on the contract's baseline but excludes from/adds to EV the value of budget changes (C3) with no impact on the product's functionality (no change to the project value). This is of high managerial importance, allowing the Owner to understand how much of the "budget evolution" or "cost growth" to date is actually true cost variance, and further estimate trends at completion.
- **CAPEX efficiency (CPI-CAPEX)** – this is measured against the CAPEX baseline, which serves as the investor's performance reference, using progress measured from the Owner's perspective and considering only value-producing scope. This is of major managerial importance because it reflects the investor's business perspective.

A.3 - Implications for the schedule performance index (SPI)

The distinction established in this EVM-FFP framework between operational contract execution and delivery of business value suggests that two complementary schedule perspectives may also exist.

The differentiation between the contract and the owner's cost performance further raises the question as to whether the same rationale should be considered for schedule performance measurement.

For example, if a schedule extension caused by the owner needs to be integrated into the schedule, then from the contractor's perspective, the baseline should be updated to incorporate that extension. After all, it is not the contractor's responsibility, and therefore SPI should not indicate that the contractor is behind schedule because of it.

However, from an owner's perspective, if such a schedule extension does not add value to the project, then it is actually a delay, and SPI should indicate that situation. Therefore, the same reasoning suggests that there are two complementary levels of schedule performance:

- SPI-Contract – schedule performance assuming variance that is exclusively due to the contractor's performance. This indicator is measured against the updated baseline (PV-Contract) agreed between the owner and contractor, which will include all approved changes. It measures the contractor's schedule performance.
- SPI-Owner – schedule performance assuming a baseline (PV-Owner) where only changes that affect the project's value (or product functionality) are considered. Schedule changes for which the owner is responsible but that add no value to the project are not incorporated in this baseline. It measures project performance from an Owner's business perspective.

Additionally, as with cost performance, the CAPEX perspective can also be considered for schedule performance through an SPI-CAPEX measured against the investor's CAPEX baseline (PV-CAPEX).

For example, a project may have been approved by the investor for completion in 12 months but awarded to a contractor with a contractual duration of 10 months, creating a procurement "buyout" schedule variance of +2 months. Consider a scenario in which the contractor remains on schedule (SPI-Contract = 1), but a delay for which the Owner is responsible causes contract execution to fall behind schedule, resulting in an SPI-Owner of 0.8. However, when measured against the investor's 12-month CAPEX baseline, the project may still be ahead of schedule, with an SPI-CAPEX of 1.05. This illustrates that, just as with cost performance, schedule performance should be interpreted from different analytical perspectives. Each perspective answers a different management question and supports decision-making at a different level of responsibility: operational execution (Contract), project management (Owner), and investment performance (CAPEX).

