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IMPLEMENTING CONTROLLED EARNED VALUE MANAGEMENT TECHNIQUES IN CONSTRUCTION

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Research Paper

Abstract: *The Earned Value Method is crucial for project forecasting because it provides an integrated approach to measuring cost, schedule, and performance which enables project managers in early identifying the deviations in the projects. Therefore, the study aimed to explore the role of earned value methodology in the construction projects of private and public sector buildings. For this purpose, the case study approach and quantitative data collected were analyzed on the cost performance index, schedule performance index, and cost variance percentage. The Project One public sector university building construction reszszzssults indicated that the cost performance index was lower than 1 which indicated that there was no proper implementation of the earned value method in the cost forecasting. On the other hand, in project two which was conducted on the construction of a private university building, the cost performance index was greater than 1 which showed the importance of the earned value method in controlling the cost. The cost variance percentage of Project One was found negative while Project two cost variance percentage was also positive which also showed the proper implementation of the earned value method in their construction. The study with results highlighted the crucial role of the Earned Value Method EVM in cost control and forecasting which demonstrates that its proper implementation leads to better financial performance in construction projects. The comparison between public and private sector projects emphasizes the need for stricter EVM adoption in public-sector construction to improve cost efficiency.*

Keywords: *Earned value methods, Decision Sciences, Cost performance index, and Construction, Project Management*

1. Introduction

The construction industry has become competitive for contractors to complete their projects successfully on time while managing cost and time efficiently cost

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(Proboretno et al., 2024). Despite the increasing efforts in the management of construction projects, issues related to increasing costs and delays in projects affect the industry in both developed and emerging countries (Demirkesen & Ozorhon, 2017). This is the reason, many construction projects have experienced significantly increasing costs from the initial budget costs (Demirkesen & Ozorhon, 2017). In several cases, cost overruns have ranged from minor increases to extreme deviations from the planned budget cost (Proboretno et al., 2024). On the other hand, delays in project completion are common where many projects extend their original timelines by weeks or even months (Fashina et al., 2021). Even in regions where advanced project management techniques and software are used, many projects still fail to meet their expected cost and time objectives (Obiuto et al., 2024). These repeating challenges in the construction industry are highlighting in managing the complexity of construction projects to control the financial costs and risks (Datta et al., 2023).

Various factors are associated with the increase of the financial cost and delays in projects but among those is weak administrative management, especially in the areas where there is a need for work supervision, and proper planning related to projects (Zhu et al., 2022). This is due to the weak estimation of the time and costs, and communication gaps among the stakeholders which often lead to inefficiencies (Memon et al., 2023). The same evidence is further supported by other studies where they also highlighted that inadequate planning is a leading cause of delays and budget overruns along with additional issues including changes in project scope, poorly scheduled activities, design modifications, and weak collaboration among project participants (Parsamehr et al., 2023). Another common problem is that many contractors do not follow structured project management frameworks, relying instead on informal methods that hinder communication and oversight (Sharma & Gupta, 2021). As a result, project managers often struggle to monitor the real-time financial and technical progress of their projects which is leading to unexpected challenges (Obiuto et al., 2024). However, to overcome this issue, there is a need for a more structured approach in construction management which ensures that projects are executed with efficiency, transparency, and greater control over time and costs.

To address the issues of delays in projects and increasing costs of projects, globally one of the integral practices of management is the Earned Value Management (EVM) method (Soliman et al., 2024). This approach could be used in assessing the project performance by utilizing the cost and schedule indicators which allow the project managers to detect potential issues by tracking the actual performance of the project (Al-Somaydaii & Abdaljader, 2024). EVM originated in the 1960s when the U.S. introduced it based on a cost and schedule control system. With time EVM has increased its acceptance with the refined methodology and eventually becomes a standard tool for project performance measurement (Wotango et al., 2024). This is the reason, this method has been widely applied in various industries with different names like Earned Value Analysis (EVA) and Earned Value Technique (EVT). Regardless of the terminology, the core principles remain the same in integrating the cost, schedule, and performance metrics to provide a comprehensive view of project progress (Getawa Ayalew & Ayalew, 2024). Therefore, through the implementation of the EVM, organizations could enhance decision-making, improve resource allocation, and increase the likelihood of completing projects within budget and on schedule which could increase the company's competitive advantage (Bria et al., 2024). Therefore, the study focused on the EVM in controlling costs and increasing the efficiency of the project.

Several researches have been explored on the EVM but still, these researches have various gaps, especially in the private and public sector construction projects. Historically, the EVM has been used as the best technique in controlling cost and accuracy forecasting (Bria et al., 2024; Getawa Ayalew & Ayalew, 2024; Jones, 2024), while previous research has primarily focused on its use in large-scale infrastructure and defense projects, with limited attention to its effectiveness in both private and public construction projects. Therefore, the study contributed literature from both private and public sector university projects to know the variation in the project's costs and efficiency in their projects. In other words, extant studies have also examined the role of EVM on a theoretical basis with limited attention to addressing the practical issues, such as the accuracy of initial baseline estimates, integration with evolving project management methodologies, and adaptability to dynamic and unpredictable construction environments (Fulpagare et al., 2024; Jones, 2024; Proaño-Narváez et al., 2022; Venkataraman & Pinto, 2008). Therefore, this study contributed EVM technique on two different projects to test the scope of EVM on a practical basis. Additionally, existing literature tends to emphasize its use in government-funded initiatives, often overlooking its applicability and impact on private sector projects, which may have different financial constraints, contractual requirements, and operational complexities (Aramali et al., 2021; Parsamehr et al., 2023; Proaño-Narváez et al., 2022). Therefore, this study contributed empirical findings comparing both private and public sector university projects which fulfills a novel gap in understanding how project characteristics, funding mechanisms, and organizational structures influence its effectiveness. Therefore, this research aimed to bridge these gaps by evaluating EVM's role in managing both private and public construction projects by identifying best practices to enhance its application across diverse projects.

