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ANALYSIS OF COST AND TIME VARIANCE IN CONSTRUCTION PROJECTS USING CV AND SV PARAMETERS: A CASE STUDY OF THE JEMBER LUNG HOSPITAL BUILDING

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Keywords

cost variance; construction project; performance analysis; project efficiency; schedule variance

ABSTRACT

Cost and time management in construction projects is an important aspect of project management. In this study, the cost and time performance of the Jember Lung Hospital Building construction project is evaluated using Schedule Variance and Cost Variance analysis. The study aims to provide practical and applicable solutions to improve time and cost efficiency without sacrificing project quality. The results show that the project experienced a cumulative delay of 29 calendar days and considerable cost overruns compared to the original budget. In addition, the study focuses on analyzing the effectiveness of CV and SV variance analysis in the context of construction projects in Indonesia. The findings highlight the importance of strengthening risk management, more careful planning, and the application of more advanced project management technologies to improve the efficiency and sustainability of future projects.

INTRODUCTION

Infrastructure development is one of the main indicators in improving the quality of public services, including in the health sector. In Indonesia, health facility development projects such as hospitals are prioritized to support better access to health services. One of the ongoing efforts is the construction of the Lung Hospital Building in Jember. This project aims to increase the capacity of health services, particularly in dealing with lung diseases, such as tuberculosis and asthma. However, like many other construction projects, it faces challenges in cost and time control.

In any construction project, time and cost control are two very important aspects to ensure project success. Previous research shows that delays often occur in construction projects in Indonesia due to various factors such as design changes, technical constraints, and material procurement issues (Kog, 2019; Nikjow et al., 2021; Purushothaman et al., 2024; Sanni-Anibire et al., 2022; Santoso & Gallage, 2020). In addition, project costs are often inflated due to the lack of careful planning and the absence of an effective supervision system (Chadee et al., 2022; Gadisa & Zhou, 2020; Kakar et al., 2024; Kelau et al., 2021; Schmidt, 2023).

Cost and time variance analysis is one of the effective approaches to evaluate project performance. Cost Variance (CV) and Schedule Variance (SV) parameters are used to measure the cost and time efficiency of the project. CV shows the difference between planned cost and actual cost, while SV describes the deviation between planned schedule and actual progress of the project.

These parameters provide critical information about the successful execution of the project as well as help in decision-making for corrective action if required.

Effective control in construction projects involves not only monitoring of cost and time, but also requires an integrative approach that includes resource and risk management. The construction of the Jember Lung Hospital Building also faced technical obstacles, especially in the first phase of the project which involved structural works such as foundations and columns. Damages discovered during the maintenance period of the first phase affected the workflow in the second phase, which included mechanical and electrical installations. This caused significant delays in the project schedule. Of note, research on the construction project of the Nutrition Department Lecture Building in East Kalimantan showed that low SV at week 24 indicated the need for accelerated action to avoid further delays (Huda et al., 2018).

The imbalance between time and cost was also a challenge in this project. Other studies have shown that efforts to accelerate projects often increase costs, especially if they are not well planned. For example, the crashing method used on a flat construction project in Tual reduced the project duration but increased the total implementation cost (Rivaldy et al., 2023).

In this study, the main focus is the analysis of CV and SV variances in the Jember Lung Hospital Building construction project. The results of this analysis are expected to provide a clear picture of the project performance, including the estimated cost of completion and the estimated completion time. This study also aims to identify solutions that can improve time and cost efficiency without sacrificing project quality. In addition, this study attempts to evaluate the effectiveness of CV and SV variance analysis in the context of construction projects in Indonesia. Although this approach has been widely used in various countries, its application in Indonesia still faces challenges such as the lack of accurate data and gaps in implementation in the field. By understanding these constraints, this research can contribute to the development of more adaptive control methods.

This study evaluates the cost and time performance of the Jember Pulmonary Hospital construction project using Schedule Variance (SV) and Cost Variance (CV) analysis. This research seeks to contribute to the field of project management with a focus on CV and SV variance analysis. By using this approach, this research aims to provide practical and applicable solutions in overcoming cost and time problems in construction projects. The results of this research are expected to not only provide benefits for the Jember Lung Hospital Building construction project, but also for the construction industry in general in Indonesia.

METHODS

This research employs a quantitative approach with analytical descriptive methods to assess cost variance (CV) and schedule variance (SV) in the construction of the Jember Lung Hospital Building. The study focuses on evaluating the project's cost and time efficiency using actual data collected during implementation. A systematic data collection process is prioritized, utilizing both descriptive and analytical approaches to not only observe variances but also conduct an in-depth evaluation of the factors affecting project management efficiency. The insights gained aim to provide recommendations for future projects.

