Time Performance Analysis Using Earned Value on the Construction of the Aranaway Kiram Bridge in Banjar Baru City

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Abstract

When implementing a project in the field, it is fairly uncommon for numerous projects to be delayed or even halted. This also has an impact on project cost escalation, resulting in project losses. Earned value analysis can help manage construction projects efficiently and effectively. The results value analysis was done to estimate the extent to which the project was carried out according to the work plan. This assessment was performed on the Aranaway Kiram Bridge Construction project in Banjarbaru City. The project was aimed to determine weekly time performance and project completion time. The method employed was earned value analysis. According to the results of the analysis method (earned value analysis), the results from the 3rd to the 18th week experienced delays, as evidenced by the performance of the Schedule Variance (SV) which was Negative (-) and the Schedule Performance Index (SPI) which was less than 1, but work accelerated in the 19th week of the Banjarbaru City Aranaway Kiram Bridge Construction Project, as evidenced by the SV performance which was Positive (+) and SPI greater than 1. The research results estimated the project's completion time as 253 days.

Keywords

Value of results, Time, Project performance

Introduction

In analyzing a construction project, numerous strategies can be employed to develop an efficient cost budget plan, one of which is cost control. Effective cost control ensures that expenditures remain reasonable and aligned with the project's requirements, preventing budget overruns. The initial cost budget is established through the contract formulated during the planning phase, which includes a comprehensive set of activities and a detailed schedule (Kerzner, 2017). Activity scheduling is crucial as it outlines the sequence of tasks, imposes time constraints, and sets completion deadlines. Deviations from the work plan during execution can lead to significant challenges, particularly in project funding. Many contractors face difficulties in securing adequate funds for their projects (Project Management Institute, 2021). To mitigate potential losses and ensure project success, the Earned Value Management (EVM) technique can be employed. EVM is a robust tool for tracking a project's progress over

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time and estimating the costs and time required for project completion. By analyzing the Earned Value, project managers can gain insights into the current status of the project, enabling informed decision-making to realign project execution with initial objectives (Fleming & Koppelman, 2016). This study focuses on the Aranaway Kiram Bridge Construction project in Banjarbaru City, which has a contract value of ID 13,614,681,225.00. The project necessitates stringent control measures to ensure adherence to the planned schedule (Banjarbaru City Government, 2023). The methodologies applied in this study include the S-Curve and Earned Value scheduling techniques. This research aims to demonstrate the implementation of the Earned Value method in managing the Aranaway Kiram Bridge Construction project effectively (Vanhoucke, 2014). Additionally, this study addresses the optimization of cash flow in construction projects to maximize profitability. Cash flow projections are developed using the Precedence Diagram Method (PDM) and Microsoft Project, considering various monthly payment systems and progress payments with and without down payments of 20%, 25%, and 30%. These projections are based on scheduling conditions such as Earliest Start Time (EST), Latest Start Time (LST), and Slack Time (Lewis, 2020). The research objectives are to assess project performance in terms of time using the Earned Value method, estimate the project completion time, and calculate cash flow based on the project schedule and monthly payments for the Aranaway Kiram Bridge Construction project in Banjarbaru City. By achieving these objectives, the study aims to provide a comprehensive framework for improving project management practices, ensuring timely and cost-effective project completion (Kerzner, 2017; Project Management Institute, 2021; Fleming & Koppelman, 2016).

Methodology

The work location for the construction of the Aranaway Kiram Bridge, Banjarbaru City is shown in Figure 1 below.

Figure 1. Research Location

To support this analysis, the authors used a case study, the Colonel Soepirman Road Shoulder Construction Project. To simplify the analysis, data directly related to the project is required, including:

1. Work Location Map
2. CBP (Cost Budget Plan)
3. Time Schedule/S curve
4. Monthly and Weekly Reports
5. As-Built Drawing
6. Photos of activities

Data collection techniques are the methods used for obtaining data. This study's data includes a schedule, CBP, and monthly and weekly reports. This information was gathered from the project's supervisory consultant, who oversaw construction. The method used is secondary data collecting. Secondary data is information gathered by researchers from existing sources.

The stages of data analysis are a series of steps carried out systematically and logically in accordance with the problem's underlying theory, resulting in an accurate analysis that meets the author's objectives. The study's stages are as follows:

1. To gain a better understanding of the research issue, a literature review must be conducted before performing any research. Then, it was followed by determining the problem formulation and data complications.
2. Determination of BCWP and BCWS. BCWP is calculated from the actual weight of all work towards the contract value. BCWS is calculated from the weight of work against the planned cost budget.
3. Determination of PV, EV, SV, SPI, ETC, and EAC.
4. Analyze time performance on projects by looking at the results of SPI discussions.