The study with the above objective contributed practically in several ways. Firstly, the study contributed that proper planning about the financial and time management approaches could increase the project performance which helps to make timely decisions which could reduce the over-cost and delays in projects. Secondly, the study also contributed to project management practices, emphasizing the significance of a well-defined Work Breakdown Structure (WBS) for effective project organization. The WBS should categorize deliverables projects at different levels which ensures alignment with a structured charts that accurately records the costs associated with each component. This enhances financial transparency and accountability which allows for precise cost tracking. The study was further divided into four chapters. The second chapter was the literature review which aimed to highlight the significant gaps after reviewing various studies. The third chapter was research methodology where different research methods were used for the collection of data. Forth chapter consists of data analysis and results. The last chapter consisted of a discussion of the results and implications of the study.

2. Literature Review

Utilization of various tools in the management of projects becomes an integral requirement for project managers to increase profit by minimizing cost (Proboretno et al., 2024) For this purpose, Lipke et al. (2009) highlighted that Earned Value Management (EVM) is a methodology that has been gaining prominence across various sectors, particularly in construction. EVM helps in facilitating to tracking the

projects which helps to minimize the cost through integrating key components such as scope, cost, time, and schedule within a unified framework (Vandevoorde & Vanhoucke, 2006). EVM strengths are also supported by the findings of cost Proboretno et al. (2024) who also found that companies in construction are applying the respondent's EVM in their projects because this method requires less data manipulation, they do not provide the same level of informative insights or proactive alerts that enable risk mitigation and preventive measures. In other words, Kineber et al. (2024) also explored EVM acceptance among managers of construction industry. Their findings revealed that the majority of respondents endorsed the implementation of EVM. Most of these respondents believed that EVM applied to both large and small-scale projects. Similarly, Moeisra et al. (2024) surveyed public project managers to examine their perspectives on EVM as a performance measurement system. Their findings indicated that project managers pay little attention to EVM because they are focusing on traditional reporting methods.

Furthermore, Kineber et al. (2024) study also emphasized that companies with little attention to the EVM increase the cost of projects from their projections. A similar finding has been identified in the study of Jahan (2024) where they highlighted additional limitations such as the high cost of implementation, difficulties in measuring on-site progress, contractual restrictions, and challenges in obtaining integrated time and cost data. These obstacles suggest that a lack of understanding of the EVM hinders its extensive adoption as a standard tool in project management. To address the challenges of cost, Uddin et al. (2024) highlighted various measures to control costs training project personnel, defining structured work procedures, and leveraging software solutions for data recording. Similarly, Venkataraman and Pinto (2008) also emphasized the importance of disciplined data collection and efficient management of cost and duration-related information. While implementing these strategies incurs additional operational expenses, the long-term benefits, such as improved project efficiency and cost management which minimizes the costs could eventually improve the profit of the companies.

On the other hand, Stanitsas et al. (2021) further conducted a study on the implementation of EVM in construction projects. Their findings demonstrated that cost analysis positively increased the profits when EVM was implemented from the project's inception. In a case study by Kerzner (2013), EVM also significantly contributed to the management of cost which ensured that the project was completed within budget on time. The study identified three crucial factors for success: (1) a well-structured work breakdown aligned with financial accounts to enable accurate progress assessment, (2) close monitoring of performance indicators to facilitate informed decision-making and supplier negotiations, and (3) effective data validation to enhance analytical accuracy. Further, the empirical study of Moeisra et al. (2024) also examined a study on a building project where EVM was applied in four stages. Despite performance indicator alerts, project success largely depended on the ability of managers to take timely corrective actions. Similarly, Kineber et al. (2024) further analyzed construction professionals' perspectives on EVM implementation and indicated that EVM is a significant predictor of minimizing the cost of the project. They also highlighted the significance of the importance of strategic decision-making and financial resource availability in effective EVM applications. Sohrabi and Noorzai (2024) further extended the significance of organizational culture in promoting stakeholder participation, a critical factor in the successful adoption of EVM. The study findings highlighted that EVM supports essential project management processes

which consist of planning, and scheduling that control to minimize the cost and increase efficiency of projects to complete on time.

In contrast to previous studies, Pratama et al. (2025) further argued that EVM is not always effective as a project management tool. They concluded that there is a significant gap in the implementation of project efforts and actual bearing cost. Their results also suggested that EVM's usefulness depends on project type and the conservative approach adopted by project teams in defining measurement baselines. Consequently, firms that integrate EVM into their project management practices may gain a competitive advantage, securing more contracts and achieving higher project success rates in the long run. In contrast, Francis (2025) conducted on the implementation of EVM. The study results indicated that EVM helps to control costs, ensuring the project was completed on time and within budget. Their study also highlighted the significance of EVM for another sector to know the variation in the findings. Yalçın et al. (2024) further evaluated EVM's application in construction projects and found that despite performance indicator alerts, the method's success heavily depended on managerial decision-making. Bahrudin et al. (2025) examined professionals' perspectives on EVM implementation, highlighting external factors such as financial liquidity, risk management, and social considerations that influence its effectiveness. Kasprowicz and Starczyk-Kołbyk (2024) also emphasized that a supportive organizational culture and stakeholder engagement are critical for EVM's success, particularly in large-scale infrastructure projects. Conversely, EVM's effectiveness is project-dependent, with significant discrepancies between implementation efforts and actual benefits realized. More recently Rohim et al. (2024) also explored EVM in software development and healthcare projects where they found that the industry has various challenges in the adoption of technological resources such as data accuracy, resource allocation, and real-time tracking limitations. Despite these challenges, empirical evidence suggests that when EVM is effectively implemented then it could provide valuable insights into project performance, support proactive decision-making, and enhance overall efficiency across diverse project environments.

