Vol. 4, No. 12, December 2025
E-ISSN: 2723 – 6692
P-ISSN:2723– 6595
http://jiss.publikasiindonesia.id/

Analysis of Project Delay in the Development of the Green Open Space at Kediri City Square Using the Earned Value Method

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KEYWORDS
Earned value method; Cost performance; Project delay; Schedule performance

ABSTRACT
This study adopts a quantitative case study approach using the Earned Value Method (EVM) to assess project cost and schedule performance, complemented by a Time–Cost Trade Off (Crashing Analysis) to formulate acceleration strategies that restore the project to its planned timeline. Primary data were collected through field observations and interviews, while secondary data were obtained from weekly and monthly reports, the project time schedule, and the Project Budget Plan (RAB). The analysis indicates that the project experienced delays, reflected by the condition BCWP < BCWS, which signifies a schedule deviation. However, the project remains cost-efficient because ACWP < BCWP, indicating that actual spending is lower than the value of work completed. This condition is supported by a cost performance index (CPI) > 1, which signifies cost efficiency, while a schedule performance index (SPI) < 1 indicates schedule delays. The estimated cost at completion (EAC), amounting to Rp 13,125,412,382.00, shows that the project is expected to finish below the original budget of Rp 17,968,594,000.00, whereas the time estimate (TE) shows a potential delay of 11.82 weeks beyond the contract duration. Through crashing analysis, adding 5 hours of overtime per day can reduce the remaining critical path duration from 11.82 weeks to 6 weeks with an additional cost of Rp 143,390,625.00, equivalent to approximately 4.3% of the total crash cost.

INTRODUCTION

The increasing urban population over time exacerbates pressure on urban space utilization. Green Open Space (*Ruang Terbuka Hijau*, RTH) requires particular attention as one such area. Green open spaces, such as city parks, serve ecological, economic, and planning functions. Well-maintained city parks can educate the public on history while providing areas for exercise and recreation (Febriarto, 2019). City parks are currently undergoing reconstruction to enhance their appeal as tourist attractions, such as the Green Open Space development at Kediri City Square.

Project management involves a series of processes to achieve objectives and ensure timely completion. Therefore, project scheduling must account for cost and quality to avoid delays. Delays in project completion—which require additional time for all or part of a construction project—remain a persistent issue in both developing and developed countries (Sesmiwati, 2017). Such delays are closely linked to cost and time overruns: the longer the delay, the greater the costs. Thus, effective project management plays a crucial role in minimizing failure (Telaumbanua, 2017).

Implementing a construction project demands effective management in planning, execution, and control (Alotaibi et al., 2025; Alzoubi, 2022; Messner, 2023; Shayan et al., 2022; Sima, 2022; Zarzycki, 2024). Project delays often stem from inadequate planning and control, compounded by factors such as financial constraints, material shortages, equipment problems, labor issues, and unfavorable environments (Sandriawan et al., 2021). These obstacles have serious consequences for project management. For instance, delayed completion times can inflate expenses far beyond the budget, erode customer trust through complaints, and even lead to contractor failure or closure (Banjarnahor, 2018).

Project control frequently encounters issues that cause schedule delays and costs exceeding the contract value. In the case of the Kediri City Square Green Open Space construction—with a contract value of Rp17,968,594,000 and a planned duration of 31 weeks—a 14.366% work delay occurred starting in the 10th week. This stemmed from the contractor's agreement that the MC-0 (Mutual Check-0) work volume matched the volume and S-curve of the work schedule, equalized with the tender bid. Similar delays affected the Kediri City Square project overall. Such delays arise when implementation deviates from the plan, causing losses for providers or users. Extended timelines lead to cost overruns, diminished contractor credibility, and potential disputes.

