

Bridging Governance Gaps in Construction through Integrated Management and Emerging Technologies

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Abstract

INTRODUCTION: Digital transformation pressures are reshaping construction governance in the construction sector, as emerging technologies such as Artificial Intelligence (AI) analytics and on-site Augmented Reality (AR) visualization tools increasingly complement traditional project management practices.

OBJECTIVES: This study aims to diagnose governance gaps in a Portuguese construction firm, propose a Project Management Office (PMO) supported by Earned Value Management (EVM) and a structured lessons-learned system, and outline how AI-based forecasting and AR-based job-site visualization could be integrated into this governance framework.

METHODS: A mixed-methods case study conducted within a construction company employed document analysis, employee surveys, and semi-structured interviews to map existing processes and identify inefficiencies in budgeting, procurement, and interdepartmental coordination.

RESULTS: The analysis identified inconsistent cost tracking, limited schedule visibility, and ad hoc knowledge capture as key areas of concern. The proposed PMO framework standardizes workflows, the EVM module provides real-time performance metrics, and the lessons-learned repository institutionalizes continuous improvement. The findings also support the feasibility of future integration of AI-driven variance prediction and AR-based progress visualizations.

CONCLUSION: By integrating established governance practices with a clear pathway toward AI and AR augmentation, this study provides an adaptable framework for construction firms seeking to enhance collaboration, optimize resource utilization, and prepare for the next phase of digital transformation.

Keywords: Construction Project Management, Emerging Technologies, Organizational Governance.

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1. Introduction

Effectively managing projects has grown into one of the most decisive elements behind how well an organization performs and adapts in today's competitive environment. The increasing complexity of construction projects, combined with budget constraints and tight deadlines, demands structured project management methodologies to ensure successful outcomes. Hadjinicolaou and Dumrak [1] suggest that many companies are shifting toward a project-oriented structure as a strategy to boost their operational agility and results. However, despite these intentions, studies from Project Management Institute [2] deduce that project success remains low due to inadequate resource management alongside unstructured methodologies. In Portugal, for example, Ribeiro [3] found that massive infrastructural works are subject, on average, to a 40% tardiness of the initially envisioned planning, which serves to highlight the importance of enhanced project management procedures and organizational governance models.

To address these concerns, this study examined organizational governance structures for project management to identify areas of inefficiency and opportunities for improvement within a construction company. In this context, a process-based analysis was conducted, focusing on key domains including budgeting, procurement, and administrative coordination. This structured segmentation enables a more targeted examination of management practices, facilitating the identification of specific areas requiring improvement.

The overarching objective of this study was to propose a set of project management and organizational governance improvements aimed at enhancing project efficiency in alignment with industry best practices. Specifically, it seeks to identify deficiencies in the traditional project management approach employed by the company and address these shortcomings through the adoption of structured methodologies, including a Project Management Office (PMO), Earned Value Management (EVM), and a systematic approach to continuous improvement by a lessons-learned framework. Collectively, these elements are intended to promote a more efficient and disciplined approach to project management within the construction sector, while strengthening overall organizational governance.

Several studies highlight the need for strong governance frameworks to improve project outcomes. Jusoh and Kasim [4] emphasize that poor resource allocation and lack of structured methodologies significantly contribute to construction project failures. Additionally, Ershadi et al. [5] stated that procurement processes represent over 50% of construction project activities, requiring strategic planning to avoid delays and cost escalation. Despite advances in project management methodologies, the construction industry lags behind other sectors in implementing modern governance strategies [3].

Construction is a vital sector for infrastructure development and economic prosperity, but unfortunately,

the sector suffers from ongoing project management and organizational governance issues. Project management is critical to ensuring timely project completion, adherence to budget constraints, and overall operational effectiveness. Nevertheless, many organizations in this sector face fragmented communications, inefficient resource management, and non-standardized methodologies, leading to project delays and cost overruns [3]. Studies emphasize that implementing standardized project management structures can advance governance substantially through the provision of explicit guidelines for decision making and optimization of processes [3].

With the evolution of the construction industry, the integration of governance mechanisms has become increasingly critical for meeting market demands and maintaining competitiveness. By strengthening organization governance through the adoption of disciplined project management methodologies, centralized management offices, and systematic learning from past experiences, organizations can achieve sustainable development and operational excellence [6].

Recent studies highlight the central role of project management in enhancing organizational performance. Scheffer and Soares [7] demonstrate that a strong understanding of project management and governance contributes significantly to project success and overall organizational effectiveness. Their findings indicate that organizations adopting structured governance models, combined with effective knowledge-sharing practices, tend to achieve superior project outcomes. Furthermore, their study shows that integrating project governance with strategic benefits management supports more proactive risk management and improves decision-making processes. Similarly, Barrocas et al. [8] emphasize the importance of data analytics and visualization techniques in project monitoring, underscoring their contribution to improved project performance and success.