Summarizing the above literature, it has been highlighted that EVM is widely recognized as an effective tool for tracking project costs and performance in the construction industry. This helps to control the project like cost, and time to improve efficiency and minimize overruns. Many organizations have successfully adopted EVM to enhance decision-making, financial monitoring, and project control. However, challenges such as high implementation costs, contractual restrictions, and difficulties in measuring real-time progress limit its widespread adoption. These challenges could be handled through the proper implementation of effectiveness, EVM's success largely depends on managerial decision-making, organizational culture, and the ability to adapt to industry-specific challenges.

Despite its advantages, EVM adoption differs significantly between public and private projects. Public sector projects often face bureaucratic barriers, rigid regulations, and a lack of integrated cost-time tracking, making EVM implementation challenging. In contrast, private projects have greater flexibility but may struggle with financial constraints and resource allocation. Additionally, public project managers tend to rely on traditional reporting methods, while private firms that strategically implement EVM gain a competitive edge. Previous studies highlighted that there is a gap in the extant study to conduct a study on the private and public sectors in one

model. These gaps highlight that there is a need for research to explore research on both private and public projects in adaptations of EVM to improve its effectiveness across different project environments. Therefore, the study aimed to explore the role of earned value methodology in the construction projects of private and public sector buildings.

3. Research Methods

The study aimed to explore the role of earned value methodology in the construction projects of private and public sector buildings. Aligned with the research objective, researchers employed a case study approach and focused on quantitative data which allows for generalizations from specific cases to broader theoretical insights. In terms of purpose, it is categorized as fundamental research. The findings of this study aim to assist organizations in better understanding the application of EVM in construction projects. The case study organization was selected for its significant role in the city's economic sector, its execution of key projects, and its openness to sharing data, including negative results. The research followed four stages. The first stage was the data collection where data the researchers gathered the project details such as schedules, budgets, expenses, and contractual documents. The second was the data processing where data was structured in the tables based on work breakdown structures (WBS) and adjusting for scope changes.

Table 1: Key Performance Indicators

Metric	Formula	Interpretation
Cost Variance (CV)	CV = EV - AC	Measures cost performance. A positive value indicates cost savings (under budget), while a negative value signals overspending. Helps in financial adjustments.
Schedule Variance (SV)	SV = EV - PV	Assesses project schedule adherence. A positive value means ahead of schedule, while a negative value indicates delays requiring corrective actions.
Cost Performance Index (CPI)	CPI = EV / AC	Evaluates cost efficiency. A CPI < 1 means overspending, CPI = 1 indicates costs are on track, and CPI > 1 suggests cost savings.
Schedule Performance Index (SPI)	SPI = EV / PV	Determines schedule efficiency. SPI < 1 means the project is behind schedule, SPI = 1 is on track, and SPI > 1 indicates early progress.
Cost Variance Percentage (VAC%)	VAC% = (BAC - EAC) / BAC	Predicts cost deviation from the budget. A positive VAC% means potential savings, while a negative value suggests additional costs.
Estimated Cost to Complete (ETC)	ETC = (BAC - EV) / CPI	Forecasts the remaining budget needed for completion, helping in financial planning.
Estimated Cost at Completion (EAC)	EAC = AC + (BAC - EV) / CPI	Predicts the final project cost based on current cost performance, guiding budget adjustments.

Note: CV-cost variance, EV-earned value, AC-actual cost, SC-standard cost, BAC-initial plan budget.

The third schedule was the methodology application which defined EVM procedures and performance metrics to assess project efficiency. In the fourth section, data analysis is conducted to evaluate cost and schedule performance through key metrics (PV, AC, EV, BAC) and indicators (CPI, SPI, CV, SV), with graphical representations for better visualization and evaluation. One aspect is EV determination in the EVMs. Kasprowicz and Starczyk-Kołbyk (2024) outlined various

techniques for determining project progress which depend on task duration and deliverable characteristics. Based on the collected data, this study adopted the percentage completion method, which evaluates progress through the rate of physical units achieved. Stage five showed the graphical results which were analyzed to identify key findings regarding project execution and management errors. These insights led to recommendations for improving the application of the EVM in construction projects which ensures more effective project control and management. The measurement indicators are projected in Table 1 Above.

4. Data Analysis and Results

Table 2 predicted values show the cost and time durations in both public and private university projects. The first project, which falls under public university projects was initially allocated a budget of $4,989,834.00. However, the actual executed amount reached $5,482,929, indicating a possible adjustment in costs or scope during implementation. This project was carried out over 15 months. On the other hand, the second project which was categorized under private university projects where an original budget of $8,893,993.00 while the actual cost was $8,362,777 which suggests a slightly lower expenditure than initially planned. This project was completed within a shorter duration of 12 months. These results show that it might be effect of decreasing costs in private universities is due to the proper implementation of EVM. Table 2 highlights the above results.

