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Analysis of Cost and Time Performance in the Drainage Channel Construction Project of Laju Lor Village, Tuban Regency, using the Earned Value Method

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ABSTRACT

The drainage construction project in Laju Lor Village, Tuban Regency, faced significant schedule deviations, with delays occurring at various stages. These deviations were attributed to challenges such as resource allocation issues, coordination inefficiencies, and unforeseen external factors. This research aims to assess the effectiveness of the Earned Value Method (EVM) in managing project performance, particularly in mitigating delays and cost overruns during the construction process. The research employs the Earned Value Method (EVM), which integrates time and cost indicators: Actual Cost of Work Performed (ACWP), Budgeted Cost of Work Performed (BCWP), and Budgeted Cost of Work Schedule (BCWS). Additionally, key performance indices such as the Cost Productivity Index (CPI), Schedule Performance Index (SPI), Estimated Cost at Completion (EAC), and Estimated Time for Completion (ETC) were calculated to evaluate the project's performance. The findings reveal that the project's estimated cost at completion (EAC) was Rp1,040,304,209.89, providing a cost-saving of Rp20,726,358.11 compared to the initial budget of Rp1,061,030,568. However, the project experienced an extended completion time, reaching 81 days, exceeding the original schedule by 21 days. The research demonstrates that the Earned Value Method is an effective tool for identifying project performance issues and guiding corrective actions. The results emphasize the importance of efficient resource management, proactive scheduling adjustments, and stringent supervision to minimize delays and cost overruns. The findings offer valuable recommendations for future infrastructure projects, particularly in rural areas, where similar challenges may arise.

Keywords: Cost Productivity Index, EAC, ETC, Time Productivity Index.

INTRODUCTION

Development cannot be separated from the state of a country, Indonesia, especially to get to a developed country, must strive to improve the standard of living of the people and the economy (Patta Rapanna & Zulfikry Sukarno SE, 2017). So that it is necessary to support adequate and feasible infrastructure for community mobility in carrying out economic activities. Equitable development must be carried out to support the chain of economic activities from upstream to downstream without being hampered by the conditions and access of a particular region. A lot

of progress must be made, with the existence of backwardness it is hoped that it can catch up with development in various sectors that can be felt in the form of physical development including buildings, bridges, toll roads, large or small industries, telecommunications networks, transportation networks and airports (Sugiyanto & Untoko, 2022).

function optimally, it is necessary to have an integrated drainage system approach with The rapid population growth in Indonesia has not been able to provide adequate urban infrastructure and utilities. Drainage problems are a widespread concern. As we need to know, the issue of flooding and inundation in Indonesia has become a national issue that has an impact on the community. As a result, the drainage management system in various cities in Indonesia is incomplete, so the problem is not fully resolved. Drainage management systems must be carried out as a whole, supported by community involvement, institutions and funding. Raising awareness in sustainable efforts must be done seriously from both the community and the implementer's side in order to run as effectively as possible (Namara & Suprianto, 2023).

Drainage is an important infrastructure in rural areas, especially those that are prone to overflow due to their geography (Safitri et al., 2024). Drainage serves to drain surface water into rivers or artificial infiltration structures. A poorly designed drainage system can trigger various problems, such as environmental damage, economic decline, declining housing quality, the emergence of puddles, flooding, and damage to public facilities and infrastructure. These impacts can disrupt community activities, hamper mobility, slow down the economy, and increase the risk of spreading various diseases. To restore the drainage a water system that involves various disciplines (Hambali, 2015).

The existence of qualification levels in construction companies does not mean that all contractors carry out a structured management system in accordance with the work plan which includes quality costs and time taken (Hardi et al., 2024). For example, in companies with small sub-qualifications with a lack of qualified human resources and regulations that are not too strict in making policies, the company will run improvisedly without any good management system control. One of them is human resource management and costs are important factors in supporting the management system in the company. When one of these two aspects is not maximized, even both, it will affect the development of the construction company. The performance of a company consisting of aspects of risk management control and finance is a parameter for long-term investment as a characteristic of a growing company (Milyardi, 2020).