A.4 – Worked Example: Multi-Perspective EVM Analysis

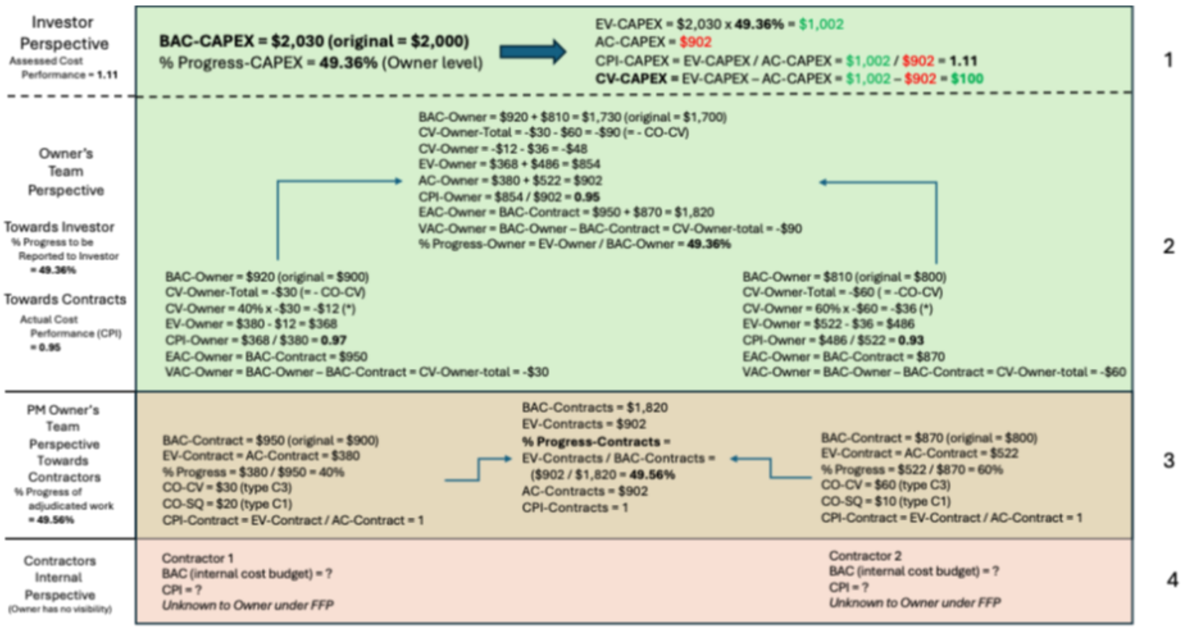
Consider a CAPEX project managed by the Owner's Team through two FFP contracts.

The current project data is as follows:

- Original CAPEX budget (BAC): $2,000
- Subsequently awarded through two contracts:

    - BAC1 = $900
    - BAC2 = $800,
    - *Hence, creating a procurement buyout variance ("budget slack") of $300*
- Scope/quality changes (CO-SQ) occurred during execution, approved by the investor:
    - Contract 1: $20
    - Contract 2: $10
- Non-value-added changes (CO-CV) occurred during execution (say, rework):
    - Contract 1: $30
    - Contract 2: $60
    - *Note: these CO-CV changes are assumed to fall within the Project Manager's delegated authority and therefore do not require investor approval or reporting.*
- Progress measured for all the adjudicated work:
    - Contract 1: 40%, with AC = $380
    - Contract 2: 60%, with AC = $522

The picture below shows the EVM performance analysis:



(*) Assuming the % of CV-Owner-Total performed is the same as the overall contract progress. In reality, CV-Owner will be mostly based on the RoC for the CO-CV work packages.

The example illustrates four complementary performance perspectives:

- (1) CAPEX – Investor
- (2) Owner

- (3) Contract
- (4) Contractor

At the contract level (3), CPI = 1, providing no meaningful indication of the Owner's actual cost performance, while the overall adjudicated work has reached 49.56% completion.

However, using the FFP EVM model, one can see that the actual cost performance of the contracts at the Owner's level (2) is **0.95**, with both contracts underperforming.

Progress excluding non-value-added changes—representing the progress that actually creates project value—stands at **49.36%**.

Despite both contracts currently underperforming, the earned value (EV) of the approved value-adding scope stands at $**1,002** for the investor (CAPEX) (level 1), while the total cost to date (AC) is $902 (common across levels 1 to 3).

Therefore, for the investor, cost performance is positive (CPI-CAPEX = 1.11), which is due to the "budget slack" (potential saving) attained in procurement (i.e., a buy-out favorable variance).

Note that at contract award, the potential CPI-CAPEX created was of $2,000 / $1,700 = 1.18. Current CPI-CAPEX, although still greater than one, has decreased because both contracts are currently underperforming (CPI-Owner < 1).

The table below shows the key management questions and the EVM metrics that address them.

