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Cost and Time Analysis Using The Earned Value Method In The Construction of Villa Kandya House, Ubud, Bali

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ABSTRACT

In the Kandya House Villa Construction project in Ubud, Bali, there was a delay with a time deviation of -11.97%. This delay has the potential to cause the completion time of the work, which according to the contract is scheduled for 53 weeks, to be exceeded. To evaluate the time and cost performance in this project, the Earned Value method was used. This method utilizes three main indicators, namely Actual Cost of Work Performed (ACWP), Budgeted Cost of Work Performed (BCWP), and Budgeted Cost of Work Scheduled (BCWS). The results of the analysis show that the project time performance has decreased, characterized by a Schedule Variance (SV) value of -Rp 375,265,411.62. This value reflects a significant difference between planned and completed work. In addition, the Schedule Performance Index (SPI) was recorded at 0.772, which means that time efficiency only reached 77.2% of the planned schedule. As a result, the projected completion of work using the Estimate to Schedule (ETS) and Estimate at Schedule (EAS) indicators increased to 421 days or equivalent to 60.090 weeks, far exceeding the contract duration. In terms of cost, the analysis shows suboptimal performance, with a Cost Variance (CV) value of -Rp 48,700,590.06. This indicates that the actual costs incurred were higher than the planned budget for the completed work. In addition, the Cost Performance Index (CPI) value was recorded at 0.963, which means that the efficiency of budget utilization only reached 96.3%.

Keywords: earned value, cost performance, time performance

INTRODUCTION

Construction projects are growing larger and more complicated today both in terms of physical and cost. In practice, a project has limited resources, whether in the form of people, materials, costs or tools. This requires a project management starting from the initial phase of the project to the project completion phase. With the increasing level of project complexity and the scarcity of resources, it is also necessary to improve a good and integrated project management system (Ahuja, 1984). Tourism is one of the construction project development sectors that is currently being promoted by the government and the private sector. This is because tourism has a very important role in Indonesia's development, especially as a foreign exchange earner besides the oil and gas sector.

The implementation of the Kandya House Ubud Bali Villa Development project work and as the Implementing Contractor is CV. RAHARJA WIGUNA KONSTRUKSI with a contract value of Rp. 3,130,896,000.00 - (Three Billion One Hundred Thirty Million Eight Hundred Ninety Six Thousand Rupiah) and carried out within a period of 53 (Fifty-three) weeks. In the implementation of the work of the Kandya House Ubud Bali Villa Development project, there were obstacles due to the influence of the Balinese Hindu holy days (September 24-26, SE Governor No.07 2023), thus affecting the time performance and cost performance of CV. RAHARJA WIGUNA KONSTRUKSI as the implementing contractor. Due to the above problems, the project showed that in week 29 the new implementation progress reached 40.57% of what had been planned at the beginning of week 29, namely 52.56%. So that there is a

deviation between the implementation progress and the plan, which is -11.98%, this large percentage of delay has the potential to cause the total completion time of the work according to the contract for 53 weeks to be exceeded.

The value for money concept is one of the tools used in project management that integrates cost and time. The earned value concept presents three dimensions, namely the physical completion of the project (the percent complete) which reflects the planned absorption of costs (budgeted cost), the actual costs that have been incurred or what is called actual cost and what is obtained from the costs that have been incurred or what is called earned value (Nurkaruniati et al., 2024). From these three dimensions, with the concept of earned value, it can be linked between cost and time performance derived from the calculation of the variance of cost and time (Fleming & Koppelman, 1994). Based on this cost and time performance, a project manager can identify the overall performance of the project and the work packages within it and then predict the cost and time performance of the project completion. The results of the project performance evaluation can be used as an early warning if there are performance inefficiencies in project completion so that management policies and changes in implementation methods can be made so that cost overruns and delays in project completion can be prevented (Purnama et al., 2023).