Thus, project control is essential in the Kediri City Square construction to align progress with expectations. The method employed is Earned Value. Earned Value is a methodology for measuring and reporting project progress using key variables of time, cost, and work. Efforts to enhance monitoring and control can leverage Earned Value Analysis to predict future outcomes. This research primarily applies Earned Value Analysis to assess construction performance, calculate costs within budget, and determine delays or accelerations needed for on-time completion without extensions.

Based on the preceding explanation, the research aims to analyze causes of delays in the Kediri City Square Green Open Space development using the Earned Value Method (EVM). This study evaluates project performance in cost and schedule, identifies delay factors, and proposes strategies to improve management practices. Benefits include demonstrating EVM's role in assessing delays, providing insights for resource allocation, and strengthening planning and execution. The findings should promote efficient public infrastructure management—ensuring on-time, on-budget completion with quality standards—and serve as a reference for local governments and contractors to minimize delays and optimize outcomes.

METHOD

This research examined the Kediri City Square Green Open Space (*Ruang Terbuka Hijau*, RTH) development project on Jl. Panglima Sudirman, Kampung Dalem Village, Kota District, Kediri City, East Java. As a main public space and city icon in downtown Kediri, the site held strategic value for recreation. The project was selected due to implementation delays, making it suitable for analysis using the Earned Value Method (EVM) to assess time and cost performance.

The research proceeded through preparation, implementation, and reporting stages. Preparation involved problem identification, literature review, title determination, and proposal development. Implementation included data collection and analysis. Reporting coincided with analysis to present results and conclusions.

Data collection drew from primary and secondary sources (Sugiyono, 2020). Primary data comprised interviews with project implementers, supervising consultants, the Commitment Making Officer (PPK), technical team, and other involved parties, plus direct observations and measurements at the site. Secondary data included project photos, time schedules with work items/volumes/S-curves, weekly progress reports, Cost Budget Plan (RAB), and actual costs.

Data processing distinguished primary data, analyzed qualitatively through interview transcription, thematic coding (e.g., managerial, technical, administrative, external factors), and tabulation of factor frequencies, from secondary data, analyzed quantitatively via EVM. This yielded Planned Value (PV/BCWS), Earned Value (EV/BCWP), Actual Cost (AC/ACWP), variances, performance indices, and projections. Qualitative findings complemented EVM results; for instance, a Schedule Performance Index (SPI) <1 indicated delays explained by interviews (e.g., material procurement issues). Interviews used a Google Form questionnaire covering respondent identity, delay factors, constraints, and mitigation efforts. Secondary data sourced from project documents like RAB, schedules, S-curves, progress reports, and cost records.

Project acceleration employed time-cost trade-off (crashing) analysis to identify efficient strategies balancing added costs and reduced duration without quality loss (Kerzner, 2017).

Data analysis integrated quantitative EVM with qualitative interview data to evaluate cost/time performance, predict future costs/duration, identify delay causes, and recommend acceleration measures for contractual completion.

RESULTS AND DISCUSSIONS

Variance Analysis

In the Kediri City Square Green Open Space Development project, deviations became increasingly apparent as the 25th week approached. The BCWP was unable to catch up with the BCWS, indicating that progress was lagging far behind the plan, while the ACWP continued to increase, indicating a growing financial burden even though the physical results were not on target.

Schedule Variance (SV)

One of the main indicators in Earned Value Management (EVM) for assessing project time performance is Schedule Variance (SV), which is the difference between the work actually completed (BCWP) and the work that should have been accomplished according to plan (BCWS). This indicator indicates whether the project is running ahead of schedule, on schedule, or running behind schedule (Fleming & Koppelman, 2016).

In this study, SV was calculated weekly using cumulative BCWP and BCWS data up to week 25, the last period before the contract was terminated. SV analysis is essential for measuring delay levels and identifying factors causing schedule deviations.

The Schedule Variance (SV) calculations, the project's SV trend has been predominantly negative since the beginning of implementation. This indicates that work progress has consistently lagged behind schedule. Only in the third week did the SV briefly become positive, indicating progress exceeding the planned target. However, the SV subsequently returned to negative territory and continued to increase until the 25th week, indicating increasingly significant delays.