Level	Management Question	Corresponding EVM Metrics
1 - Investor	What is the total program's currently approved budget?	BAC-CAPEX = $2,030
1 - Investor	What is the total program's progress?	% Progress-CAPEX = 49.36% (*)
1 - Investor	What is the program cost performance?	CPI-CAPEX = 1.11
1 - Investor	Is the program overrunning or saving? How much?	CV-CAPEX = + $100
1 - Investor	What is the current program estimate at completion?	EAC-CAPEX = $1,820 (**)
1 - Investor	What is the current program variance at completion?	VAC-CAPEX = + $210
2 - Owner's Team	What is the progress on the contracts for the Owner's Team?	% Progress-Owner = 49.36% (*)
3 - Contract	What is the progress on the total work for the contracts?	% Progress-Contract = 49.56% *Contract 1 = 40%* *Contract 2 = 60%*
2 - Owner's Team	What is the contracts cost performance for the Owner's Team?	CPI-Owner = 0.95 *Contract 1 = 0.97* *Contract 2 = 0.93*
2 - Owner's Team	Are the contracts overrunning or saving? How much?	CV-Owner = - $48 *Contract 1 = - $12* *Contract 2 = - $36*
2 - Owner's Team	What is the current contracts estimate at completion?	EAC-Owner = $1,820 (**)

This example demonstrates that contract performance, owner performance, and investor performance answer different management questions and should therefore be interpreted independently rather than expected to produce identical EVM indicators.

Annex B – Background on traditional EVM cost performance principles

Cost performance indicates whether the cost incurred to achieve current production conforms to the approved baseline.

During a project, cost is progressively incurred to perform work that produces deliverables which together form the project's product (which can be a complex physical asset, or an intangible result). This product is intended to perform a specific "functionality" that delivers the "business value" justifying the investment. When the investment budget is approved by the investor or sponsor, this decision is based on the expectation that the product will perform the specified functionality and deliver the expected business value.

During project execution, the approved baseline establishes: (a) how much should have been produced, for the time elapsed, and (b) how much cost should have been incurred to achieve what has actually been produced. For cost performance analysis, we are looking at the latter.

Whenever the actual cost incurred to achieve the current production differs from the cost established by the baseline, a cost variance emerges. This variance can be unfavorable or favorable: either more or less cost was incurred than it should be, for the current production. The concept of "production" includes work, deliverables, and ultimately the "product of the project" capable of delivering on the expected "functionality".

EVM establishes a set of measures and metrics to quantify this reality:

- AC (actual cost) – cost actually incurred to achieve the current production.
- EV (earned value) – cost that should have been incurred to achieve the current production (this is the approved budget for the current production).
- CV (cost variance) – cost overrun or underrun for the current production (equals EV-AC)
- CPI (cost performance index) – cost efficiency, measuring how much production was achieved for each unit of cost incurred.

To measure cost performance in EVM, the elementary metrics are EV and AC.

EV is measured based on budgeting all the work and deliverables of the project. This budget represents the cost that should have been incurred to achieve the current production. The project should have spent what was budgeted for what has been produced.

AC is measured by looking at the cost that was actually incurred to achieve the current production. Actual cost may arise from many sources, including materials consumed, human effort, equipment usage, services, and fixed-price deliverables acquired. The actual cost incurred, *regardless of its nature*, needs to be calculated so it can be compared with its target EV.

Annex C – Illustrative Example of Owner Cost Variance in CR and FFP Contracts

Consider that a simple project would consist of painting a wall using a CR contract; the Owner will have access to the quantities of cans of paint consumed, the hours spent by the painters, and their unit cost, and would pay based on this actual resource consumption. If there was an engineering error in estimating the area of the wall, or if the incorrect specification for the ink was communicated to the contractor, additional cans of paint and hours of work would be necessary, and the actual cost calculated based on these quantities would reflect that, exceeding the initial estimates in the baseline, thus leading to an unfavorable cost variance.