Researchers will use the Earned Value Analysis method in evaluating time performance and cost performance, for which 3 (three) indicators are used, namely, ACWP (actual cost of work performed), BCWP (budgeted cost of work performed), and BCWS (bugeted cost of work scheduled) (Crean, 1982). ACWP is the actual cost of the work that has been carried out. This cost is obtained from project accounting or financial data at the reporting date (e.g. end of month), which is a record of all actual cost expenditures from work packages or accounting codes including overhead calculations and others. So, ACWP is the actual amount of expenditure or funds used to carry out work in a certain period of time. BCWP shows the value of the results from the point of view of the value of the work that has been completed against the budget provided to carry out the work. When the ACWP figure is compared to the BCWP, it will show the comparison between the costs that have been incurred for the work that has been carried out against the costs that should have been incurred for this purpose. BCWS is the budget for a work package, but it is organized and linked to the implementation schedule. So here there is a combination of cost, schedule, and scope of work, where each work element has been given an allocation of costs and schedules that can be a benchmark in the implementation of workers. So that the implementation of construction can be in accordance with the time target and cost target that has been stated in the contract. By using the 3 indicators above, various factors can be calculated that show the progress and performance of project implementation such as: integrated cost variance (CV) and schedule variance (SV); monitoring variance changes against standard figures; productivity and performance indices; project completion cost forecasts.

Researchers will evaluate the implementation of this project by analyzing in week 29 (twenty-nine) using the Earned Value method so that a solution can be found so that the total project work time is as planned, namely 53 (fifty-three) weeks. This evaluation is needed as a project leader's review material to take action the next week or time. Based on this, the objectives of this research are described as follows:

1. Analyzing project Time Performance based on Schedule Variance (SV) and Schedule Performance Index (SPI) parameters.
2. Analyzing project cost performance based on Cost Variance (CV) and Cost Performance Index (CPI) parameters.

According to Purnama et al. (2023), earned value management (EVM) is a powerful tool for assessing the performance of construction projects, particularly in monitoring both cost and schedule performance. Their study emphasizes that the integration of time and cost variances is

essential for accurately tracking project progress and making informed decisions. Similarly, Fleming & Koppelman (1994) found that the Earned Value method provides a comprehensive way to evaluate project performance and forecast future performance, particularly in the construction industry where cost overruns and schedule delays are common.

The urgency of this research stems from the significant delays and cost overruns observed in construction projects, such as the Kandya House Villa Development in Ubud, Bali. As construction projects become increasingly complex, especially in the tourism sector, there is a pressing need for accurate and timely monitoring of both cost and time performance. Delays and inefficiencies can lead to substantial financial losses, jeopardizing the completion of projects and customer satisfaction. By applying the Earned Value method, this study aims to provide an in-depth analysis of the project's performance and offer strategies to prevent further delays and cost overruns.

While the Earned Value method has been widely applied to various construction projects, there is limited research focusing on its practical application to projects in the tourism sector, particularly in Bali. Many existing studies have concentrated on industrial or infrastructure projects, leaving a gap in understanding how this method can be effectively utilized in smaller-scale projects with unique challenges, such as the Kandya House Villa Development. This research aims to fill this gap by applying the Earned Value method to assess the performance of a tourism-related construction project.

The novelty of this research lies in its focus on a specific tourism construction project, the Kandya House Villa Development in Bali, and applying the Earned Value method to evaluate the project's time and cost performance. While the Earned Value method is well-established in larger construction projects, this study's application to a smaller-scale, tourism-related project provides new insights into how this method can be adapted for diverse types of construction. The research also introduces practical recommendations for improving project management practices in tourism development.

The primary objective of this research is to analyze the time and cost performance of the Kandya House Villa Development project using the Earned Value method, specifically focusing on Schedule Variance (SV), Schedule Performance Index (SPI), Cost Variance (CV), and Cost Performance Index (CPI). The study aims to provide actionable insights for the project team to improve efficiency and avoid further delays. The benefits of this research include offering recommendations for better project planning, cost control, and schedule management, helping stakeholders mitigate risks and enhance overall project performance in the tourism construction industry. Additionally, the findings will contribute to the broader application of Earned Value Management in various sectors of construction.

Literature Review

Previous Research

Almi et al. research, 2024 with the research title "Analysis Of Cost And Time Performance On The East Surabaya Hospital Construction Project Using The Earned Value Method" this research discusses the analysis of cost and time performance in the East Surabaya Hospital Construction Project using the Earned Value Method (EVM). The project started in 2023 and is scheduled to be completed in 2024 with a contract value of Rp. 494,603,098,000 funded by the Surabaya City Regional Budget (APBD). The study aims to measure the cost and time performance at week 22 of the project. The method used is EVM which involves three basic indicators: 1. Actual Cost of Work Performed (ACWP) 2. Planned Cost of Work Performed (BCWP) 3. Planned Cost of Work Scheduled (BCWS). This study concludes that week 22, the results of the analysis show that the cost and time performance of the project is considered unfavorable: - Cost Variance (CV) obtained at Rp. -608,118,565 - Schedule Variance (SV) of Rp. -44,410,784,255. The Cost Performance Index (CPI) value was 0.996

and the Schedule Performance Index (SPI) was 0.76, indicating that the project experienced delays and cost expenditures exceeded the budget.