Within the Portuguese construction industry, several studies have identified significant challenges in project management and proposed models to enhance project performance. Rocha, Tereso, and Couto [9] conducted a survey of recurrent difficulties, revealing substantial deviations in cost, time, and quality. Their findings underscore the need for more efficient project management practices to mitigate these deviations and improve project outcomes.

Building upon this, Oliveira, Tereso, and Fernandes [10] conceptualized a Project Management Office (PMO) tailored for engineering and construction businesses. Their framework emphasizes the alignment of project objectives with organizational strategy, aiming to standardize processes and improve efficiency.

Beyond these structural and methodological improvements, the rapid advancement of digital technologies is creating new opportunities for project governance in the construction sector. Emerging tools such as Artificial Intelligence (AI) and Augmented Reality (AR) are increasingly complementing traditional project

management frameworks, providing enhanced real-time visibility and predictive capabilities.

Nyokum and Tamut [11] point out that, in the realm of construction management, Artificial Intelligence (AI) is already making an impact, especially in areas like scheduling, resource planning, and risk mitigation. By training machine learning models on historical project data, it is now possible to forecast project durations, anticipate cost overruns, and detect fluctuations in labour productivity. One example they offer involves feeding real-time material delivery data into forecasting systems that automatically adjust inventory levels and crew assignments, effectively cutting down idle time and reducing waste.

Songke Ma [12] illustrates how merging Building Information Modeling (BIM) with Augmented and Virtual Reality (AR/VR) technologies is transforming construction oversight. Instead of relying on paper-based inspections, project managers can immerse themselves in live, data enriched environments. They can compare the “as built” progress with the original plan in real-time, using delivery updates and workforce output to adjust task sequences or reallocate resources on the fly. As a result, decisions happen faster, capital usage becomes more efficient, and delays shrink, all this while improving transparency in supervision and resource management.

Taken together, these studies treat PMO adoption, EVM-based monitoring, lessons-learned practices, and AI/AR applications largely as separate lines of inquiry. What remains comparatively unexplored is how these mechanisms can be combined into a single, staged governance framework grounded in the diagnosis of a real construction organization, rather than proposed independently or in the abstract. This is the gap addressed here: starting from an empirical diagnosis of governance inefficiencies in a Portuguese construction company, this study proposes an integrated PMO–EVM–Lessons Learned framework and outlines, as an explicitly forward-looking next step, how AI-based forecasting and AR-based site visualization could extend that framework once the underlying governance and data foundations are in place.

The remainder of this paper is organized as follows. Section 2 describes the research methodology, including the philosophical approach and the data collection methods used in the case study. Section 3 presents the findings from the case company across the application, budgeting, procurement, and administrative coordination processes, along with an exploratory outlook on digital transformation opportunities. Section 4 develops the proposed improvements, detailing the PMO, EVM, and Lessons Learned initiatives, their anticipated implementation challenges, and the AI and AR extensions envisioned for a later stage. Section 5 concludes the paper and outlines directions for future research.

2. Methodologies

Following an interpretivist mindset, this case study attempts to capture the nuances of a real organizational setting, analyzing stakeholder perspectives often missed in quantitative analyses. For that reason, a combination of qualitative and quantitative methods was employed to analyze project management and organizational governance practices in the selected construction company (case study).

2.1 Research Philosophy and Approach

The research methodological choices outlined in Figure 1, illustrate the methodology, methods and tools that were considered based on the research onion [6].

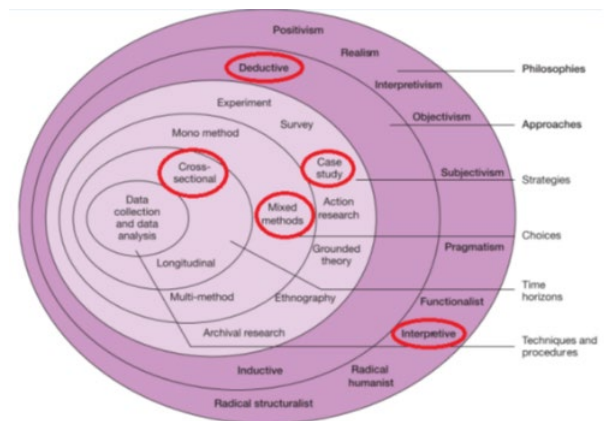


Figure 1. Research Onion
Adapted from Saunders et al [6]

The research follows an interpretative philosophy. According to Saunders et al. [6], case studies aim to understand specific and complex organizational contexts, considering that the analysis is sensitive to the interpretations and perceptions of those involved. This approach acknowledges that reality is socially constructed and varies depending on the perspective of different stakeholders, making it essential to consider multiple viewpoints when analyzing project management and organizational governance structures and decision making processes.

The study adopts a deductive approach, applying established theories and concepts of project management and organizational governance to a specific context to validate their applicability and relevance. By leveraging theoretical frameworks, the research ensures that the findings are grounded in well-established principles, providing a structured and systematic basis for analysis. This approach also facilitates the identification of patterns and trends that can inform practical recommendations for improvement.