If, instead, an FFP was used to accomplish this simple project, then once the contractor realizes that more area needs to be painted and that the paint specification given by the Owner is incorrect, a change order would be negotiated for the additional amount to be paid by the Owner. This additional amount would include the actual cost incurred by the contractor together with the contractor's profit margin. The Owner has no visibility into the contractor's actual cost, but the additional amount paid under the change order represents the additional cost incurred by the Owner in excess of the original baseline budget, leading to an unfavorable cost variance. From the owner's perspective, *the change order is the observable manifestation of the additional cost incurred* to achieve the originally intended production. Note that this change order is an extra cost to be paid to the contractor that does not enhance the "product functionality" (wall painted): the outcome of the project, in the eyes of the investor, did not change or expand. The investor will be paying more than expected when the investment was approved to get exactly the same outcome. No business value was added, as the product functionality remained unchanged.

Therefore, in FFP contracts, *cost variance is measured through change orders that have no impact on product functionality* (i.e., they do not result either from a desired change or from a planned risk response), rather than by measuring the quantities and prices of elementary cost items.

To address the challenge, it is not necessary to redefine the concept of cost variance, but only to reconsider how it is determined in an FFP environment. Cost variance continues to represent the difference between the budgeted cost and the actual cost incurred to achieve the current production. *What changes is the information available to determine that difference.*

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Dr. Rodrigues has extensive experience supporting the delivery and governance of major CAPEX programs and portfolios, particularly in the mining, oil and gas, energy, defense, and infrastructure sectors. He has led the implementation of Earned Value Management Systems (EVMS) for the planning and control of multi-billion-dollar projects and programs and has advised organizations on project governance, portfolio management, organizational project management maturity, and project controls. He is also a Senior Consultant with the Boston-based Cutter Consortium | Arthur D. Little.

Alongside his consulting career, Dr. Rodrigues has more than a decade of university teaching experience in Project Management and System Dynamics, having lectured at several European universities and supervised Master's and doctoral research. Earlier in his career, he worked in project management within the defense and consulting industries in both the United Kingdom and the United States and gained several years of professional experience as a software engineer. He regularly publishes in professional and peer-reviewed journals and has been invited to speak at numerous international conferences.

His international professional contributions include co-organizing the NATO Advanced Research Workshop on *Managing and Modeling Complex Projects* (Kyiv, Ukraine, 1996); serving as Guest Editor of the April 2001 Cutter IT Journal, chaired by Edward Yourdon, on *Multicultural Project Management*; and contributing an invited chapter on *Earned Value Management in the International Scene* to the Association for Project Management (UK) Yearbook 2003/04. He also served as the PMForum International Correspondent for Portugal and was recognized as a PM Ambassador for Portugal by PMForum in 2009.

Dr. Rodrigues has made significant contributions to the advancement of the project management profession internationally. He was the Founding President of the PMI Portugal Chapter, served as a PMI Component Mentor for the EMEA Region (2005–2007), and participated in the PMI teams responsible for developing the 3rd Edition of the PMBOK® Guide and the 1st Edition of OPM3®. He also served on the Congress Project Action Teams (CoPAT) for the PMI Global Congresses in Prague (2004) and Edinburgh (2005). He later joined the core teams that developed the Second Edition of the PMI Practice Standard for Earned Value Management and the ANSI/PMI 19-006-2019 Standard for Earned Value Management. He is also a lead author of ISO 21512 – Earned Value Management Implementation Guide, currently under development. In recognition of his contributions to the discipline, he was appointed EVM Ambassador for Europe by the Earned Value Management Europe Association research project in 2012.

Dr. Rodrigues holds a five-year degree (Licenciatura) in Systems and Informatics Engineering and a Ph.D. in Management Sciences, specializing in Project Management and System Dynamics. During his doctoral research, he received the Mike Simpson Award from the Operational Research Society. He is a Project Management Professional (PMP®), a member of the Project Management Institute (PMI®), and was formerly a Member of the Portuguese Order of Engineers (*Ordem dos Engenheiros*).