Data collection involved multiple methods, including interviews with key stakeholders such as project managers and supervisors, direct observations at the construction site, and document analysis of project reports. These methods ensure a comprehensive understanding of the project's progress, challenges, and the reasons behind cost and schedule deviations. The primary variables analyzed are CV and SV, which measure the differences between actual and planned costs and

schedules. By examining historical data, the research seeks to clarify the efficiency and effectiveness of cost and time management in the construction project.

The analysis process involves sorting and comparing collected data related to CV and SV, identifying significant deviations that may indicate project management issues. A triangulation method is used to validate data from interviews, observations, and documents, enhancing the reliability of the findings. The study aims to draw conclusions on project management effectiveness and generate practical recommendations for improving cost and time efficiency in similar future projects. By ensuring valid and reliable data, the research contributes valuable insights for effective project management practices.

RESULTS

Results

Schedule Variance (SV) Analysis

The analysis of time variance (Schedule Variance - SV) in the Jember Lung Hospital Building construction project shows significant dynamics during the implementation of the work. Based on the analyzed data, the SV value fluctuated throughout the project implementation. From week 17 to week 21, the SV value was consistently negative, reflecting the delay in work compared to the original plan. The peak of the delay occurred in week 20, with the SV value reaching -Rp 1,953,203,330.

This condition indicates that less work has been completed compared to the volume of work planned in the schedule. Up to week 23, the total cumulative delay of the project was recorded for 29 calendar days. The decrease in SV value was also accompanied by a Schedule Performance Index (SPI) that was below 1 in those weeks, indicating that the speed of work completion was below the standard set in the original schedule.

This result reflected the existence of operational constraints that affected the efficiency of work execution. Factors causing these delays were identified to include defects in the first phase that required repair before work on the second phase could proceed, as well as interdependencies between phases that created technical bottlenecks in the project workflow. Addressing these issues became a key focus in the project's mitigation strategy to ensure that the planned schedule could be achieved.

Cost Variance (CV) Analysis

The results of the cost variance (CV) analysis revealed that the project experienced significant cost inefficiencies during its implementation. By week 23, the CV value was negative at -Rp 1,210,456,230, indicating that the actual costs incurred were greater than the planned budget for the completed works. This inefficiency was also evident from the cost performance index (CPI) value which was consistently below 1, indicating that the project was not running efficiently in terms of cost expenditure. Further analysis showed that the main causes of these inefficiencies were changes in project specifications, material price increases, and additional labor requirements that were not anticipated in the initial planning.

In addition, additional costs were also incurred due to the need for repairs to the first phase of works which impacted the need for additional resources to accelerate the completion of works in the second phase. The total estimated project completion cost (Estimate at Completion - EAC) was projected to reach RP. 80,722,862,343.01, which exceeded the initial project budget. This finding indicates weaknesses in the initial planning process, especially in risk calculation and budget allocation. Therefore, significant corrective measures are required to ensure that the project remains

within the established budget limit, albeit with necessary adjustments to complete the work on schedule.

Table 1. Calculation of Time Variance (SV) Value for Each Week

WEEK	BCWP	BCWS	SV	Information
1	RP. 6.627.810,00	RP. 7.532.931,47	-RP. 905.121,47	Late
2	RP. 27.231.075,00	RP. 28.080.734,78	-RP. 849.659,78	Late
3	RP. 39.321.195,00	RP. 48.628.538,10	-RP. 9.307.343,10	Late
4	RP. 69.037.449,00	RP. 116.240.887,91	-RP. 47.203.438,91	Late
5	RP. 188.037.631,34	RP. 175.605.866,84	RP. 12.431.764,49	On time
6	RP. 693.980.344,85	RP. 666.139.335,04	RP. 27.841.009,80	On time
7	RP. 1,594,117,990.22	RP. 1,350,111,284.40	RP. 244,006,705.82	On time
8	RP. 3,582,781,148.35	RP. 2,054,815,593.35	RP. 1,527,965,555.00	On time
9	RP. 4,505,830,605.24	RP. 2,942,722,925.51	RP. 1,563,107,679.73	On time
10	RP. 5,894,354,180.63	RP. 4,328,815,770.69	RP. 1,565,538,409.94	On time
11	RP. 8,649,413,315.44	Rp 5,714,908,615.86	RP. 2,934,504,699.58	On time
12	RP. 12,175,221,449.16	RP. 7,165,326,581.51	RP. 5,009,894,867.64	On time
13	RP. 15,729,791,231.16	RP. 8,802,440,569.08	RP. 6,927,350,662.08	On time
14	RP. 18,868,706,124.18	RP. 10,497,545,951.64	RP. 8,371,160,172.54	On time
15	RP. 22,529,753,277.14	RP. 12,475,507,127.58	RP. 10,054,246,149.56	On time
16	RP. 22,792,398,359.95	RP. 14,476,992,583.54	RP. 8,315,405,776.41	On time
17	RP. 24,265,016,395.42	RP. 25,035,886,568.45	-RP. 770,870,173.03	Late
18	RP. 26,452,692,508.28	RP. 27,515,494,163.47	-RP. 1,062,801,655.18	Late
19	RP. 29,236,249,012.10	RP. 30,660,793,856.74	-RP. 1,424,544,844.64	Late
20	RP. 31,859,446,035.40	RP. 34,126,404,164.46	-RP. 2,266,958,129.07	Late
21	RP. 33,772,760,604.63	RP. 38,906,243,491.87	-RP. 5,133,482,887.23	Late
22	RP. 38,111,133,716.89	RP. 44,032,379,241.34	-RP. 5,921,245,524.45	Late
23	RP. 43,005,225,317.17	RP. 49,193,731,108.37	-Rp 6,188,505,791.20	Late