Results and Discussion

Time-based Project Performance Analysis for the Aranaway Kiram Bridge in Banjarbaru City can be described as follows:

Budgeted Cost of Work Scheduled (BCWS)

BCWS represents the planned costs for completing a task and is derived from the Time Schedule or S Curve. This metric is crucial in project management as it provides a baseline for measuring performance against the planned budget at any given point in the project timeline. By comparing the actual costs incurred with the BCWS, project managers can identify deviations from the plan and take corrective actions as necessary.

For instance, the BCWS calculation for week 1 is as follows:

BCWS (*Budgeted Cost of Work Schedule*) The planned costs for completing a work are obtained from the Time Schedule or S Curve.

Example of BCWS calculation in week 1.
BCWS = BCWS weight x BAC

BCWS = 0,16% x 12,586,681,160.19
= IDR 20,138,689.86

This calculation implies that, according to the project plan, IDR 20,138,689.86 was expected to be spent by the end of week 1 to achieve 0.16% of the total project completion. This value is crucial for establishing financial checkpoints and ensuring that the project remains on track. By regularly updating and monitoring the BCWS, project managers can forecast future budgetary needs and avoid potential cost overruns.

Subsequent weeks' calculations follow the same methodology, adjusting the BCWS weight according to the planned progress percentage for each week. This systematic approach helps in maintaining a consistent monitoring framework throughout the project lifecycle. Continuing this process for all weeks ensures that the project team has a clear financial plan and can make informed decisions based on actual versus planned expenditures. This approach helps in maintaining financial discipline and transparency, which are critical for the successful completion of any construction project.

BCWP (Budgeted Cost of Work Performance)

The Budgeted Cost of Work Performance (BCWP) is a metric used in project management to measure the value of work performed up to a certain point in time, expressed in monetary terms. It indicates the total planned budget for the completed work within a specified period. BCWP (Budgeted Cost of Work Performance) The total value of the work completed for a work within a certain period, obtained from the weekly percentage report.

Example of BCWP calculation in week 1

BCWP = BCWP weight x BAC

BCWP = 0,20% x 12,586,681,160.19

= IDR 25,173,362.32

SV (*Schedule Variants)*

Schedule Variance (SV) is a critical metric in project management that quantifies the difference between the budgeted cost of work performed (BCWP) and the budgeted cost of work scheduled (BCWS). It provides insight into whether a project is ahead of or behind schedule in financial terms. A positive SV indicates that the project is ahead of schedule, while a negative SV signifies a delay. By regularly monitoring SV, project managers can identify deviations from the schedule early and take corrective actions to bring the project back on track.

Example of SV calculation in week 1
SV = BCWP - BCWS
SV = IDR 25,173,362.32 - IDR 20,138,689.86
= IDR 5,034,672.46.

For the next week's calculation, it can be done in the same way as the calculation above.

Schedule Performance Index (SPI)

The Schedule Performance Index (SPI) is another vital project performance metric that measures the efficiency of time utilization in a project. It is calculated by dividing the BCWP by the BCWS. An SPI greater than 1 indicates better-than-expected performance, while an SPI less than 1 indicates a lag.

Example of SPI calculation for week 1:

SPI = BCWP / BCWS

SPI = IDR 25,173,362.32 - IDR 20,138,689.86

= 1.25

For the next week's calculation, it can be done in the same way as the calculation above.

Based on the calculation of SV and SPI values, a conclusion can be made to assess the performance of the Aranaway Kiram Bridge Construction Project In Banjar Baru City based on scheduling. A more detailed explanation can be seen in the following figure