Thus, the SV development pattern illustrates that the delay problem has occurred since the early phase of the project and has never been successfully corrected, which ultimately resulted in the termination of the contract.

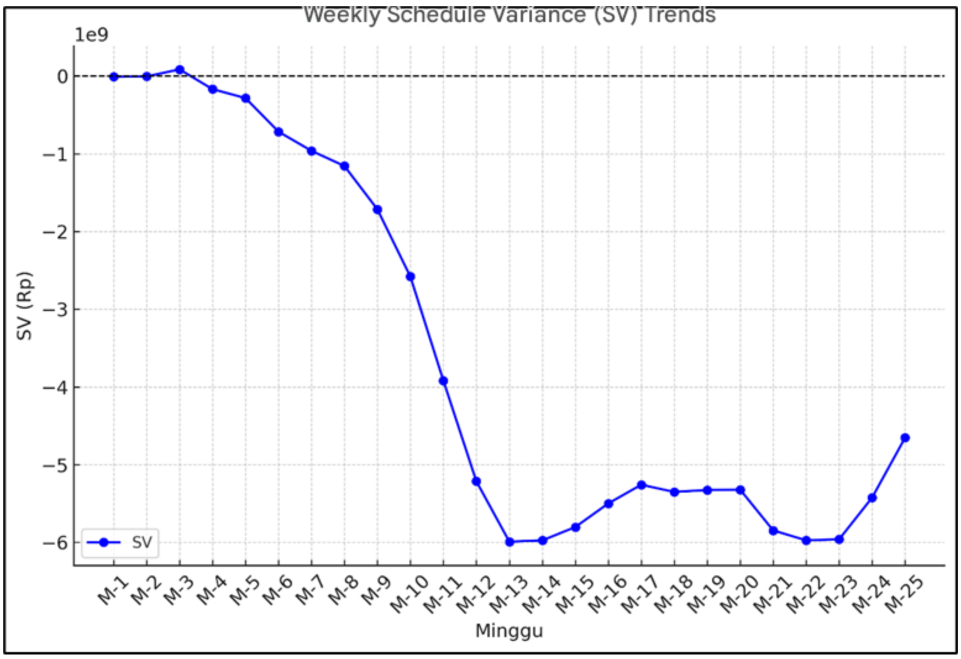

Figure 1. Weekly Schedule Variance (SV) Trends
Source :Hasil olahan Penulis

In Schedule Variance (SV) values shows a significant decline, from near zero at the start of implementation to around –6 midway through the project. A steadily declining SV value indicates that work progress is increasingly lagging behind schedule (BCWP < BCWS). This sharp decline indicates that work that should have been completed in those weeks was not achieved on schedule, resulting in a larger time deviation.

Furthermore, the decision to align the MC-0 work volume with the tender bid S-curve resulted in the planned schedule being less realistic compared to actual field conditions. Consequently, from weeks 4 to 25, the project experienced a continuous backlog of work that could not be compensated for by progress in subsequent weeks. Managerially, the sharp decline in SV indicates that the project is experiencing cumulative delays that are increasingly difficult to recover from without expedited action.

Cost Variance (CV)

Cost Variance (CV) is an indicator that shows the difference between the value of work obtained (BCWP) and the actual costs incurred (ACWP). A positive CV value indicates efficiency because actual costs are lower than the value of work, while a negative CV indicates inefficiency due to expenditures being greater than the work achieved (Fleming & Koppelman, 2016; Kerzner, 2017).