Research by Harris et al., 2023 with the research title "Aluation Of Cost And Time Performance Of Karetan - Sambimulyo Road Maintenance Project In Banyuwangi District" this research aims to evaluate the project work that is being carried out, namely in the form of Karetan-Sambimulyo Road Maintenance Banyuwangi Regency against Project Time and Cost Control, so that it can be used as a reference material by project implementers and employers in terms of decision making whether the project is feasible to complete or not. The research was conducted at the end of week 21 (twenty-one), with different assessment results, so it can be concluded as follows description: Based on the results of Cost Variance (CV) & Schedule Variance (SV) analysis obtained: The work is carried out later than the schedule plan, the cost is lower than the budget plan. Based on the Cost Performance Index (CPI) & Schedule Performance Index (SPI): Profitable but experiencing delays, Based on Estimated to Complete (ETC) & Estimated At Completion (EAC): Obtained a profit of Rp. 263,004,000.00-,; Based on Estimated Temporary Cost (ETC) & Estimated All Costs (EAS): Experienced a Time Delay of 2.09 weeks.

Ramadhani Putra & Oetomo's research, 2024 with the research title "Cost And Time Analysis Using Methods Earned Value" this research was conducted on the Tanjung Uncang Pier Construction Project in Batam City, because the project implementation was delayed from planning. The purpose of the study was to analyze the estimated time required to complete the project and analyze the estimated final cost of the project. The results of the study are based on Schedule Variance (SV) and Schedule Performance Index (SPI), the performance of the Tanjung Uncang Pier Development Project in Batam City is not as expected and does not achieve the planned work target and is experiencing delays. The estimated time required to complete the Tanjung Uncang Pier Construction Project of Batam City based on week 22 is 257 days while the planned time is 245 days. This shows that the completion time is 12 days late from the plan. The estimated project implementation cost of the Tanjung Uncang Pier Construction Project in Batam City is less than the contract value of Rp 40,038,455,635.00.

Research Irniawan et al., 2023 with the research title "Cost And Time Analysis Using Earned Value Method In Administration Building Construction Project At Polije Campus" this study aims to analyze the efficiency time carried out by the provider starting from the beginning of the work, at the time of monitoring, until the completion of the final project implementation work. And estimate how much it costs from the beginning of the work, when monitoring until the project is completed using the Earned Value Method. From the analysis, results and discussion of the Bondowoso Polije Campus Administration Building project, it can be concluded that the project work time exceeds 2,543 weeks for the total work and will suffer a loss of Rp. 393,323,318.10 from the reduction of the total contract minus the total financing. Therefore, the construction management proposes a shift in the work schedule to working hours that do not require major construction achievements. In addition, the contractor should also communicate with the commissioner of the Administration Building project to increase the duration of work on the administration building construction project. And participate in finding alternative suppliers of main materials without having to wait for vendors to get the required materials.

Nailufar et al. research, 2024 with the research title "Analysis Of Project Enforcement Delays With The Earned Value Method (Case Study: Office Of Bahtera Elang Perak Indonesia Surabaya)" this research was conducted on the Bahtera Elang Perak Indonesia Office Development project (BEPI) is one of the ongoing projects in Surabaya City consisting of 8 floors with an area of 1,081 m² and a contract value of Rp. 13,908,226,157.00. The Bahtera Elang Perak Indonesia office construction project is planned to last 43 weeks. In fact, as the pile driving work progressed, there were several changes that required rescheduling or

rescheduling. The length of implementation time became 54 weeks. The current condition of the construction progress of Bahtera Elang Perak Indonesia Office Surabaya in week 37 is 35.67% while the planned progress is 43.619% so there is a difference of -7.948%. To solve this problem, an evaluation of project cost and time efficiency during implementation is carried out using the Earned Value Method. This strategy seeks to assess project performance both in terms of cost and time. Its analysis conducted at week 41 showed that the project performance in terms of cost was below expectations with a CPI value of 0.945 indicating that the actual cost exceeded the budgeted cost. In addition, the CV value of Rp. -381,606.94 further emphasized the negative deviation. In terms of time, the project also experienced delays as indicated by the SPI value of 0.758 which is less than 1. The SV value of Rp. -2,082,524,745 further highlights these delays, indicating that fewer work packages were completed than planned.