Construction management is an element contained in the management of a project so that project scheduling planning and control achieve goals without any deviations (Tjendani et al., 2018). The effective implementation of construction projects requires organization in a good cost and control system. Management must be able to compare the performance of a program against the cost and time budget plan. The resource support system must be planned and controlled as effectively and efficiently as possible which includes labor, equipment, methods, materials and money (Putra et al., 2020).

In a project, there will always be various problems both from external and internal factors, so it is very rare to get a project that is as planned. Findings that often occur during the progress of a project are delays in both time and work progress. Due to the lack of a control system, costs that are outside of planning will arise and can experience losses. To avoid losses during work activities can still be controlled, namely by using the Earned Value concept method (Borges & Asa, 2023).

Each project has a schedule plan and budget plan that is made before the project work begins with the aim that the project is carried out in accordance with the time and cost that has been planned and determined (Kharina & Sambowo, 2019). Time and cost have a relationship with each other, which means that every additional time made when there is a delay, the costs incurred in the implementation of the project will increase. Fluctuations in building construction financing cannot be separated from the influence of the economic situation which may be in the form of cost overruns as a result of delays in the implementation time of activities due to delays. Utilization of project implementation time if not managed properly according to the plan can result in further activities being hampered as well, so that it cannot be completed on time according to the planned schedule (Megawati, 2021).

The construction of objects that are classified as vital, in its realization requires a large enough budget so that it requires maximum control in order to carry out project activities. Another problem that often arises is that when the implementation time is done at the end of the year it often coincides with the rainy season so that maximum control is needed so that there is no delay in time and cost overruns.

Based on the above background, the purpose of this research is to analyze the effect of time and cost management in a drainage construction project in Laju Lor Village, Tuban Regency, using the Earned Value Management (EVM) method, and to evaluate the effectiveness of project performance control in reducing delays and cost overruns. So that the benefit of this research is to provide more in-depth insights into the application of the EVM method in managing construction projects, as well as providing strategic recommendations for contractors and project managers to increase project efficiency and effectiveness, reduce delays, and optimize resource management. This research is also expected to contribute to better infrastructure development efforts, especially in improving the quality of drainage systems in areas that need special attention.

RESEARCH METHOD

This research focuses on the construction of a drainage channel in Laju Lor Village, Singgahan Sub-district, Tuban Regency. The project site is located in the Singgahan Sub-district area. The research was conducted to analyze the drainage system in the area. Laju Lor village became the main research area in this research. This research employs a descriptive quantitative

research design to assess the time and cost performance of the drainage channel construction project in Laju Lor Village, Tuban Regency.

Data Collection Methods

Procedures in data collection must be accurate so that data completeness is prioritized. The type of data used is secondary data. Secondary data is obtained from contractors in the form of project documents to serve as research sources. Secondary data used include time schedule and weekly reports.

Data Analysis Technique

In this research process, it is organized in stages with the following sequence:

1. The initial stage begins with collecting theoretical references or literature studies that include construction management, scheduling techniques, implementation cost budget analysis, and earned value method.
2. The data collection stage includes searching for data such as the Cost Budget Plan (RAB), time schedule, weekly and monthly reports, and recapitulation of cost calculations.
3. The data processing stage is carried out by calculating BCWS, BCWP, and ACWP. ACWP is obtained from the project's financial accounting report, while BCWS is calculated based on the work weight against the Cost Budget Plan (RAB). Meanwhile, BCWP is calculated by comparing the actual work weight to the total contract value.
4. Time-based calculations are SPI, ECD and cost-based calculations are CPI, ETC and EAC. SPI is calculated from the ratio of BCWP to BCWS. ECD is calculated from the remaining work time divided by SPI and multiplied by the time traveled. CPI is calculated from the ratio of BCWP to ACWP. ETC is calculated from the difference in budget funds (RAB) with BCWP divided by CPI. EAC is calculated from the sum of ACWP and ETC.