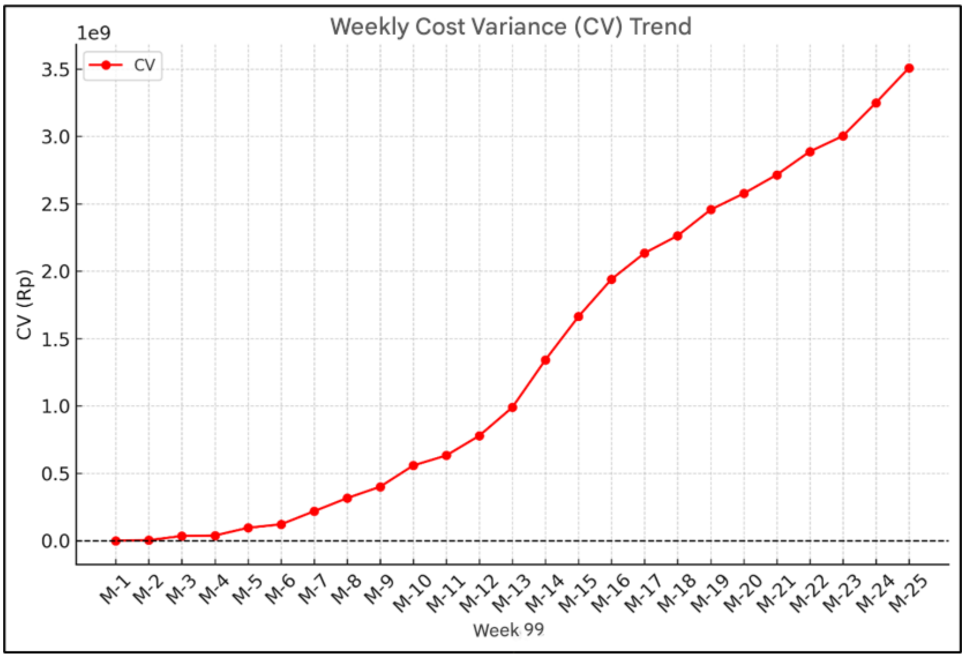

Figure 2. Weekly Cost Variance (SV) Trend
Source :Hasil olahan Penulis

Based on calculations up to week 25, the CV value tended to be positive throughout the observation period. This indicates that despite the project's schedule delays, cost utilization was relatively efficient because actual expenditures were still lower than the value of the work obtained. In other words, financially, the project was not wasteful, although time constraints remained. This stable CV trend in the positive range indicates a relatively controlled cost-sharing strategy. However, this cost efficiency does not necessarily guarantee overall project success, as achieving the time (schedule) is the most critical factor in the final contract award.

Schedule Performance Index (SPI) Analysis

The Schedule Performance Index (SPI) is one of the main indicators in Earned Value Management (EVM) used to measure the effectiveness of project time performance. The SPI value is obtained by comparing the value of work achieved with the planned cost of work for the same period (Fleming & Koppelman, 2016).

Table 1. Schedule Performance Index (SPI)

Week	Bcwp (Value Of Work Obtained) (Rp)	Bcws (Plan Cost) (Rp)	Schedule Performance Index $Spi = \frac{BCWP}{BCWS}$
M-1	Rp. 00.00	Rp9,585,710.00	0,000
M-2	Rp13,117,070.00	Rp18,666,120.00	0.703
M-3	Rp128,295,760.00	Rp42,756,830.00	3,001
M-4	Rp141,772,200.00	Rp310,725,270.00	0.456