Case study methodology is employed because it is particularly effective for analyzing internal practices and examine individual, discrete processes that occur at the

organizational level. Case studies enable in-depth examination of practical issues, making them especially valuable for capturing nuance and context-specific factors that are often overlooked in broader, generalized research [6]. Through close observation and detailed exploration of key stakeholders, this approach offers rich insights into organizational governance and the dynamic nature of project management operations.

A mixed-methods approach is used, combining quantitative methods (surveys) with qualitative methods (interviews and document analysis). This comprehensive methodology allows for a broader understanding of organizational processes by integrating numerical data with detailed qualitative narratives. The combination of both approaches strengthens the validity of the research by triangulating data sources, ensuring a well-rounded analysis that captures both measurable outcomes and subjective experiences.

The study follows a cross-sectional time horizon, which means that the research is conducted over a specific period of time (between the end of 2022 and the first half of 2023) rather than over an extended period. This design is particularly useful for capturing a snapshot of current practices, challenges, and opportunities within the organization. Although it does not track changes over time, the cross-sectional approach provides a detailed and focused analysis that can serve as a foundation for future longitudinal studies.

The research methodology followed a structured approach to ensure a comprehensive understanding of project management (PM) practices and governance within the organization. The objectives were divided into five key areas, each supported by specific research methods as shown in Table 1.

2.2 Research - Objectives and Methods

The research was designed around five core objectives aimed at diagnosing current project management inefficiencies and proposing a multi-layered governance framework. This structured approach, summarized in Table 1, allows the validation of the proposed improvements within the construction firm's specific context.

Table 1. Research objectives & Research Methods

Research Objective	Research Methods
O1: Identify and analyze deficiencies in the company's current PM practices.	Surveys, Observation, Semi-structured Interviews, Document Analysis
O2: Propose targeted improvements to PM and governance frameworks.	Surveys, Observation, Document Analysis

O3: Anticipate potential implementation challenges and recommend appropriate mitigation strategies.	Surveys, Observation, Document Analysis, Focus group
Research Objective	Research Methods
O4: Explore and propose the integration of AI into construction PM.	Document Analysis
O5: Evaluate and propose the application of AR in construction PM.	Document Analysis

The case was defined as the project management practices of the case-company; a Portuguese engineering and construction group with over 50 years of operation and more than 130 employees, examined across four core processes: proposal; budgeting; procurement; and administrative-site coordination. A single-case design was adopted because the research aimed at an in-depth, practice-level understanding of governance gaps within one organization rather than statistical generalization across firms, and because the researcher's direct, ongoing involvement with the company's departments made an action-oriented case study feasible. Data collection combined document analysis of the company's existing management and function manuals and process matrices, semi-structured interviews with key role-holders in each process (including the budgeting team, the procurement and logistics leads, and the company's CFO for administrative-site coordination), and structured questionnaires. The questionnaires were completed by 22 employees directly involved in the analyzed processes (8 project managers, 3 budgeting officers, 1 procurement lead, 1 logistics lead, and 9 members of the finance and administrative department), covering employees' perceptions of current practices, process-specific issues, and improvement suggestions. Document analysis was conducted first and informed the design of both the questionnaires and the interview guides. Finally, interviews were then used to explore the reasoning behind the issues identified quantitatively.

3. Case Study

This chapter presents a detailed analysis of the case study, structured around to core project management processes. It focuses on understanding how these processes function in practice, identifying inefficiencies and areas of waste, and highlighting opportunities for improvement based on both empirical evidence and relevant theoretical frameworks.

A systematic and structured analytical approach is adopted to enable a thorough examination of each process, assessing its contribution to project management performance and overall organizational governance. This approach facilitates deeper insights into operational effectiveness and process integration.

The findings derived from this analysis provide a robust foundation for the development of targeted recommendations aiming at enhancing governance structures, standardized procedures, and optimizing project workflows.

The study was conducted at a construction company based in Portugal with over 50 years of industry experience and a workforce exceeding 100 employees. The firm primarily specializes in the construction of food retail outlets and industrial warehouse facilities. In addition to its core operations, the company is supported by three subsidiary businesses focused on aluminum works, carpentry, and metal fabrication.

The case study is structured around key process areas that reflect the core stages of project planning and execution. These include planning and initiating, risk management, communication and coordination, performance monitoring, and documentation practices. Each of these domains is critical to the efficiency of project delivery and the achievement of successful outcomes. By examining these processes, the study provides valuable insights into existing practices, while also identifying gaps and areas for improvement.

The project management processes examined in this study are categorized into key domains that are essential for effective project evaluation and management.

3.1 Application Process

Application Process involves the planning, preparation and submission of project proposals. A key issue identified at this stage is the lack of a structured approach to bid preparation, which results in inconsistent proposal quality and frequent rework. This is largely driven by insufficient project scoping during the early phases.