Research Rohim et al., 2024 with the research title "Analysis Of Project Enforcement Delays With The Earned Value Method (Case Study: Office Of Bahtera Elang Perak Indonesia Surabaya)" this research was conducted on the construction of the GX Bali Office & Co Working Project. The project will be completed in 42 weeks, but in week 27 there is an indication of a delay of 4.31% from the initial plan. The Earned Value Method (EVM) is a method that analyzes the time and cost of performance assessment methods that can be used to develop strategies to minimize delays. This research aims to evaluate the time and cost performance of the GX Project Office & Co Working Bali project using the earned value method. The quantitative method is a method used to collect and analyze project schedules, actual costs, and progress reports. The main indicators of the earned value method are planned value (PV), earned value (EV), and actual cost (AC) are analyzed to determine schedule variance (SV), cost variance (CV), schedule performance index (SPI), and cost performance index (CPI). The results show that the project experienced delays mainly in week 1 to week 14 and week 19 to week 27, with SPI values mostly below 1. However, the project showed improved efficiency in cost management with CPI values above one after week 14 to week 27, indicating the actual costs incurred were lower than the value of the work completed. These findings highlight the need for corrective action and more effective management strategies to address delays in a cost-efficient manner.

Research by Hariyadi et al., 2024 with the research title "Cost And Time Analysis Using The Earned Value Analysis Method" this research aims to evaluate a road widening project in Mojokerto Regency with a target completion time of 150 days. To prevent delays and cost overruns, researchers used the Earned Value method to identify early warnings about project performance. This method integrates the value of time and cost through the measurement of Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Estimated At Completion (EAC), and Estimated Schedule At Completion (EAC). Research findings show that the additional cost required (ETC) reaches Rp 3,276,704,110.14, with additional time (ETS) until week 12 being 87 days. The project cost change (EAC) reached Rp 3,961,767,811.01 from the contract cost, while the project completion time (EAS) was 171 days. The results of the analysis show that the construction service provider has implemented efficient implementation methods with consistent supervision, ensuring the smooth progress of the project.

Cost, Quality, and Time Relationship

Provisions regarding the cost, quality and time of completion of construction are already tied up in the contract and set before construction begins. If things arise that are not taken into account during the implementation process, they must be corrected immediately. However, efforts to correct such deviations cannot change the agreement on financing and implementation period. In fact, all forms of deviation from the agreement on the quality and timing of work usually carry risks and penalties.

In organizing a project, the cost factor is a major consideration because it usually involves a large amount of investment that must be invested by the assignor which is vulnerable to the risk of failure. Fluctuations in the financing of a building construction are also inseparable from the influence of the economic situation which may be in the form of an increase in material prices, equipment prices and labor wages due to inflation, cost increases due to the development of bank interest, working capital constraints, or delays in the implementation of activities due to delays. In addition, there are still influences that come from productivity issues, then the availability of initial project site facilities and infrastructure, or special events such as legal disputes and so on. While the problems that affect the construction implementation time are mostly caused by the organizing mechanism, such as delays in the planning schedule, changes in work during construction, schedule feasibility, productivity problems, government regulations regarding the safety of planning and construction implementation methods, environmental impacts, policies on employment and so on. Then the problems that affect the quality of work results are more originated and dominated by the quality of human resources related to technical capabilities and skills. For example, in the preparation of planning criteria and specifications, financial management as support, procedures for the provision of materials, equipment and supervision. Furthermore, there are still additional issues that are quite important that affect the schedule, time, and quality, namely efforts to analyze high cost economics, labor training programs.

Project Planning

Planning is one of the most important functions of project management, which is to select and determine the steps needed to achieve the goals of a project. This means that we must first determine the goals to be achieved and then try to arrange a sequence of activity steps to achieve them.