Table 2: Actual cost and time duration of two projects

Projects	Type of Project	Original Amount In $	Amount Executed in $	Duration (Months)
Project 1	Public university projects	4,989,834.00	$54,829,29	15 Months
Project 2	Private University Projects	8,893,993.00	$83,627,77	12 Months

4.1 Project 1 Evaluation

The analysis of Project 1 based on the Cost Performance Index (CPI) and Schedule Performance Index (SPI) over 15 months reveals fluctuations in cost and time efficiency. Two performance indicators have been used to test the evaluation of the projects. Among those, the cost performance index (CPI) shows how efficiently economic resources are being utilized (Petter, 2014). Literature cited that if the CPI value is less than 1 it means, it has a cost overrun which shows that it exceeds from budget cost (Morrison, 2012). This threshold value helps the individuals in determining the project's financial and time management. Project 1 valuation report demonstrates strong cost efficiency in the initial months, with CPI values exceeding 1.5 which indicates that actual costs were lower than budgeted. However, from month 5 onward, CPI gradually declined and reached below 1 in month 15 (0.89) which signaled a cost overrun. On the other hand, in term of In terms of time efficiency SPI, the project consistently performs well, maintaining values above 1 which indicates that work progresses ahead of schedule. However, minor declines occur in later months, but SPI remains near 1 which suggests the project is largely on schedule. These findings show that the project started with strong cost and time efficiency while cost was increased in later months. The research findings trend has been aligned with the weakness of EVM because the companies rely more on the early stages costs. In this case, the initial favorable cost performance might have created a false sense of

control which led to later cost appreciations that EVM did not fully anticipate. Additionally, EVM struggles with adapting to unforeseen project complexities and changes in scope which become evident in later phases contributing to the observed cost increases. Below is Table 3 and Figure 1 indicating the findings of CPI and SPI.

Table 3: Project 1 CPI and SPI Index

Period (Months)	CPI	SP1
1	1.83	1.15
2	1.73	1.33
3	1.83	1.94
4	1.84	1.6
5	1.35	1.32
6	1.24	1.47
7	1.1	1.33
8	1.23	1.03
9	1.03	1.03
10	1.02	1.05
11	1.01	1.07
12	1.05	1.09
13	1.01	1
14	1.02	1.05
15	0.89	1

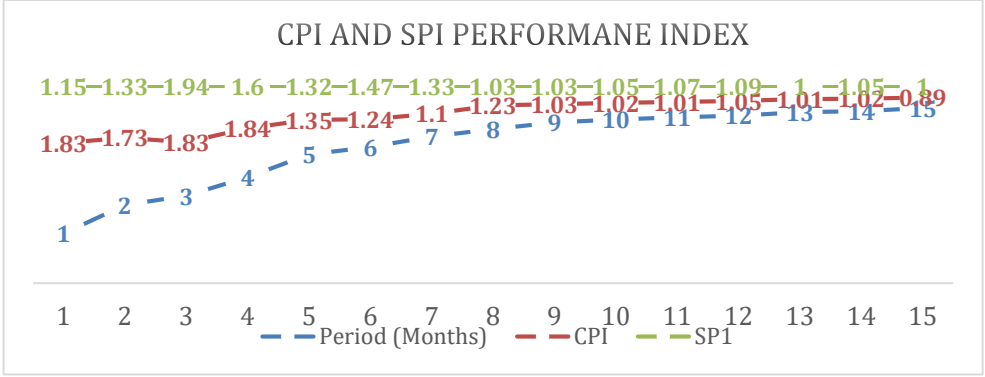

Figure 1: Project 1

4.2 Project Two valuation

This section shows the project valuation of Project 2 from both CPI and SPI perspectives. The findings of Project 2 are reversed from Project 1. The CPI cost of project two was lower than 1 in the initial stage which reveals an increase of cost in the initial stage. In the first three months, the CPI value was lower than 1 which indicates that actual costs exceeded the budget, though the SPI remains above 1 which suggests the project was progressing ahead of schedule despite the higher costs. While from the fourth month, the CPI reaches 1.02, aligning the actual and budgeted costs, while SPI remains slightly above 1 which reflects efficient time utilization. Furthermore, from the fifth month onward, CPI consistently exceeds 1 which has reached on peak of 1.3 in the tenth month which is signaling improved cost efficiency as the actual costs remain lower than projected. For the time being, the SPI continues to stay above 1 which confirms that the project remains ahead of schedule. In the final two months, while the CPI slightly declines to 1.23 and here cost efficiency is still maintained, and the SPI, though reduced to 1.05 indicates that the project remains on

track but at a slower pace. Overall, Project Two demonstrates strong cost and schedule efficiency after the initial phase, ensuring both financial and timeline optimization. These findings highlighted that strong cost and schedule efficiency after the initial phase aligns with the strength of EVM ability which helped to track performance metrics which ensures financial and timeline optimization. The above results are depicted in Table 4 and Figure 2.

Table 4: Project 2 CPI and CPI index

Period (Months)	CPI	SPI
1	0.85	1.5
2	0.79	1.25
3	0.95	1.1
4	1.02	1.05
5	1.10	1.08
6	1.15	1.1
7	1.2	1.12
8	1.25	1.15
9	1.28	1.18
10	1.30	1.16
11	1.27	1.12
12	1.23	1.05