Source: Researcher's Analysis Data, 2024

Table 2. Calculation of Cost Variance (CV) Value for Each Week

11	RP. 8,649,413,315.44	RP. 8,927,370,482.11	-RP. 277.957.166,67	Waste
12	RP. 12,175,221,449.16	RP. 12,478,447,449.16	-RP. 303.226.000,00	Waste
13	RP. 15,729,791,231.16	RP. 16,058,286,064.49	-RP. 328.494.833,33	Waste
14	RP. 18,868,706,124.18	Rp 19,222,469,790.85	-RP. 353.763.666,67	Waste
15	RP. 22,529,753,277.14	RP. 22,908,785,777.14	-RP. 379.032.500,00	Waste
16	RP. 22,792,398,359.95	Rp 23,196,699,693.28	-RP. 404.301.333,33	Waste
17	RP. 24,265,016,395.42	RP. 24,694,586,562.08	-RP. 429.570.166,67	Waste
18	RP. 26,452,692,508.28	RP. 26,907,531,508.28	-RP. 454.839.000,00	Waste
19	RP. 29,236,249,012.10	RP. 29,716,356,845.43	-RP. 480.107.833,33	Waste
20	RP. 31,859,446,035.40	RP. 32,364,822,702.06	-RP. 505.376.666,67	Waste
21	RP. 33,772,760,604.63	RP. 34,303,406,104.63	-RP. 530.645.500,00	Waste
22	RP. 38,111,133,716.89	RP. 38,667,048,050.22	-RP. 555.914.333,33	Waste
23	RP. 43,005,225,317.17	RP. 43,586,408,483.83	-RP. 581.183.166,67	Waste

Source: Researcher's Analysis Data, 2024

Table 3. Schedule Performance Index (SPI) Calculation for Each Week

WEEK	BCWP	BCWS	SPI
1	RP. 6.627.810,00	RP. 7.532.931,47	0,88
2	RP. 27.231.075,00	RP. 28.080.734,78	0,97
3	RP. 39.321.195,00	RP. 48.628.538,10	0,81
4	RP. 69.037.449,00	RP. 116.240.887,91	0,59
5	RP. 188.037.631,34	RP. 175.605.866,84	1,07
6	RP. 693.980.344,85	RP. 666.139.335,04	1,04
7	RP. 1,594,117,990.22	RP. 1,350,111,284.40	1,18
8	RP. 3,582,781,148.35	RP. 2,054,815,593.35	1,74
9	RP. 4,505,830,605.24	RP. 2,942,722,925.51	1,53
10	RP. 5,894,354,180.63	RP. 4,328,815,770.69	1,36
11	RP. 8,649,413,315.44	RP. 5,714,908,615.86	1,51
12	RP. 12,175,221,449.16	RP. 7,165,326,581.51	1,70
13	RP. 15,729,791,231.16	RP. 8,802,440,569.08	1,79
14	RP. 18,868,706,124.18	RP. 10,497,545,951.64	1,80
15	RP. 22,529,753,277.14	RP. 12,475,507,127.58	1,81
16	RP. 22,792,398,359.95	RP. 14,476,992,583.54	1,57
17	RP. 24,265,016,395.42	RP. 25,035,886,568.45	0,97
18	RP. 26,452,692,508.28	RP. 27,515,494,163.47	0,96
19	RP. 29,236,249,012.10	RP. 30,660,793,856.74	0,95
20	RP. 31,859,446,035.40	RP. 34,126,404,164.46	0,93
21	RP. 33,772,760,604.63	RP. 38,906,243,491.87	0,87
22	RP. 38,111,133,716.89	RP. 44,032,379,241.34	0,87
23	RP. 43,005,225,317.17	RP. 49,193,731,108.37	0,87