The absence of standardized criteria further limits the ability to effectively assess feasibility and conduct early-stage risk analysis. In addition, weak coordination and communication contributes to delays and incomplete submissions, ultimately reducing the likelihood of successful project approval.

Implementing a standardized proposal framework, supported by clear development guidelines and defined submission timelines, would significantly improve consistency, efficiency and overall success rates in the application process.

3.2 Budgeting Process

Budgeting Process is central to project feasibility assessment and effective cost control. The study highlights recurring issues such as inaccurate cost estimation, which frequently leads to budget overruns and weak financial management. A significant concern is the limited effectiveness of existing budgeting and cost control practices. Many processes still rely on manual or outdated spreadsheet-based methods, which lack the integration,

accuracy, and real-time monitoring capabilities offered by modern project management tools.

Furthermore, budget planning is often conducted without comprehensive risk analysis, resulting in unforeseen financial constraints during project execution. To address these challenges, the implementation of a more robust and systematic budgeting framework is recommended. This should include integrated digital tools, thorough risk-informed planning, contingency provisions, and regular cost monitoring and review to enhance financial discipline and project outcomes.

3.3 Procurement Process

Procurement Process is a critical element in ensuring that projects are supplied with the necessary materials and services in a timely manner. However, several inefficiencies are evident, particularly in supplier selection, order processing, and delivery tracking, often leading to project delays and increased costs. A major contributing factor is the absence of a centralized procurement system, which limits visibility and coordination and disrupts project timelines.

Additionally, inadequate communication among stakeholders further exacerbates procurement challenges, resulting in misunderstandings, delays, and inconsistent quality. To improve efficiency, it is essential to establish a robust procurement framework that includes systematic supplier evaluation, centralized tracking and monitoring systems, and clearly defined quality standards. Such measures would enhance coordination, reduce delays, and contribute to overall project performance.

3.4 Administrative Department Coordination with Project Management

Administrative Department Coordination with Project Management is essential for effective project execution and monitoring. The analysis reveals notable gaps in integration, particularly in communication and workflow alignment, which lead to misaligned priorities and redundant administrative efforts. The absence of standardized reporting protocols further impairs timely and informed decision-making, contributing to inefficiencies in project monitoring.

Additionally, delays in document approvals, slow financial processing, and lack of up-to-date expenditure tracking undermine accurate project status assessment. These issues collectively reduce transparency and hinder overall performance.

To address these challenges, stronger interdepartmental coordination is required, supported by integrated workflow systems, standardized reporting formats, and milestone-based management approaches. The adoption of unified communication platforms would further enhance collaboration and information flow.

Overall, each of these processes plays a crucial role in determining project success. Addressing the identified inefficiencies through structured methodologies can strengthen project management practices, improve organizational governance, reduce overall delays, and enhance overall efficiency.

3.5 Digital Transformation Opportunities

In addition to improvements in project workflows, the company's digital transformation initiatives could be significantly enhanced through the integration of Artificial Intelligence (AI) analytics and Augmented Reality (AR) tools at the operational level. Unlike the processes examined in the previous sections, derived directly from case study observations, the considerations presented here regarding AI and AR are forward-looking and not based on direct company data.

By leveraging data generated through methodologies such as Earned Value Management (EVM), AI-driven machine learning models could be utilized to identify early indicators of cost overruns or schedule deviations, enabling proactive intervention well before such issues become apparent through conventional monitoring approaches.

At the operational level, AR technologies, implemented through devices such as tablets or smart glasses, could allow site supervisors and project managers to overlay real-time construction progress with BIM plans. This capability would facilitate immediate comparison between planned and actual work, supporting rapid adjustments and improved decision-making on site.

Although these technologies are still emerging within the construction sector, their integration with the governance and process improvements outlined earlier could deliver substantial benefits. These include enhanced

real-time visibility, faster and more informed decision-making, and a reduction in rework and material waste, ultimately contributing to greater project efficiency and performance.

It should be noted that this assessment is exploratory rather than diagnostic. The case company's current digital maturity, data reliability, and staff readiness for AI or AR adoption were not evaluated as part of this study and would need to be assessed before any implementation could realistically proceed.

4. Proposals for Improvement in the Project Management System

This chapter presents structured proposals aimed at enhancing the company's project management system, with a particular focus on strengthening governance frameworks, improving control mechanisms, and fostering effective knowledge management and retention.

Building on the findings of the case study analysis in Chapter 3, the proposals identify key areas where project execution can be optimized through the adoption of best practices and standardized methodologies. These improvements are designed to address the inefficiencies previously identified, establishing greater consistency, transparency and operational control.

Overall, the proposed measures seek to establish a more robust, efficient, and sustainable project management framework that supports improved decision-making, better resource utilization, and enhanced project outcomes.