In organizing projects, the stages and uses of planning can be divided into basic planning and control planning. As soon as project activities begin, basic planning is prepared in the form of preparing master schedules, budgets, setting quality standards, determining the implementation organization, and sequencing the steps of carrying out work. So this stage of planning is intended to lay the foundations of a project organizer, therefore it is referred to as basic planning. At the project organizer stage, that is, when physical implementation is already underway, these data and information are then analyzed and compared with basic planning data. This activity is in the form of analyzing and comparing the results of physical implementation in the field against basic planning and then making the necessary corrections, often followed by re-planning. The making of re-planning aims so that the implementation of the work is always guided towards the target called planning for control (Ritz, 1994).

The elements of planning related to project management are schedules, forecasts, goals, procedures, and budgets. Not all plans contain these elements. A good plan requires a clear description of the elements that are part of the plan, so that all parts of the organization and the personnel involved know the intended course of action.

Policies and procedures play an important role in organizing a large activity. Because policies and procedures are communication tools that are expected to organize, coordinate, and unite the direction of motion of the parts of the activities carried out. Policies can be interpreted as instructions for decision making. If the policy provides instructions on what needs and can be done, then the procedure explains how to do it.

Earned Value Concept Method

The earned value method can be used to analyze performance and make estimates of goal achievement. According to Auzan N et al. (2017), there are three indicators in the concept of earned value analysis, namely ACWP (Actual Cost of Work Performed), namely the actual cost of work that has been carried out, BCWP (Budgeted Cost of Work Performed), namely the budget worth the work that has been carried out, BCWS (Budgeted Cost of Work Schedule),

namely the amount of the budget for the planned work. For further explanation can be seen below:

1. ACWP (Actual Cost of Work Performed)

   It is a representation of the overall expenditure incurred to complete the work in a given period. ACWP can be either cumulative up to the performance calculation period or the sum of the expenditure costs within a specific period of time.

   ACWP = direct cost + indirect cost
2. BCWP (Budgeted Cost of Work Performed)

   It is the value received from the completion of work during a certain period of time. BCWP is what is called earned value. This BCWP is calculated based on the accumulation of completed jobs. There are several ways to calculate BCWP including: Fixed formula, Milestone weights, Milestone weights with percent complete, Unit complete, Percent complete, Level of effort.

   BCWP = % actual weight x contract value
3. BCWS (Budgeted Cost of Work Schedule)

   It is a cost budget allocated based on the work plan that has been prepared against time. BCWS The Earned Value Concept for Construction Project Management is calculated from the accumulated planned cost budget for the work within a certain period of time. BCWS at the end of the project (100% completion) is called Budget at Completion (BAC). BCWS is also a measure of the time performance of project implementation. BCWS reflects the cumulative absorption of planned costs for each work package based on its sequence according to the planned schedule.

   BCWS = % plan weight x contract value

Variance Analysis

Cost and time variance analysis. Analyzing project completion using a simple variant method is considered insufficient, because variant analysis cannot integrate cost and schedule aspects. To overcome this, BCWS, BCWP, and ACWP indicators are used in determining Cost Variance and Schedule Variance in an integrated manner. Cost Variance (CV) and Schedule Variance (SV) are formulated as follows:

1. Cost Variance (CV) = BCWP - ACWP
   Cost Variance = 0; project cost as planned
   Cost Variance > 0; Cost Underrun (cost under plan)
   Cost Variance < 0 ; Cost Overrun (cost above plan)
2. Schedule Variant (SV) = EV - PV or SV = BCWP - BCWS
   Schedule Variance = 0; project on time
   Schedule Variance > 0; project ahead of schedule
   Schedule Variance < 0; project is behind schedule

Productivity and Performance Index Analysis

Project managers often want to know the efficiency of resource use, which can be expressed as a productivity index or performance index. This performance index consists of Cost Performance Index (CPI) and Schedule Performance Index (SPI). The formula for this Performance Index is:

1. Cost Performance Index (CPI) = EV/AC or CPI = BCWP/ACWP
   CPI = 0; project cost as planned
   CPI > 0; Cost Underrun (cost under plan)
   CPI < 0; Cost Overrun (cost above plan)
2. Schedule Performance Index (SPI) = EV/PV or SPI = BCWP/BCWS
   SPI = 1; project on time
   SPI > 1; project ahead of schedule
   SPI < 1; project is behind schedule

METHOD

Location and Time of Research

This research will be conducted on the Kandya House Ubud Bali Villa Development project which will be implemented in 2024.