Week	Bcwp (Value Of Work Obtained) (Rp)	Bcws (Plan Cost) (Rp)	Schedule Performance Index $Spi=\frac{BCWP}{BCWS}$
M-5	Rp353,442,240.00	Rp637,012,860.00	0.555
M-6	Rp448,136,730.00	Rp1,163,769,690.00	0.385
M-7	Rp807,688,300.00	Rp1,769,917,640.00	0.456
M-8	Rp1,168,677,350.00	Rp2,326,727,030.00	0.502
M-9	Rp1,482,409,000.00	Rp3,198,028,840.00	0.464
M-10	Rp2,063,872,700.00	Rp4,645,254,230.00	0.444
M-11	Rp2,340,589,050.00	Rp6,258,626,300.00	0.374
M-12	Rp2,883,060,900.00	Rp8,097,512,140.00	0.356
M-13	Rp3,662,718,200.00	Rp9,653,874,780.00	0.379
M-14	Rp4,967,238,120.00	Rp10,942,072,900.00	0.454
M-15	Rp6,156,040,300.00	Rp11,959,353,780.00	0.515
M-16	Rp7,183,304,820.00	Rp12,683,027,250.00	0.566
M-17	Rp7,900,251,720.00	Rp13,159,159,650.00	0.600
M-18	Rp8,376,778,830.00	Rp13,728,272,380.00	0.610
M-19	Rp9,091,928,870.00	Rp14,418,898,300.00	0.631
M-20	Rp9,536,471,890.00	Rp14,858,987,210.00	0.642
M-21	Rp10,050,373,680.00	Rp15,896,996,840.00	0.632
M-22	Rp10,688,438,450.00	Rp16,662,721,640.00	0.641
M-23	Rp11,115,911,300.00	Rp17,077,059,740.00	0.651
M-24	Rp12,028,895,560.00	Rp17,453,244,460.00	0.689
M-25	Rp12,988,059,110.00	Rp17,641,944,300.00	0.736

The Schedule Performance Index (SPI) describes a project's time performance, with a value of 1 indicating on-time performance, less than 1 indicating delay, and more than 1 indicating acceleration (Kerzner, 2017; Fleming & Koppelman, 2016). The results in Table 4.9 show that for most of the observation period, the SPI was below one, indicating the project was consistently behind schedule. Only in the third week did the SPI briefly exceed one, reflecting a temporary acceleration, but this did not persist. Overall, the low SPI value confirms that improvement efforts were not effective enough to offset the time deviations that had occurred since the beginning of implementation.

Cost Performance Index (CPI) Performance Index Analysis

The Cost Performance Index (CPI) is a key indicator in Earned Value Management (EVM) used to assess the efficiency of project cost utilization. The CPI value is obtained by comparing the value of the work produced with the actual costs incurred during the same period (Fleming & Koppelman, 2016).

Table 2. Cost Performance Index (CPI)

Week	Bcwp (Value Of Work Obtained) (Rp)	Acwp (Actual Cost) (Rp)	Cost Performance Index $Cpi=\frac{BCWP}{ACWP}$
M-1	Rp. 00.00	Rp. 00.00	0
M-2	Rp13,117,070.00	Rp9,573,640.00	1,370
M-3	Rp128,295,760.00	Rp93,638,070.00	1,370
M-4	Rp141,772,200.00	Rp103,474,010.00	1,370
M-5	Rp353,442,240.00	Rp257,963,720.00	1,370
M-6	Rp448,136,730.00	Rp327,077,540.00	1,370

Week	Bcwp (Value Of Work Obtained) (Rp)	Acwp (Actual Cost) (Rp)	Cost Performance Index $Cpi=\frac{BCWP}{ACWP}$
M-7	Rp807,688,300.00	Rp589,500,230.00	1,370
M-8	Rp1,168,677,350.00	Rp852,972,080.00	1,370
M-9	Rp1,482,409,000.00	Rp1,081,952,590.00	1,370
M-10	Rp2,063,872,700.00	Rp1,506,340,300.00	1,370
M-11	Rp2,340,589,050.00	Rp1,708,304,780.00	1,370
M-12	Rp2,883,060,900.00	Rp2,104,233,860.00	1,370
M-13	Rp3,662,718,200.00	Rp2,673,275,350.00	1,370
M-14	Rp4,967,238,120.00	Rp3,625,393,630.00	1,370
M-15	Rp6,156,040,300.00	Rp4,493,054,030.00	1,370
M-16	Rp7,183,304,820.00	Rp5,242,814,390.00	1,370
M-17	Rp7,900,251,720.00	Rp5,766,086,010.00	1,370
M-18	Rp8,376,778,830.00	Rp6,113,884,590.00	1,370
Week	**Bcwp (Value Of Work Obtained) (Rp)**	**Acwp (Actual Cost) (Rp)**	**Performance Index** $Cpi=\frac{BCWP}{ACWP}$
M-19	Rp9,091,928,870.00	Rp6,635,844,750.00	1,370
M-20	Rp9,536,471,890.00	Rp6,960,299,380.00	1,370
M-21	Rp10,050,373,680.00	Rp7,335,376,280.00	1,370
M-22	Rp10,688,438,450.00	Rp7,801,074,910.00	1,370
M-23	Rp11,115,911,300.00	Rp8,113,070,690.00	1,370
M-24	Rp12,028,895,560.00	Rp8,779,422,340.00	1,370
M-25	Rp12,988,059,110.00	Rp9,479,478,460.00	1,370