The following Table 2 provides a concise overview of the five proposed improvement initiatives, highlighting their key components, expected benefits, potential implementation challenges, and corresponding mitigation strategies.

Table 2. Summary of Proposed Improvement Initiatives

Initiative	Key Components	Main Benefits	Key Challenges	Mitigation Strategies
PMO	Standardized workflows, centralized oversight, defined roles	Strategic alignment, resource optimization, accountability	Resistance to change, cultural adaptation	Training programs, phased implementation
EVM	CPI, SPI, PV, EV, AC metrics	Real-time performance tracking, early deviation detection	Data integration, staff training	Standardized data collection, financial-PM coordination
Lessons Learned	Centralized repository, milestone reviews, structured templates	Continuous improvement, knowledge retention	Low adoption, inconsistent documentation	Digital repository, review sessions at milestones
AI Analytics	ML models trained on EVM data, predictive dashboards	Early variance forecasting, automated reporting	Data maturity, model training	Built on existing EVM pipeline

Initiative	Key Components	Main Benefits	Key Challenges	Mitigation Strategies
AR Visualization	BIM overlay on tablets/smart glasses	Real-time as-built vs as-planned comparison	Technology adoption, hardware costs	Pilot testing on selected sites

The proposed improvements are centered on three key initiatives: the establishment of a Project Management Office (PMO), the adoption of an Earned Value Management (EVM) system, and the implementation of a formal methodology for capturing and managing lessons learned.

By integrating these initiatives, the company can enhance decision-making processes, strengthen resource planning, improve risk management practices, and increase overall effectiveness in project execution. Detailed descriptions of each proposal, including anticipated implementation challenges and corresponding mitigation strategies, are presented in the following sections.

The reviewed literature examines various dimensions of project governance, with a strong emphasis on formalized procedures and structured management frameworks. Hadjinicolaou and Dumrak [1] highlight both the benefits and challenges associated with portfolio management, while other studies emphasize the role of PMOs in enhancing project monitoring and supporting informed decision making [10]. Furthermore, the literature consistently underscores the significant influence of effective governance and knowledge management practices on overall organizational performance [1].

Quadri [13] further observes that PMOs remain comparatively underexplored as platforms for more innovative, forward-looking decision-making beyond their conventional coordination and monitoring role — a gap that is directly relevant to the roadmap proposed later in this paper, where the PMO is positioned not merely as a governance mechanism but as the structural foundation through which AI and AR capabilities could eventually be layered in.

The reviewed literature indicates that the adoption of a PMO to standardize and control processes [14], the implementation of EVM for enhance project monitorization [14], and the systematic capture of lessons learned to prevent recurring errors and replicate past successes [2] collectively contribute to improved control, greater predictability, and continuous improvement in project management outcomes.

To complement these three governance initiatives, the roadmap should also incorporate a dedicated digital innovation component, leveraging two lightweight, open-source technologies that are gaining maturity within the sector.

First, **AI driven predictive analytics**, trained on future project data generated through EVM, could be used to forecast potential schedule and cost variances in advance. This capability would provide the PMO with a robust, data-driven basis for early intervention and more proactive decision-making [11]

Second, integration of an **Augmented Reality** layer, accessible via tablets or smart glasses, will enable site teams and project managers to overlay live BIM data model onto the project environment. This would facilitate real-time comparisons between “as-built” and “as-planned” conditions, support progress validation, and allow for direct updates to lessons learned records from the field, thereby strengthening the feedback loop between planning and execution [12]

These digital enhancements can be seamlessly integrated into the proposed PMO, EVM, and knowledge management framework, further improving project visibility, responsiveness, and resource optimization, while reinforcing, rather than disrupting, the core governance structure.

4.1 Implementation of a Project Management Office (PMO)

This proposal responds directly to the fragmented coordination and lack of standardized procedures identified across the application, procurement, and administrative processes examined in Chapter 3.

The establishment of a Project Management Office (PMO) represents a critical step toward enhancing project execution efficiency and strengthening organizational governance. A well-structured PMO functions as a central coordinating body, where project practices are standardized, monitored, and continuously improved across the organization. Evidence from the literature suggests that many project inefficiencies stem from the absence of unified standards, resulting in inconsistencies and uneven performance across different project phases.

When effectively implemented, a PMO provides several key benefits. It improves the alignment of projects with the organization’s strategic objectives, enhances risk management capabilities, and promotes more efficient allocation of resources. By introducing a centralized structure for project oversight, the PMO reduces duplications of efforts, increases process consistency, and strengthens accountability across teams. Moreover, a mature PMO fosters a culture of continuous improvement by systematically monitoring performance and integrating lessons learned into future projects [14].

A core function of the PMO is to bridge formal project management practices with broader organizational governance. This includes establishing standardized methodologies for project planning, execution, and monitoring, clearly defining roles and responsibilities, embedding structured risk management processes, and

enhancing reporting systems to support informed decision-making.