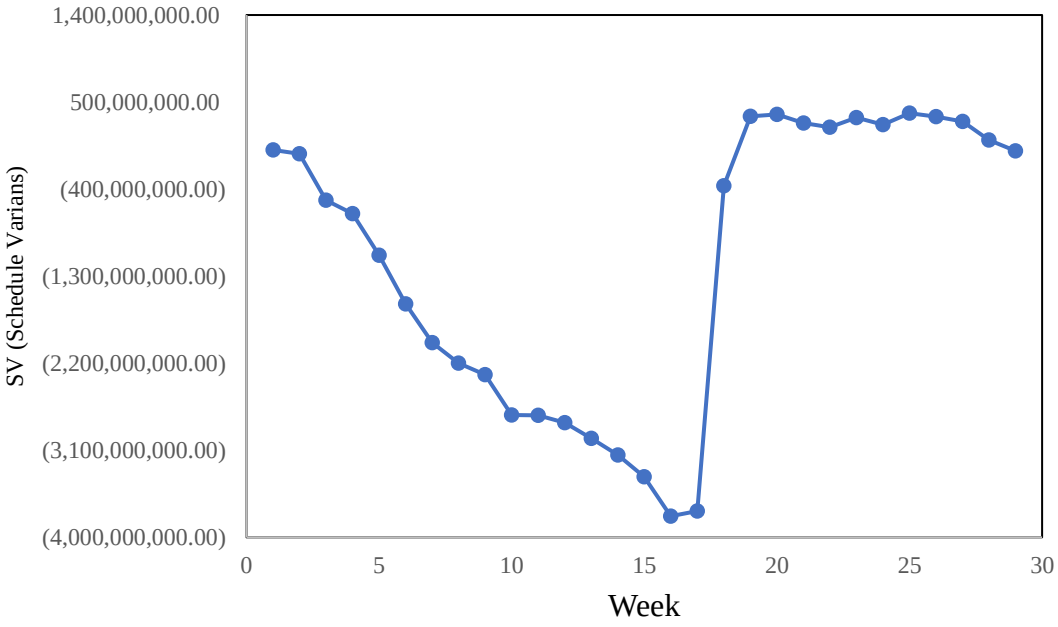

Figure 2. Graph of SV (*Schedule Varians*)

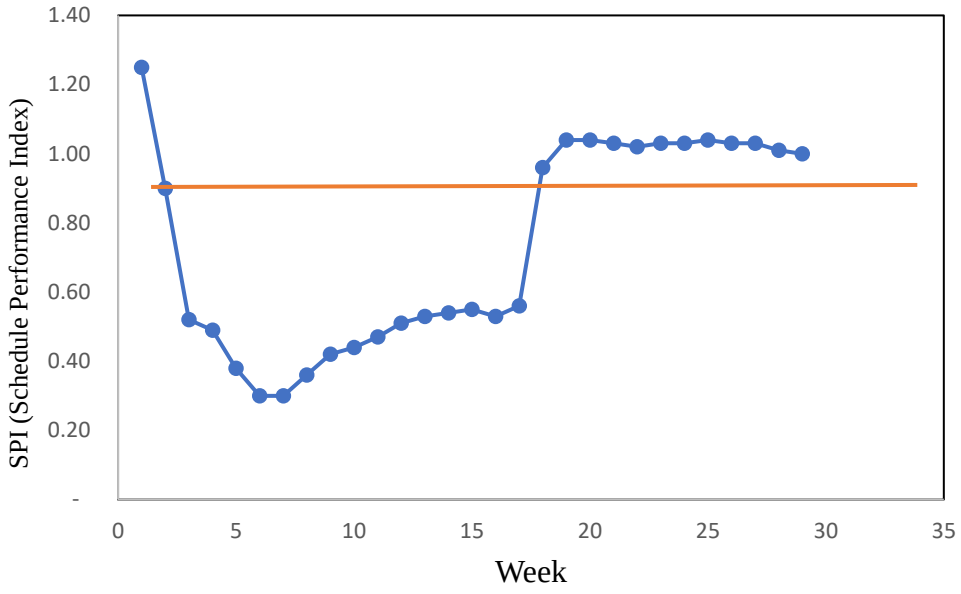

Figure 3. Graph of SPI (*Schedule Performance Index*)

Based on the analysis presented in the table and figures above, the Aranaway Kiram Bridge Project in Banjarbaru City experienced significant delays from the 3rd to the 18th weeks. These delays are indicated by negative Schedule Variance (SV) values and Schedule Performance Index (SPI) values below one. The most notable delay occurred in the 16th week, with an SV of -3,781,039,020.52 and an SPI of 0.52.

Conversely, during the 19th week of the project, there was a notable acceleration in work progress compared to the planned schedule. This acceleration is reflected in a positive SV value and an SPI greater than one, specifically with an SV of 352,427,027.49 and an SPI of 1.04. This improvement indicates that the project's performance exceeded expectations for that particular period, showing effective management interventions to regain schedule adherence.

Results of Estimated Time for Completion of the Aranaway Kiram Bridge Construction Project, Banjarbaru City

Time Estimate (TE) Is the estimated time for project completion. From the existing data, I can estimate the completion time for the Aranaway Kiram Bridge Construction Project in Banjarbaru City.
Example of calculation at week 29

TE = ATE + (OD-(ATE x SPI)) / SPI
Is known :
ATE (Actual Time Expended) = Time taken 203 days (9^{th} week)
OD (Orginal Duration) = Planned time 253 days (36 weeks)
SPI week 29 = 1.00
TE = 203 + ((253-(203 x 1.00)) / SPI)
= 253.14 or 253 days

Conclusion

The construction of the Aranaway Kiram Bridge in Banjarbaru City experienced delays from the 3rd to the 18th week, reflected in negative Schedule Variance (SV) and a Schedule Performance Index (SPI) below one. However, by the 19th week, there was a notable improvement with positive SV and an SPI exceeding one. The projected duration of the project is 253 days, indicating that the work progressed precisely according to the planned schedule.

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