The cost performance index (CPI) is used to assess the extent to which spending efficiency is achieved in a project. In general, a CPI value of 1 indicates that actual costs are proportional to the value of the work obtained, a CPI > 1 indicates efficiency because the work achieved is higher than the costs incurred, while a CPI < 1 indicates waste due to spending exceeding the value of the work (Fleming & Koppelman, 2016; Kerzner, 2017). The analysis results in Table 4.10 show that the project's CPI value consistently remained at 1,370 from week 2 to week 25. This indicates that cost management was efficient, as the work obtained exceeded the actual costs incurred. However, despite sound financial control, the project still faced schedule delays, so cost efficiency was not fully matched by optimal time performance.

This section comprehensively discusses the analysis results obtained in the previous chapter, both from the aspects of cost performance, time performance, and the effectiveness of the implemented project acceleration strategy. The discussion is carried out by linking the results of the Earned Value Method (EVM) and Time–Cost Trade Off (Crashing Analysis) calculations with project management theory and actual conditions in the field. Through this approach, a comprehensive understanding is obtained regarding the level of efficiency of the Alun-Alun Kediri Green Open Space project implementation, the causes of delays that occurred, and alternative corrective actions that can be implemented to achieve project completion according to the contract schedule.

In addition, the synthesis at the end of this chapter aims to integrate the quantitative and qualitative findings, thus producing conceptual conclusions regarding the relationship between project performance, the effectiveness of acceleration strategies, and their implications for construction project control practices in local government environments.

Project Performance from Cost Side

Earned Value Method (EVM) analysis , the cost performance of the Kediri Square Green Open Space project showed a negative deviation from the budget plan. This is reflected in the Cost Performance Index (CPI) value which was below 1 (CPI < 1) in the 25th week, which means that every rupiah of costs incurred resulted in a physical progress value of less than one rupiah against the work plan (Planned Value).

This condition indicates a cost overrun, where the project's cost efficiency is not optimal. However, after a crash analysis, a new Estimate at Completion (EAC) was obtained of Rp3,487,311,609, an increase of approximately 4.31% compared to the total normal project cost of Rp3,343,921,984. This increase is still within a reasonable tolerance limit (<5%) and is considered economical because it can avoid delay fines (liquidated damages) whose value is much greater than the additional acceleration costs.

Conceptually, these results indicate that project cost efficiency can be maintained despite acceleration measures, as long as the implemented strategy is based on critical activities and oriented towards resource optimization (Kerzner, 2017; PMI, 2019). Thus, from a cost perspective, this project demonstrates good control potential after interventions based on EVM data and time–cost trade-off analysis .

Project Performance in Terms of Time

In terms of time, the EVM analysis results showed a significant delay in week 25, with a Schedule Performance Index (SPI) value of <1 and a Time Estimate (TE) of 35.3 weeks. This means the project is projected to be completed 4.53 weeks behind the contract schedule (31 weeks).

To overcome this, a time–cost trade-off analysis was conducted with a focus on activities on the critical path, namely A → B → J → K → O → P → Q. Based on the results of the remaining duration calculation, the total time still needed to complete the project is 11.82 weeks, while the remaining calendar time is only 6 weeks. By implementing an acceleration strategy in the form of 5 hours of overtime per day, the project completion duration can be returned on time to 31 weeks according to the contract schedule.