However, the implementation of a PMO may face challenges, particularly resistance to organizational change. Overcoming this requires demonstrating tangible improvements in project outcomes and clearly communicating the value of the PMO to stakeholders. Supporting this transition through targeted training programs can improve the adoption of PMO practices. In addition, the use of digital tools for project tracking, documentation management, and performance evaluation further strengthens the PMO's role as a driver of efficiency, transparency, and organizational accountability [14].

Empirical evidence from the construction sector reinforces this diagnosis. In a study involving 171 construction professionals, Almansoori et al. [15] applied a PLS-SEM model to identify which factors most affect PMO implementation performance, finding that resistance to change within organizational culture, additional administrative workload perceived by project teams, and inexperienced PMO leadership stood out as the three most influential barriers. These findings are broadly consistent with what emerged from the case company, and they suggest that a PMO rollout tends to succeed or fail less on the technical design of its processes than on how the transition itself is led and communicated.

4.2 Implementation of Earned Value Management (EVM)

This proposal follows directly from the budgeting and process findings in Section 3.2, where inaccurate cost estimation and reliance on manual, spreadsheet-based tracking emerged as the company's most pressing performance-monitoring gap.

Earned Value Management (EVM) is widely recognized as a robust methodology for integrating cost, schedule, and scope into a single, comprehensive performance measurement framework [14]. As identified in the case study analysis (Chapter 3), a key weakness in the company's current project management practices is the absence of a reliable and structured mechanism for performance monitoring. EVM addresses this gap by providing quantitative metrics that enable real-time tracking of project progress against planned objectives.

A key strength of EVM lies in its ability to enhance project control through performance indicators such as the Cost Performance Index (CPI) and the Schedule Performance Index (SPI). These metrics allow project managers to detect deviations early and take corrective action before issues escalate. In addition, EVM supports more accurate forecasting by enabling early identification of potential cost overruns and schedule delays, thereby reducing the likelihood of major project disruptions. When effectively integrated into project workflows, EVM contributes to improved financial oversight, greater operational transparency, and more predictable project outcomes [2].

However, the successful implementation of EVM depends heavily on the availability and quality of data. Without a well-established system for collecting, standardizing, and integrating financial and scheduling information, key indicators such as Planned Value (PV), Earned Value (EV), and Actual Cost (AC) become unreliable. Beyond monitoring, there is also a body of work exploring how EVM data can be made more predictive before problems fully materialize. Chen and Lin [16], for example, proposed a modelling approach that improves the forecasting power of planned value itself, rather than only the project's final cost and duration estimates, and validated it on four real construction and engineering projects. Their method reduced out-of-sample forecasting error by an average of 23.7% for earned value and 17.4% for actual cost compared with using planned value curves directly. This is a useful reference point for the present proposal, since it shows that meaningful gains in EVM's predictive accuracy are achievable through relatively simple statistical reformulations of existing data, well before any AI layer is introduced, that is if the underlying cost and schedule records are captured consistently in the first place. To ensure effectiveness, organizations must adopt standardized data management practices and facilitate seamless coordination between finance and project management functions [17].

Equally important is the development of staff competencies in EVM principles and applications. Targeted training initiatives can enhance the ability of project managers and financial analysts to interpret performance metrics and make informed decisions. Ultimately, embedding EVM within the broader project management and governance framework strengthens transparency, improves cost control, and enhances overall project performance.

4.3 Implementation of Lessons Learned

This proposal is grounded in a pattern that recurred across all four processes examined in Chapter 3. The same types of issues including inconsistent proposals, budget overruns and procurement delays, repeatedly emerged across projects, highlighting the absence of a mechanism for capturing, retaining and reusing organizational knowledge and experience.

Effectively capturing and applying lessons learned is fundamental to driving continuous improvement in project management. The case study presented in Chapter 3 revealed a recurring inefficiency: the absence of a structured and systematic approach for documenting, analyzing, and reusing knowledge gained from past projects. Without a clearly defined process, valuable insights are often lost, leading teams to repeat avoidable mistakes while failing to replicate proven successes.

To address this gap, it is essential to establish a consistent framework for lessons learned that integrates seamlessly into the project lifecycle. This includes not only documenting successes and challenges but also ensuring that these insights are actively reviewed and incorporated

into future planning and execution. By doing so, organizations can transform past experiences into actionable knowledge, enabling more informed decision-making and improved project outcomes over time [2].

A well-defined lessons learned framework involves systematically capturing insights from completed projects, critically assessing both successes and shortcomings, and integrating those findings into future planning and decision-making processes. Regular, structured review sessions at key project milestones can help embed this practice into team routines, ensuring that reflection and knowledge sharing become standard rather than ad hoc activities.

In addition, establishing a centralized digital repository for lessons learned is essential to preserving organizational knowledge. Such a repository enables easy access, promotes knowledge reuse, and ensures that valuable insights remain available over time. When effectively maintained and actively utilized, it supports more consistent performance, reduces the likelihood of repeated mistakes, and helps replicate successful practices across projects [14].