Source: Researcher's Analysis Data, 2024

Discussion

Schedule variance (SV) and cost variance (CV) analysis are important indicators in evaluating the performance of construction projects (Hasan et al., 2021; Konior & Szóstak, 2021; Mayo-Alvarez et al., 2022; Przywara & Rak, 2021; Salih & El-adaway, 2024), such as the construction of the Jember Lung Hospital Building. In this project, a negative SV value indicates a significant delay in the completion of the work compared to the planned schedule. The cumulative delay of up to 29 calendar days is evidence of operational and technical constraints affecting the project workflow. One of the main factors causing this delay was the defects in the first phase of works, which had to be repaired before the second phase started. This interdependence between phases created technical obstacles that were not well anticipated in the initial planning.

To overcome this delay, the project team implemented a crashing strategy by adding labor to critical activities. Although this measure successfully reduced the completion time, its impact on project costs was significant. This is reflected in the negative CV value, which indicates that the actual cost exceeded the plan budget for the completed work. This cost overrun was largely due to increases in material prices, changes in project specifications, and the need for additional labor. These factors indicate weaknesses in the initial planning process, especially in risk calculation and budget allocation.

In project management, SV and CV not only provide an overview of time and cost performance, but also form the basis for more strategic decision-making. On this project, SPI and CPI values consistently below 1 indicate low implementation efficiency. To improve efficiency, a

thorough evaluation of the project planning and execution process is necessary. For example, the use of more sophisticated project management software can assist in monitoring progress in real-time, so that deviations from the plan can be immediately detected and addressed.

In addition, the importance of communication and coordination between project teams is also key in overcoming the challenges faced. Specification changes or schedule adjustments must be effectively communicated to all parties involved to ensure that any corrective measures can be implemented efficiently. In this project, a more collaborative approach can help mitigate the negative impact of sudden changes and ensure that resources are optimally utilized.

Further analysis of the SV and CV values also shows the need for strengthening in risk management. Risks such as work breakdowns, material procurement delays, or labor shortages should be identified and mitigated early on. In the context of this project, the addition of time and cost buffers in early planning can help reduce the impact of unforeseen risks. In addition, involving experts in risk planning can provide a more comprehensive insight into potential problems that may arise during project implementation.

From a broader perspective, the experience from this project provides important lessons for the management of other construction projects. Better integration between planning, execution, and supervision can help reduce deviations from schedule and budget. For example, a data-driven approach that uses historical and predictive analysis can help in identifying recurring patterns of problems and provide more proactive solutions. As such, future projects can be better prepared for operational and technical challenges, while improving efficiency and sustainability.

In the long run, the implementation of a more structured and technology-based project management system can provide significant benefits. These systems not only allow for tighter oversight of time and cost performance, but also encourage transparency in decision-making. In the Jember Lung Hospital Building construction project, the use of technology such as Building Information Modeling (BIM) can assist in more accurate visualization and planning, so that problems such as delays and cost overruns can be minimized.

Overall, the analysis of time and cost variances in this project highlights the importance of more integrated and adaptive management. Delays and cost overruns are not only the result of weaknesses in planning, but also a lack of ability to respond to changes quickly and effectively. Therefore, investment in project manager training, development of more sophisticated management tools, and improved communication between teams can be effective measures to improve project performance in the future.

CONCLUSION

The construction project for the Jember Lung Hospital faced significant challenges, evidenced by a cumulative delay of 29 days and substantial cost overruns, as indicated by negative Schedule Variance (SV) and Cost Variance (CV) values. Key factors contributing to these issues included early-stage work defects, rising material prices, and unexpected labor requirements, with performance indices consistently below 1 highlighting inefficiencies. To enhance future project outcomes, it is crucial to strengthen early planning through comprehensive risk analysis, utilize technologies like Building Information Modeling (BIM) for improved accuracy in project visualization, and implement tighter monitoring of time and costs using advanced project management software. Additionally, fostering better coordination and communication among stakeholders, along with training project managers for effective decision-making, is essential. Future research should focus on developing a comprehensive risk management framework and

examining the integration of advanced technologies and communication strategies to mitigate delays and improve project performance.

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