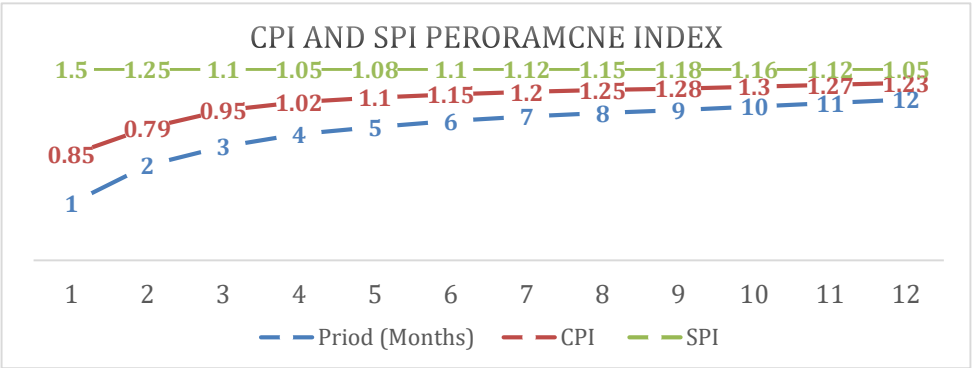

Figure 2: Project 2

4.3 Comparison of Findings of Project 1 and Project 2

This section shows the differences between Project 1 and Project 2 where the construction public sector university project was related to Project 1 and the private university was related to project 2. These two projects show a significant difference in cost efficiency and budgeted variance. The Project 1 CPI was 0.97 which shows that there is a huge cost difference between the estimated cost and the actual cost. On the other hand, the SPI value was greater than 1 which indicated that the project has been completed on schedule. Additionally, the negative VAC (-4.32%) confirms that the project exceeded its planned budget which is resulting in a financial loss. A possible reason for this increasing cost is that technical staff is inefficient in its organizational structure, which consists only of technical staff and they are lacking dedicated project management oversight. In contrast, Project 2 demonstrates strong cost efficiency with a CPI of 1.23 which indicates that the project was completed under budget. Its SPI of 1.05 suggests it was slightly ahead of schedule. The significantly high VAC of 12.20% suggests a substantial budget surplus, which may be attributed to effective cost management and resource allocation which is likely facilitated by the presence of both

a project manager and technical staff. These findings highlight that Project 2 has superior cost and schedule efficiency over Project 1 which emphasizes the effectiveness of EVM in tracking project performance through key metrics like CPI and SPI. These findings demonstrated how EVM aids in proactive decision-making, ensuring financial and operational success through identifying variances early and optimizing resource allocation. Table 5 below indicates the above comparison findings.

Table 5: Comparison of two Projects

Parameter	Project 1	Project 2
Construction industry sector	Public Sector university	Private Sector University
Time of execution in months	15	12
Cost of execution	$54,829,29	$83,627,77
Organization Structure	just technical staff	Project Manager and technical staff
CPI	0.87	1.23
SPI	1	1.05
VAC in percentage	–4.32	12.20

5. Discussion

The study aimed to explore the role of earned value methodology in the construction projects of private and public sector buildings. For this purpose, two construction projects were evaluated one from public-sector universities and one from private-sector universities. Overall results show that Project 2 was completed at a low cost as compared to Project 1. These results were differentiated due to management decision-making and financial control applying EVM in project forecasting. Therefore, in the meantime, project 1 of public sector university results show that CPI is less than 1 which indicates that budget overruns, meaning the project exceeded its planned costs. This suggests issues with financial management and cost control. The findings are supported by the study of (Harris et al., 2024; Morrison, 1993) where they argued that public sector projects often struggle with cost overruns due to bureaucratic inefficiencies, rigid procurement policies, and weak budget oversight. These problems are often caused by slow approval processes, limited financial independence, and a lack of flexibility in handling budget issues. On the other hand, VAC also confirmed the inefficiency in the finances. This is also supported by prior literature where they found that poor forecasting and weak financial oversight created a major reason of budget increasing costs in public sector projects (Al-Gahtani et al., 2024; Oluseye et al., 2024). They also highlighted that lack of adaptive financial planning could also make budget shortfalls worse which is leading to long-term financial difficulties.

A possible reason for increasing actual cost as compared to budget cost is that there is no proper implementation of EVM in their projects. They used the EVM in their project completion but they failed to prevent budget overruns, which suggests that financial planning and forecasting were inadequate. There is a major limitation in the implementation of EVM in public sector projects is that they rely more on accurate initial cost estimates. If the original budget is unrealistic or lacks flexibility, EVM cannot fully compensate for cost overruns. Furthermore, public sector constraints, such as bureaucratic delays and rigid procurement processes, reduce the effectiveness of EVM. Unlike in the private sector, where managers can quickly adjust financial plans and public sector projects often lack the flexibility needed for EVM to work effectively.

These findings align with Kineber et al. (2024), who emphasize that inaccurate forecasting and weak financial oversight limit EVM's effectiveness in controlling costs. These findings enforced that public sector project managers should properly address the implementation of EVM in their forecasting which could minimize the cost of projects which will ultimately increase the profitability of the organization. On the other hand, SPI of 1 shows that the project was completed on time. The outcome is supported by the study of Titu and Uddin (2024) who indicated that strict regulations help public sector projects meet deadlines even if they struggle financially. These results indicate that while public sector projects may face financial constraints, their structured timelines help prevent delays.

Further results in the Project 2 private sector university results indicated that both indicators namely CPI and SPI are performing well as per the requirement. The CPI value was greater than 1 indicating that projects are completed under the budget where actual cost is lower as compared to budget cost. This shows that cost management was effective, resources were used efficiently, and the budget was well-controlled. The results are supported by prior literature where they found that private-sector projects often achieve better financial performance due to structured management, fast decision-making, and proactive risk management (Choiriyah et al., 2024; Titu & Uddin, 2024). Strong financial governance, real-time budget monitoring, and flexible financial adjustments contribute to this efficiency. On the other hand, the SPI value was greater than 1 which also indicated that the project was finished ahead of schedule which is highlighting the benefits of flexible resource allocation and adaptive scheduling which is also supported by the study of (Soliman et al., 2024; Wotango et al., 2024). They also argued that private sector organizations can quickly adjust resources, modify schedules, and use advanced project tracking tools to meet deadlines efficiently. The high positive VAC further confirms strong financial discipline which is supported by the study of (Wyke et al., 2024) where they argued that strict financial controls and proactive budget monitoring could lead to significant cost savings in private sector projects. They also emphasized that effective financial planning allows private organizations to reinvest surplus funds into future projects and maintain financial stability. Project 2 success in cost efficiency was due to the effective use of EVM because it helped to maintain financial control and efficiency. EVM also provided real-time cost tracking and performance schedules which allowed the team to quickly identify the projects. Furthermore, proactive budget adjustments based on EVM metrics contributed to the high financial surplus. These strengths confirm that EVM when applied properly, can significantly improve project efficiency in the private sector. These findings enforced that in construction projects project managers should apply EVM that could minimize the cost and increase the revenue.