Ideally, this repository should be supported by a standardized template and structured according to project type, risk profiles, and recurring patterns of success or failure. Such organization enables project managers to quickly locate relevant insights and apply them effectively to comparable initiatives, improving decision-making efficiency and consistency.

Equally important is fostering a culture of continuous learning within the organization. Encouraging teams to regularly reflect on experiences and openly share knowledge helps embed these practices into everyday workflows. Over time, this learning-oriented mindset not only enhances project execution but also contributes to stronger, more adaptive organizational governance.

4.4 Anticipated Challenges and Mitigation Strategies

Implementing improvements in project management often presents a range of foreseeable challenges that must be proactively addressed. One of the primary difficulties lies in adapting existing workflows to align with new methodologies. Such transitions can trigger resistance from both employees and project stakeholders, particularly when changes disrupt established routines or introduce uncertainty.

To mitigate this, it is essential to ensure that new approaches are carefully aligned with existing organizational structures and processes. A gradual, well-communicated integration strategy can help reduce friction and foster acceptance. Providing adequate training, clearly articulating the benefits of the changes, and involving key stakeholders early in the process can further ease the transition. By promoting transparency and encouraging active participation, organizations can minimize disruption

and enhance the effectiveness of the implementation while maintaining operational stability.

Another significant challenge relates to the collection and integration of reliable project data. The effectiveness of tools such as Earned Value Management (EVM) and lessons learned frameworks depends on the availability of accurate, timely, and consistent information. Without standardized procedures for data capture, these tools risk producing incomplete or misleading insights. To address this, organizations must establish clear data governance practices, ensuring that all departments adhere to a unified system for data collection, validation, and reporting.

In addition, coordination across project teams and administrative units can be complex, particularly when striving to maintain clear communication and accountability. Silos between departments may hinder information flow and delay decision-making.

Implementing a centralized governance structure, such as a Project Management Office (PMO), can help streamline these interactions by defining roles, standardizing processes, and promoting transparency. However, its success depends on careful planning, strong leadership support, and active stakeholder engagement to ensure smooth adoption and sustained effectiveness.

To address these challenges, the organization should adopt structured approaches to both implementation and continuous improvement, alongside comprehensive training in the proposed project management methodologies and tools. Equipping employees with the necessary knowledge and skills not only facilitates smoother adoption but also reduces resistance to change.

A phased implementation strategy, supported by pilot testing of new processes, can further minimize risk by allowing the organization to identify and resolve potential issues in a controlled environment before full-scale deployment. Continuous monitoring of project performance is also essential, enabling early detection of obstacles and informed decision-making.

Additionally, establishing regular feedback loops is critical to sustaining improvement efforts. By encouraging teams to share real-time insights and experiences, the organization can refine its methodologies, adapt to evolving challenges, and ensure that practices remain relevant and effective over time.

4.5 AI-Enhanced Project Management

As the PMO begins systematically collecting Planned Value (PV), Earned Value (EV) and Actual Cost (AC) through Earned Value Management (EVM), these data streams can be leveraged to support advanced analytics and predictive modelling. In particular, they provide a strong foundation for supervised learning models capable of forecasting cost and schedule variances several reporting cycles in advance.

Recent research highlights that machine learning techniques, such as gradient boosting algorithms and recurrent networks, can significantly outperform

traditional manual trend extrapolation when applied to EVM data. By incorporating not only EVM indices but also context variables (e.g. weather conditions, workforce availability, and supply chain delays), these models enable more accurate identification of emerging risks, including potential cost overruns and schedule inefficiencies.

Although this remains an emerging area, some early evidence points in this direction. Karim Zadeh, Bagheri Khoulenjani and Safaei [18] tested AI-supported estimation and resource-allocation routines in an agile software context and reported around a 20% gain in estimation accuracy and a 15% reduction in team idle time after a single iteration, while Celestin and Vanitha [19] associate AI-driven predictive analytics with a reported 30% improvement in resource management and a 20% reduction in unforeseen risks across the studies they reviewed. These figures should be read with some caution, since they originate from software-development settings and from a literature-based review rather than construction case data, but they offer a preliminary indication that gains of this order are not unrealistic, therefore, reinforcing why this component of the framework is presented here as a forward-looking opportunity still to be validated, rather than an established result.

Integrating such AI-driven capabilities into project management practices allows organizations to move from reactive to proactive decision-making. Project managers can anticipate issues earlier, allocate resources more effectively, and implement corrective measures before deviations escalate. Over time, this data-driven approach enhances forecasting accuracy, improves project outcomes, and reinforces the strategic value of the PMO within the organization [11].