RESULT AND DISCUSSION

BCWS Calculation Analysis

BCWS is the budgeted cost of work whose budget has been determined which is scheduled in a certain period (Pratama et al., 2025). To get the BCWS value, the first thing to do is to look at the S curve (Time Schedule) of the project first. In the S curve there will be a percentage plan, if the total cost budget plan for a job is multiplied by the percentage plan, the BCWS value will be obtained. The BCWS calculation in this research is expressed as follows.

Table 2. BCWS calculation

Sunday	Cumulative Plan	Budget	BCWS
1	0,38%	IDR 1,061,030,568	IDR 4,031,916
2	5,58%	IDR 1,061,030,568	IDR 59,205,506
3	6,52%	IDR 1,061,030,568	IDR 69,179,193
4	10,82%	IDR 1,061,030,568	IDR 114,803,507
5	16,36%	IDR 1,061,030,568	IDR 173,584,601

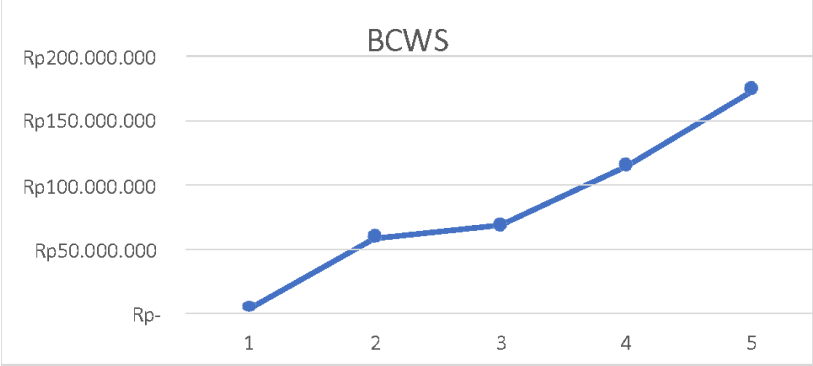

Figure 1. BCWS graph

Based on the table and figure, it is shown that the BCWS value increases over time from the first week to the fifth week. It peaks with a value of IDR 173,584,601.

BCWP Calculation Analysis

BCWP is the budgeted cost of work that has been completed in a certain period of time. To get the BCWP value, the first step is to look at the weekly progress of the project (Konior & Szóstak, 2021). There will be progress in the actual percentage field. BCWP can be calculated by multiplying the percentage of realization progrees in the field by the amount of the planned cost budget on a worker (BAC).

Table 3. BCWP Calculation

Sunday	Plan Cumulative		Budget	BCWP
1	0,00%	Rp	1.061.030.568	Rp...
2	1,11%	Rp	1.061.030.568	IDR 11,777,439.30
3	14,77%	Rp	1.061.030.568	IDR 156,714,214.89
4	14,84%	Rp	1.061.030.568	IDR 57,456,936.29
5	9,35%	Rp	1.061.030.568	IDR 99,206,358.11

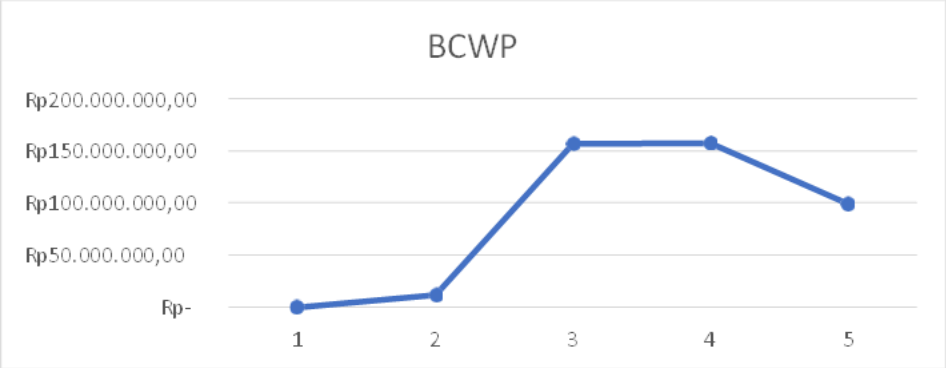

Figure 2. BCWP graph

From the table and figure, it can be seen that the BCWS value fluctuates from the first week to the fifth week, with a peak of Rp156,714,214.89.