Overall, a comparison of both projects shows that the structure affects the efficiency of projects. In the hierarchal structure of the organizations, it has been found that project 1 which is relevant to the public sector has little attention on project managers to manage the project which contributed to cost overruns and weak financial management. The absence of a project manager likely resulted in delayed decision-making, poor cost control, and limited accountability. In contrast, Project 2 had a project manager and technical team which led to better cost efficiency and schedule control. This supports the findings of Turner and Müller (2005) who argued that when dealing the projects construction companies have trained project managers, they help to minimize risk management and control costs in completing the project successfully. The significant difference in the VAC of projects 1 and 2 highlights the

impact of structured financial planning. This is further supported by the study of (Kineber et al., 2024) where they emphasized that accurate budgeting and financial oversight play a key role in preventing cost overruns and ensuring financial stability. An experienced project manager raises a culture of accountability, enhances communication, and aligns financial goals with project objectives. These findings emphasized that construction companies should have proper dedicated teams and an EVM approach for project management to lead the better cost and schedule performance that could increase the overall profit.

6. Implications and Recommendations

The study results have various contributions that were necessary for the successful implementation of EVM in the management of projects. Firstly, the study contributed that proper planning about the financial and time management approaches could increase the project performance which helps to make timely decisions which could reduce the over-cost and delays in projects. Secondly, the study also contributed to project management practices, emphasizing the significance of a well-defined Work Breakdown Structure (WBS) for effective project organization. The WBS should categorize deliverables at different levels which ensures alignment with a structured chart of accounts that accurately records the costs associated with each component. This enhances financial transparency and accountability, allowing for precise cost tracking. It is recommended that public sector projects develop an independent WBS separate from the overall budget to allow for more dynamic financial monitoring and adaptive control mechanisms. Thirdly, the study also contributed to understanding the importance of real-time tracking in the management of projects that could improve cost control measures. Costs must be recorded during the same period in which they are incurred, rather than being delayed by accounting processes. One of the most frequent challenges in project management is the misconception that cost control is synonymous with accounting management. To mitigate this challenge, construction should have an effective project in the cost control along with the WBS which ensures continuous alignment between financial data and project progress. Lastly, the study could also help in assigning clear roles and responsibilities to the project stakeholders which is important for accountability and efficiency. The implementation of EVM successfully depends on the expertise and commitments of the project manager on project completion. Therefore, this study contributed to enhancing the importance of human resource management in the execution of the projects by emphasizing the importance of continuous professional training programs to enhance competency in EVM techniques. Therefore, construction companies should have a proper continuous learning process because the learning process of project management can evolve to ensure improved financial and schedule performance.

7. Conclusion and Future Directions

The study aimed to explore the role of earned value methodology in the construction projects of private and public sector buildings. To get this object case study approach and quantitative data collected were analyzed on the cost performance index, schedule performance index, and cost variance percentage. The Project One public sector university building construction results indicated that the

cost performance index was lower than 1 which indicated that there was no proper implementation of the earned value method in the cost forecasting. On the other hand, in project two which was conducted on the construction of a private university building, the cost performance index was greater than 1 which showed the importance of the earned value method in controlling the cost. The cost variance percentage of Project One was found negative while Project two cost variance percentage was also positive which also showed the proper implementation of the earned value method in their construction. The study with results highlighted the crucial role of the Earned Value Method EVM in cost control and forecasting which demonstrates that its proper implementation leads to better financial performance in construction projects. The comparison between public and private sector projects emphasizes the need for stricter EVM adoption in public-sector construction to improve cost efficiency. The study with the contributions has various limitations which need to be addressed in future studies.

The study was conducted on the public and private sector universities where infrastructure is different from other sectors which limited the scope of the study. Therefore, future research could be explored on construction projects to increase the generalizability of the study findings. In addition, the study did not use the structural equation modeling technique because the study mainly focused on the implementation of the earned value method in the projects. Therefore, future studies should use structural equation modeling techniques by employing complex models to increase the generalizability of the study findings. Further, the study did not use the survey methods to collect quantitative data which also limited the scope of the study. Hence, future research might be explored on survey methods to collect the data.

References

Al-Gahtani, K. S., Alsanabani, N. M., Alsugair, A. M., Aljadhai, S. I., & Alotaibi, H. F. (2024). Dynamic BIM Adoption Impact on Contract Cost Variance Factors Using PLS-SEM Techniques. *Applied Sciences*, *14*(17), 8017. https://doi.org/10.3390/app14178017

Al-Somaydaii, J. A., & Abdaljader, A. (2024). Earned value management application in construction projects of Anbar governorate. AIP Conference Proceedings, 0094-243X. https://doi.org/10.1063/5.0190450

Aramali, V., Gibson Jr, G. E., El Asmar, M., & Cho, N. (2021). Earned value management system state of practice: Identifying critical subprocesses, challenges, and environment factors of a high-performing EVMS. *Journal of Management in Engineering*, *37*(4), 04021031. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000925

Bahrudin, M. S., Patriadi, A., & Sajiyo, S. (2025). Analysis of Time and Budget Efficiency In The Bungur-Kedoyo Road Project Using Earned Value Method. *Asian Journal of Social and Humanities*, *3*(4), 770-784. https://doi.org/10.59888/ajosh.v3i4.477

Bria, T. A., Mubasher, M., & Chen, W. T. (2024). Current state of the application of evm in the construction industry. *International Journal of Organizational Innovation*, *16*(4). https://ijoi-online.org/attachments/article/487/1361%20Final.pdf

Choiriyah, S., Listyaningsih, D., Nuciferani, F., Ferdaus, F., Perdana, G. S., & Sekartadji, R. (2024). Performance Evaluation of Projects using Earned Value Concept.