These results indicate that the implemented acceleration strategy successfully closed the time deviation by 5.82 weeks without incurring a significant cost increase. Methodologically, this approach aligns with the principles of time control based on actual performance data as recommended by PMI (2019) and Soeharto (1995).

Causes of Delays and Waste

Analysis of the results of interviews with project implementers and supervisors identified several main causes of delays, including: Labor limitations in the initial period of structural work, which hampered progress on foundation and reinforced concrete work. Delays in material supplies, particularly for wall and ceiling work, and architectural elements, are due to post-pandemic distribution chains. Coordination between subcontractors is not optimal, causing overlap and idle time on interior and utility work. Lack of effective working hours, due to restrictions on daily working hours without implementing an overtime system.

The combination of these factors causes accumulated delays on the critical path and reduces schedule efficiency . Based on project management theory (Kerzner, 2017; Ervianto, 2005), these causes fall into the categories of resource-related delay and management-induced delay, which can be improved by adding resources and strengthening the coordination system in the field.

Improvement and Acceleration Strategy

Based on the crash analysis and interviews with the implementation team, the most feasible acceleration strategy was to add five hours of overtime per day. Respondents stated that the overtime option was more effective than adding new workers because it required no adaptation time and could immediately increase daily output .

The implementation of 5 hours of overtime per day was proven to reduce the remaining duration of critical path activities from 11.82 weeks to 6 weeks, so that the project returned to schedule . From a cost perspective, the additional overtime cost of Rp143,390,625 (approximately 4.3% of the total crash cost) is still considered efficient.

In addition to overtime strategies, supporting actions identified through field interviews include: Rearranging the work sequence so that interior and finishing activities can be carried out in parallel (fast tracking). Addition of light aids to support intensive physical work Optimization of experienced workforce in activities with low productivity levels. More intensive field supervision to avoid delays due to coordination constraints. These strategies are consistent with the principles of fast tracking and crashing as explained by PMI (2019) and Soeharto (1995), namely accelerating implementation time by increasing productivity and utilizing resources more efficiently without sacrificing the quality of work.

Synthesis

The synthesis results of the overall analysis show that the integration of the Earned Value Management (EVM) and Crashing Analysis methods is able to provide a comprehensive picture of the project performance conditions as well as optimal solutions in restoring completion time. Quantitatively, this approach successfully reduced the time deviation from a projected delay of 35.3 weeks to an on-time result of 31 weeks with a relatively small additional cost (4.31%).

Qualitatively, this finding confirms that the effectiveness of project acceleration is highly dependent on resource control and work schedule management. The 5-hour overtime per day strategy is a realistic solution that aligns with technical recommendations in the field and the principles of efficient construction project management (Soeharto, 1995; Ervianto, 2005; Kerzner, 2017). Thus, the application of a combination of EVM and time–cost trade off not only helps in data -driven decision making , but also provides a basis for developing more adaptive time and cost management policies for future public infrastructure projects.

CONCLUSION

The analysis of the Alun-Alun Kota Kediri Green Open Space project using Earned Value Management (EVM) and time-cost trade-off (crashing) analysis revealed that the project lagged behind schedule (BCWP < BCWS; SPI = 0.83) but maintained cost efficiency (ACWP < BCWP; CPI = 1.37), with an Estimate at Completion (EAC) of IDR 13,125,412,382—yielding savings against the initial budget—yet projecting an 11.82-week delay under current performance. Crashing via overtime reduced this to 6 weeks at IDR 143,390,625 (4.3% of total crash costs), selected due to space constraints, successfully aligning completion without extensions. For future research, studies could explore hybrid EVM integrations with AI-driven predictive analytics or BIM for real-time delay mitigation in similar Indonesian public infrastructure projects.

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