ACWP Calculation Analysis

ACWP is the actual cost incurred for work that has been completed within a certain period of time. The ACWP calculation includes direct costs and indirect costs associated with the project.

Table 4. ACWP Calculation

Sunday	ACWP	
1	Rp	-
2	Rp	9.990.000
3	Rp	105.880.000
4	Rp	107.530.000
5	Rp	78.480.000

The highest ACWP value was recorded in week 4 with a total of Rp. 107,530,000. Calculation of material costs, materials, workers' wages, and indirect costs can be obtained through the contractor's finance department.

Calculation of Cost Performance Index and Schedule Performance Index

Schedule Performance Index is a performance efficiency factor in completing work by comparing the value of work that has been physically completed BCWP with the planned cost expenditure based on the work plan (BCWS) (Oktrianto & Susetyo, 2020). Meanwhile, the Cost Performance Index is a cost efficiency factor that is incurred by comparing the value of work that has been physically completed (BCWP) with the costs that have been incurred in the same period (ACWP) (Susilowati & Kurniaji, 2020).

Table 5. SPI and CPI comparison table

Sunday	SPI	CPI
1	0	0
2	0,198924731	1,178922853
3	2,265337423	1,480111588
4	1,371534196	1,464307043
5	0,571515892	1,264097326

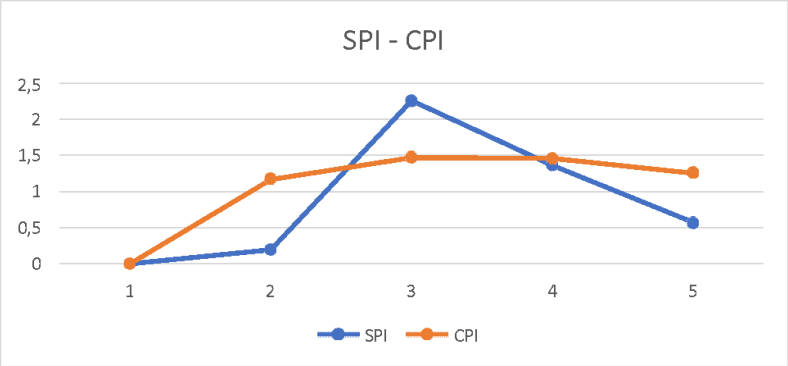

Figure 3. SPI and CPI Comparison Chart

Through the analysis in the table and graph, it can be concluded that seen from the performance index value, if the CPI value> 1, it means that the expenditure on the project is less than budgeted. Conversely, CPI < 1 means that expenditures are greater than budgeted. Then, the SPI value < 1 means that the project implementation time is slower than the plan schedule, while the SPI value > 1 means that the project implementation time is faster than the plan schedule.

Calculation of Time and Project Cost Estimates

Cost and schedule estimates can provide an early warning for future progress. Then the estimated remaining time can be calculated using the formula:

ETS = (Time remaining)/SPI

ETS = (60-32) / 0,57

ETS = 28 / 0,57

= 49 Days

Meanwhile, the estimated time for completion of work can be calculated using the formula:

EAS = Finish Time+ ETS

= 32+ 49

= 81

In the above calculation, it is obtained that the processing time requires an additional 21 days from the planned schedule of 60 days, the anticipation that can be done is to speed up the delivery of uditch by providing complete installation equipment to fit the schedule.