Jurnal Teknologi dan Manajemen, *5*(1), 21-30. https://doi.org/10.31284/j.jtm.2024.v5i1.4620

Datta, S. D., Sobuz, M. H. R., Nafe Assafi, M., Sutan, N. M., Islam, M. N., Mannan, M. B., Akid, A. S. M., & Hasan, N. M. S. (2023). Critical project management success factors analysis for the construction industry of Bangladesh. *International Journal of Building Pathology and Adaptation*. https://doi.org/10.1108/IJBPA-01-2022-0006

Demirkesen, S., & Ozorhon, B. (2017). Measuring project management performance: Case of construction industry. *Engineering Management Journal*, *29*(4), 258-277. https://doi.org/10.1080/10429247.2017.1380579

Fashina, A. A., Omar, M. A., Sheikh, A. A., & Fakunle, F. F. (2021). Exploring the significant factors that influence delays in construction projects in Hargeisa. *Heliyon*, *7*(4). https://doi.org/10.1016/j.heliyon.2021.e06826

Francis, F. J. (2025). Using a contingent valuation method to evaluate an ecotourism site in Borneo, Malaysia: A case of the Rainforest Discovery Centre, Malaysia. *Journal of Policy Research in Tourism, Leisure and Events*, *17*(1), 36-50. https://doi.org/10.1080/19407963.2022.2150770

Fulpagare, P., Patil, A. R., & More, A. B. (2024). Investigate Strategies for Maximizing the Return on Investment in Construction Projects and Predicting their Viability. *Educational Administration: Theory and Practice*, *30*(5), 3981-3993. https://doi.org/10.53555/kuey.v30i5.3561

Getawa Ayalew, G., & Ayalew, G. M. (2024). Developing fuzzy-based earned value analysis model for estimating the performance of construction projects. A case of selected public building projects in Ethiopia. *Cogent Engineering*, *11*(1), 2348210. https://doi.org/10.1080/23311916.2024.2348210

Harris, O., Marleno, R., & Oetomo, W. (2024). Analysis of cost and time for the completion of the maintenance project of the karetan–sambimulyo road in banyuwangi regency. *Journal Of Management, Accounting, General Finance And International Economic Issues*, *3*(2), 432-437. https://doi.org/10.55047/marginal.v3i2.1040

Jahan, S. A. (2024). How project management principles can lead to successful project completion in construction industry. *IPHO-Journal of Advance Research in Business Management and Accounting*, *2*(11), 01-08. https://doi.org/10.5281/zenodo.14249290

Jones, R. (2024). *Improved Forecasting of Defense Acquisition Program Performance Using Digital Twin Models of a Revenue Centric Versus Cost Centered Approach (Enhanced Earned Value Management (E2VM))*. https://dair.nps.edu/handle/123456789/5134

Kasprowicz, T., & Starczyk-Kołbyk, A. (2024). Application of the Randomized Earned Value Method to assess the advancement of the construction of the office building under the unstable implementation conditions. *Archives of Civil Engineering*, *70*(1). http://dx.doi.org/10.24425/ace.2024.148906

Kerzner, H. (2013). *Project management metrics, KPIs, and dashboards : a guide to measuring and monitoring project performance* (2nd ed.). Wiley,International Institute for Learning, Inc. https://cir.nii.ac.jp/crid/1130282272903508608

Kineber, A. F., Ali, A. H., Elshaboury, N., Oke, A. E., & Arashpour, M. (2024). A multi-criteria evaluation and stationary analysis of value management implementation barriers for sustainable residential building projects. *International Journal of Construction Management*, *24*(2), 199-212. https://doi.org/10.1080/15623599.2023.2267870

Lipke, W., Zwikael, O., Henderson, K., & Anbari, F. (2009). Prediction of project outcome: The application of statistical methods to earned value management and earned schedule performance indexes. *International journal of project management*, *27*(4), 400-407. https://doi.org/10.1016/j.ijproman.2008.02.009

Memon, A. H., Memon, A. Q., Khahro, S. H., & Javed, Y. (2023). Investigation of project delays: Towards a sustainable construction industry. *Sustainability*, *15*(2), 1457. https://doi.org/10.3390/su15021457

Moeisra, D. A., Insyira, A. H., & Haripriambodo, T. (2024). Accelerating the middle–rise building construction duration using BIM 4D, a case study in central Jakarta. IOP Conference Series: Earth and Environmental Science, *1324(1), 012022.* http://doi.org/10.1088/1755-1315/1324/1/012022

Morrison, C. J. (1993). *A microeconomic approach to the measurement of economic performance: productivity growth, capacity utilization, and related performance indicators*. Springer-Verlag. https://cir.nii.ac.jp/crid/1130000796548420096

Obiuto, N. C., Adebayo, R. A., & Olajiga, O. K. (2024). Integrating artificial intelligence in construction management: Improving project efficiency and cost-effectiveness. *Int. J. Adv. Multidisc*, *4*(2), 639-647. https://doi.org/10.62225/2583049X.2024.4.2.2550