Embedding these forecasts within the EVM dashboard enables the PMO to transition from reactive variance detection to proactive risk mitigation. Instead of responding only after deviations occur, project teams can act in advance, triggering early procurement, resequencing tasks, or reallocating resources before deterioration in Cost Performance Index (CPI) or Schedule Performance Index (SPI) reaches critical levels. In this way, AI elevates EVM from a descriptive control mechanism into a real-time, predictive governance tool, enhancing responsiveness while preserving the integrity of the underlying methodology.

Beyond predictive insights, the same data pipeline can support the automated generation of periodic progress reports. A trained model can continuously update a live dashboard that integrates raw EVM metrics (e.g. CPI, SPI) with variance forecasts. Coupled with a lightweight natural language generation component, the system can compile concise, one-page summaries that include visualizations, key risk indicators, and recommended actions, and distribute them to stakeholders ahead of control meeting. This hands-free reporting approach reduces reliance on manual spreadsheet work, ensures consistent access to up-to-date information across all stakeholders, and creates a timestamped audit trail that can be leveraged for future lessons learned and performance analysis.

4.6 Augmented Reality for Real-Time Project Management

The **proposed PMO platform** can be further enhanced through the integration of an **Augmented Reality (AR) field application**, enabling project teams to overlay BIM designs directly onto the physical work environment using tablets or smart glasses. During routine site inspections, supervisors can visually compare the current “as built” status with the planned design and schedule in real-time, significantly improving accuracy and situational awareness.

This real-time alignment between digital models and on-site conditions supports three key operational functions:

- **Variance capture:** When discrepancies or delays are identified, supervisors can immediately flag them with the AR interface. These observations are recorded and transmitted to the central project database, automatically updating the EVM dashboard used by project management teams.
- **Progress confirmation:** Visual verification allows supervisors to confirm daily progress more reliably. This information can be instantly shared across stakeholders, ensuring a consistent and up-to-date understanding of project status.
- **Knowledge integrations:** Each identified variance, along with its root cause and corresponding corrective action, is documented and stored in the lessons learned repository. This creates a continuous feedback loop that strengthens organizational learning and supports future project planning.

In essence, AR transforms traditional site visits into dynamic, data-driving management activities. By enabling immediate validation, streamlined reporting, and direct integration with project control systems, it enhances governance and decision-making while reducing administrative burden.

5. Conclusion

This study provides a practical, research-informed roadmap for improving project execution and decision-making governance within the organization. The analysis identified several critical inefficiencies across key areas, including project proposal development, planning, procurement, and interdepartmental coordination. In response, three core improvements were proposed: the establishment of a PMO, the adoption of EVM, and the implementation of a structured Lessons Learned system.

The creation of a **Project Management Office (PMO)** emerges as a central enabler for organizational improvement. By unifying processes, enforcing

methodological consistency, and optimizing resource allocation, the PMO introduces a structured approach to project oversight. This centralization strengthens governance, enhances transparency, and supports more efficient and coordinated workflows across departments.

Equally significant is the integration of **Earned Value Management (EVM)** as a robust performance management tool. By incorporating key indicators such as cost and schedule variances, EVM provides greater visibility into project performance. This allows for early identification of deviations and timely corrective action, improving the likelihood of delivering projects within scope, time, and budget constraints.

The study also highlights the importance of embedding a **Lessons Learned** framework as a driver of continuous improvement. Establishing a formal mechanism to capture, store and reuse insights from past projects enables the organization to refine its practices, avoid recurring errors, and replicate successful strategies. Over time, this contributes to a more adaptive and knowledge-driven organizational culture.

Despite these benefits, the implementation of such improvements presents notable challenges. Resistance to change, difficulties in aligning new methodologies with existing structures, and concerns regarding data quality and reliability must be carefully managed. Addressing these challenges requires a phased implementation approach, strong stakeholder engagement, targeted training, and continuous performance monitoring to ensure sustainable adoption.

It is important to acknowledge that this study is based on a single organizational context, focusing specifically on its internal project management and governance practices. As such, the generalizability of the findings may be limited. Further research across different organizations, particularly within the construction sector, would be valuable to validate and expand upon these recommendations.

Building on this foundation, the integration of emerging technologies such as **Artificial Intelligence (AI)** and **Augmented Reality (AR)** represents a natural evolution of the proposed framework. Machine learning models trained on EVM data can predict cost and schedule deviations of several reporting cycles in advance, enabling proactive intervention before issues escalate. At the same time, AR-based field applications allow supervisors to compare “as-built” and “as-planned” conditions in real-time, improving on-site verification and immediate variance reporting. These discrepancies can be automatically logged, updating project dashboards and contributing to the Lessons Learned repository, thereby closing the loop between planning, execution, and knowledge management.

Ultimately, this study contributes to the broader field of construction project management and organizational governance by offering actionable, context-specific recommendations. If implemented effectively and continuously refined, these approaches can significantly enhance operational efficiency, strengthen risk management, and improve overall project outcomes. More importantly, they equip the organization to better navigate

complexity and adapt to change, reinforcing its competitiveness in an increasingly dynamic and demanding industry.

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