Calculation of Final Project Cost Estimate

At the end of the review carried out, namely in week 5, to find out the estimated final cost of the project with the remaining time, it can be calculated using the following formula:

ETC = BAC - BCWP

ETC = Rp. 1,061,030,568 - Rp. 99,206,358.11 ETC= Rp. 961,824,209.89

EAC = ACWP+ ETC

EAC = Rp. 78,480,000+ Rp. 961,824,209.89 EAC = Rp. 1,040,304,209.89

From the above calculation, the final cost value is less than the contract cost.

Discussion

The findings of this research highlight the challenges faced during the construction of the drainage channel project in Laju Lor Village, Tuban Regency, particularly regarding schedule deviations and cost efficiency. The results indicate that while cost management was effectively maintained within budget, significant delays occurred, extending the project timeline by 21 days beyond the planned 60-day schedule. These delays underscore the critical need for improved planning and proactive management strategies to address potential risks during project execution.

The Earned Value Method (EVM) proved to be an effective tool for integrating time and cost analysis. Indicators such as ACWP, BCWP, and BCWS provided a clear understanding of

project progress relative to the budgeted schedule. The positive Cost Productivity Index (CPI) values reflect that actual expenditures were consistently below the planned budget, indicating efficient cost control measures. This was achieved through careful resource allocation, minimized material wastage, and stringent financial oversight.

Conversely, the negative Schedule Productivity Index (SPI) values reveal that project execution lagged behind the planned timeline. Factors contributing to these delays likely include inadequate labor management, unforeseen weather conditions, and potential miscoordination between project stakeholders. These findings emphasize the need for real-time performance monitoring, enhanced workforce planning, and contingency measures to address unexpected challenges.

The estimated cost at completion (EAC) of Rp1,040,304,209.89 demonstrates cost efficiency, achieving savings of Rp20,726,358.11 compared to the initial budget. However, the extended timeline highlights the importance of balancing cost-saving efforts with timely project completion. Integrating additional management tools, such as resource leveling and schedule optimization, could help improve project adherence to timelines in future implementations.

This research underscores the importance of continuous supervision and detailed project evaluations in ensuring infrastructure projects meet both budgetary and scheduling goals. For rural projects like the Laju Lor Village drainage channel, effective project management strategies are particularly crucial, given the limited resources and potential external challenges.

The findings of this research align with previous research on the importance of performance monitoring tools like the Earned Value Method (EVM) for improving project outcomes. Studies by (Tjendani et al., 2018) and (Vanhoucke & de Koning, 2016) have highlighted that effective project management requires constant monitoring of time and cost performance, which is consistent with the positive results seen in this research's Cost Performance Index (CPI). The under-budget results observed in this project mirror findings from (Hardi et al., 2024), who emphasized that good resource management and strict financial control are crucial for minimizing project costs. However, delays in project timelines are a recurring issue, as noted by (Megawati, 2021), who identified that unforeseen factors such as weather conditions and workforce management issues are common contributors to schedule deviations. This research reinforces the necessity of integrating real-time project tracking systems and risk management strategies, as suggested by (Namara & Suprianto, 2023), to ensure timely completion. Future research should focus on enhancing scheduling methods, incorporating tools like Building Information Modeling (BIM), and exploring strategies for better workforce management to mitigate delays in rural infrastructure projects. These improvements can provide a more robust framework for future projects, ensuring that they are completed efficiently both in terms of cost and time.

CONCLUSION

The conclusion of this research shows an assessment of the performance of the drainage project in Laju Lor District, with a focus on time and cost control. The findings show that although the project is behind schedule, as indicated by the Schedule Performance Index (SPI) of 0.57, it is under budget with a Cost Performance Index (CPI) of 1.26, resulting in cost savings of IDR 20,726,358.11. However, the estimated project completion time exceeds the original plan by 21 days. This research highlights the importance of monitoring project progress with indicators such as SPI and CPI, and recommends future research to optimize time and cost management in construction projects. Future contributions include improving control over material use, cost tracking, and time management to ensure timely and on-budget project completion.

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