Oluseye, O., Oyeyemi, O. A., Ehis, O. G., & Aigbavboa, C. (2024). Effects of building contractors' value systems on corruption manifestations in Nigeria's construction sector. *International Journal of Construction Education and Research*, *20*(2), 136-156. https://doi.org/10.1080/15578771.2023.2203956

Parsamehr, M., Perera, U. S., Dodanwala, T. C., Perera, P., & Ruparathna, R. (2023). A review of construction management challenges and BIM-based solutions: perspectives from the schedule, cost, quality, and safety management. *Asian Journal of Civil Engineering*, *24*(1), 353-389. https://doi.org/10.1007/s42107-022-00501-4

Petter, J. L. (2014). An analysis of stability properties in earned value management's cost performance index and earned schedule's schedule performance index. https://scholar.afit.edu/etd/719

Pratama, I. D., Nugroho, L. D., & Muhammadun, H. (2025). Measurement of Project Cost and Time Efficiency with Earned Value Approach In The Implementation of Baggage Handling System at Sultan Hasanuddin International Airport Makassar. *Asian Journal of Social and Humanities*, *3*(4), 741-758. https://doi.org/10.59888/ajosh.v3i4.478

Proaño-Narváez, M., Flores-Vázquez, C., Vásquez Quiroz, P., & Avila-Calle, M. (2022). Earned value method (EVM) for construction projects: current application and future projections. *Buildings*, *12*(3), 301. https://doi.org/10.3390/buildings12030301

Proboretno, W., Witjaksana, B., & Tjendani, H. T. (2024). Time Performance Analysis On Afv Earthwork In Kedungpeluk Sidoarjo Using The Earned Value Method. *Journal Of Humanities, Social Sciences And Business*, *3*(2), 465-475. https://doi.org/10.55047/jhssb.v3i2.1005

Rohim, A., Witjaksana, B., & Tjendani, H. T. (2024). Estimated Cost And Time For Completion Of The Bali GX Office And Co Working Project Using The Earned Value Method. *International Journal of Science, Technology & Management*, *5*(3), 689-695. https://doi.org/10.46729/ijstm.v5i3.1076

Sharma, S., & Gupta, A. K. (2021). Analysis of factors affecting cost and time overruns in construction projects. Advances in Geotechnics and Structural Engineering: Select Proceedings of TRACE 2020, 55-63. https://doi.org/10.1007/978-981-33-6969-6_6

Sohrabi, H., & Noorzai, E. (2024). Risk-supported case-based reasoning approach for cost overrun estimation of water-related projects using machine learning. *Engineering, Construction and Architectural Management*, *31*(2), 544-570. https://doi.org/10.1108/ECAM-05-2022-0450

Soliman, E., Alrasheed, K. A., Alghanim, S., & Morsi, E. (2024). Integrating Risk Management and Earned Value Framework to Detect Early Warning Signs–Case Study. *Journal of Engineering Research*. https://doi.org/10.1016/j.jer.2024.05.029

Stanitsas, M., Kirytopoulos, K., & Leopoulos, V. (2021). Integrating sustainability indicators into project management: The case of construction industry. *Journal of Cleaner Production*, *279*, 123774. https://doi.org/10.1016/j.jclepro.2020.123774

Titu, R. H., & Uddin, S. M. K. (2024). Evaluating public funded construction project performance through earned value management. http://www.iccesd.com/proc_2024/Papers/942.pdf

Turner, J. R., & Müller, R. (2005). The project manager's leadership style as a success factor on projects: A literature review. *Project management journal*, *36*(2), 49-61. https://doi.org/10.1177/875697280503600206

Uddin, S., Ong, S., Lu, H., & Matous, P. (2024). Integrating machine learning and network analytics to model project cost, time and quality performance. *Production Planning & Control*, *35*(12), 1475-1489. https://doi.org/10.1080/09537287.2023.2196256

Vandevoorde, S., & Vanhoucke, M. (2006). A comparison of different project duration forecasting methods using earned value metrics. *International journal of project management*, *24*(4), 289-302. https://doi.org/10.1016/j.ijproman.2005.10.004

Venkataraman, R. R., & Pinto, J. K. (2008). *Cost and value management in projects*. John Wiley & Sons. https://cir.nii.ac.jp/crid/1130000798158115456

Wotango, M. D., Asrat, F. S., & Worku, S. A. (2024). Investigating Strategies to Enhancement the Use of Earned Value Management (EVM) on Performance Evaluation of Construction Projects: A Case Study of Sidama Region, Ethiopia. *Int J Cur Res Sci Eng Tech*, *7*(2), 58-70. https://doi.org/10.30967/IJCRSET/Mekdes-Dawit-Wotango/144

Wyke, S., Lindhard, S. M., & Larsen, J. K. (2024). Using principal component analysis to identify latent factors affecting cost and time overrun in public construction projects. *Engineering, Construction and Architectural Management*, *31*(6), 2415-2436. https://doi.org/10.1108/ECAM-02-2022-0189

Yalçın, G., Bayram, S., & Çıtakoğlu, H. (2024). Evaluation of Earned Value Management-Based Cost Estimation via Machine Learning. *Buildings*, *14*(12), 3772. https://doi.org/10.3390/buildings14123772

Zhu, H., Hwang, B.-G., Ngo, J., & Tan, J. P. S. (2022). Applications of smart technologies in construction project management. *Journal of Construction Engineering and Management*, *148*(4), 04022010. https://doi.org/10.1061/(ASCE)CO.1943-7862.0002260