Data Collection Procedure

In the research conducted on the construction of Villa Kandya House Ubud Bali, data collection as research material was obtained from the executing contractor and also some from the supervisory consultant. The types of data collected are secondary data types and literature studies, including the following:

- Primary Data
  a. Identify work problems at the project site.
  b. Interview about work issues at the project site.
- Secondary Data
  a. Cost Budget Plan (RAB) Construction of Villa Kandya House Ubud Bali.
  b. Time Schedule of Villa Kandya House Ubud Bali Construction project plan.
  c. Weekly report of the construction project of Villa Kandya House Ubud Bali.
  d. Actual Cost of Villa Kandya House Ubud Bali Construction project.

Data Processing and Analysis

a. BCWS is the budgeted cost for work scheduled for a certain period and specified in the budget, obtained by multiplying the percentage of progress plans contained in time schedule with the project implementation costs listed in the RAB.
b. ACWP is obtained from the project finance department. This calculation is only an estimate or estimate that is assumed to be the real cost used (real cost). Real cost is obtained from the product of the use of materials and labor with the unit price of materials and wages in the field (real unit price).
c. Cost variance and integrated schedule, it has been mentioned earlier that analyzing project progress with simple variance analysis is considered insufficient, because this method does not integrate cost and schedule aspects. To overcome this, BCWS, BCWP, and ACWP indicators are used in determining Cost Variance and Schedule Variance in an integrated manner.
d. Productivity and performance indices, project managers often want to know the efficiency of resource use, which can be expressed as a productivity index or performance index. This performance index consists of the Cost Performance Index (CPI) and the Schedule Performance Index (SPI).

RESULTS AND DISCUSSION

Earned Value Analysis

In the earned value method, monitoring or evaluation is required at a time to determine the performance of a project. In the implementation of the construction of Villa Kandya House Ubud Bali, the method used in controlling costs and time in the field is to use a Time Schedule. Earned value analysis is carried out in week 29.

a. BCWS Calculation

An example of BCWS calculation in week 5, as follows:

BCWS = % plan weight x project value
= 3.635% x IDR 3,130,896,663.80,-
= IDR 113,801,709.92,-.

The BCWS value for week 5 is IDR 113,801,709.92. The recapitulation of the BCWS calculation is as follows:

Table 1. BCWS Calculation

Period	Plan Weight	(BCWS)
Week 1	0,212	IDR 6,634,000.00
Week 2	0,600	IDR 18,787,934.62
Week 3	1,246	IDR 39,005,014.57
Week 4	2,411	IDR 75,471,489.84
Week 5	3,635	IDR 113,801,709.92
Week 6	4,859	IDR 152,131,930.01
Week 7	7,432	IDR 232,673,452.01
Week 8	9,828	IDR 307,695,039.40
Week 9	13,028	IDR 407,905,667.20
Week 10	15,622	IDR 489,095,983.91
Week 11	18,833	IDR 589,637,289.41
Week 12	21,560	IDR 675,032,466.84
Week 13	23,113	IDR 723,651,937.51
Week 14	26,041	IDR 815,326,639.52
Week 15	28,317	IDR 886,578,288.48
Week 16	30,593	IDR 957,829,937.44
Week 17	32,869	IDR 1,029,081,586.40
Week 18	35,144	IDR 1,100,333,235.35
Week 19	37,42	IDR 1,171,584,884.31
Week 20	39,696	IDR 1,242,836,533.27
Week 21	41,539	IDR 1,300,533,649.80
Week 22	43,382	IDR 1,358,230,766.33
Week 23	44,223	IDR 1,384,571,184.62
Week 24	45,064	IDR 1,410,911,602.92
Week 25	45,843	IDR 1,435,311,114.85
Week 26	46,84	IDR 1,466,525,796.79
Week 27	47,837	IDR 1,497,740,478.73
Week 28	50,122	IDR 1,569,261,715.67
Week 29	52,56	IDR 1,645,594,811.24

Based on table 1, the calculation of BCWS (Budgeted Cost of Work Schedule) in week 29 amounted to IDR 1,645,594,811.24, -.

b. BCWP Calculation

An example of BCWP calculation for week 5, as follows:

BCWP = % realization weight x project value

= 5.936% x IDR 3,130,896,663.80,-

= IDR 185,834,957.35,-

The BCWP value for week 5 is IDR 185,834,957.35. The recapitulation of BCWP calculations is as follows:

Table 2. BCWP calculation

Period	Realization Weight	EV (BCWP)
Week 1	0,420	IDR 13,141,568.45
Week 2	2,693	IDR 84,310,251.60
Week 3	4,021	IDR 125,884,876.72
Week 4	4,620	IDR 144,662,147.27
Week 5	5,936	IDR 185,834,957.35
Week 6	9,135	IDR 286,016,773.31
Week 7	10,519	IDR 329,330,193.02

Week 8	12,480	IDR 390,737,951.43
Week 9	14,004	IDR 438,459,086.81
Week 10	15,622	IDR 89,095,983.91
Week 11	17,264	IDR 540,519,572.25
Week 12	18,562	IDR 581,170,950.92
Week 13	19,820	IDR 620,534,432.15
Week 14	22,114	IDR 692,360,422.21
Week 15	23,467	IDR 734,740,167.37
Week 16	24,122	IDR 755,229,175.01
Week 17	24,991	IDR 782,431,093.86
Week 18	28,173	IDR 882,075,192.16
Week 19	28,999	IDR 907,937,022.55
Week 20	30,030	IDR 940,215,597.56
Week 21	31,071	IDR 972,791,497.56
Week 22	33,325	IDR 1,043,368,574.19
Week 23	34,620	IDR 1,083,930,442.48
Week 24	34,986	IDR 1,095,383,888.98
Week 25	37,371	IDR 1,170,050,670.60
Week 26	38,881	IDR 1,217,332,785.63
Week 27	39,122	IDR 1,224,864,821.21
Week 28	39,571	IDR 1,238,916,088.42
Week 29	40,574	IDR 1,270,329,399.62

Based on table 2, the calculation of BCWP (Budgeted Cost for Work Performed) in week 29 amounted to IDR 1,270,329,399.62, -.

c. ACWP Calculation

The ACWP value for each week is IDR 8,250,000.00, -. The ACWP calculation recapitulation is as follows:

Table 3. ACWP Calculation

Period	Realization Weight	Direct costs	Indirect costs (cumulative)	AC (ACWP)
Week 1	0,420	IDR 11,170,333.18	IDR 8,250,000.00	IDR 19,420,333.18
Week 2	2,693	IDR 71,663,713.86	IDR 16,500,000.00	IDR 88,163,713.86
Week 3	4,021	IDR 107,002,145.21	IDR 24,750,000.00	IDR 131,752,145.21
Week 4	4,620	IDR 122,962,825.18	IDR 33,000,000.00	IDR 155,962,825.18
Week 5	5,936	IDR 157,959,713.75	IDR 41,250,000.00	IDR 199,209,713.75
Week 6	9,135	IDR 243,114,257.31	IDR 49,500,000.00	IDR 292,614,257.31
Week 7	10,519	IDR 279,930,664.06	IDR 57,750,000.00	IDR 337,680,664.06
Week 8	12,480	IDR 332,127,258.72	IDR 66,000,000.00	IDR 398,127,258.72
Week 9	14,004	IDR 372,690,223.78	IDR 74,250,000.00	IDR 446,940,223.78
Week 10	15,622	IDR 415,731,586.32	IDR 82,500,000.00	IDR 498,231,586.32
Week 11	17,264	IDR 459,441,636.41	IDR 90,750,000.00	IDR 550,191,636.41
Week 12	18,562	IDR 493,995,308.29	IDR 99,000,000.00	IDR 592,995,308.29
Week 13	19,820	IDR 527,454,267.33	IDR 107,250,000.00	IDR 634,704,267.33
Week 14	22,114	IDR 588,506,358.88	IDR 115,500,000.00	IDR 704,006,358.88
Week 15	23,467	IDR 624,529,142.27	IDR 123,750,000.00	IDR 748,279,142.27
Week 16	24,122	IDR 641,944,798.76	IDR 132,000,000.00	IDR 773,944,798.76
Week 17	24,991	IDR 665,066,429.78	IDR 140,250,000.00	IDR 805,316,429.78
Week 18	28,173	IDR 749,763,913.33	IDR 148,500,000.00	IDR 898,263,913.33
Week 19	28,999	IDR 771,746,469.17	IDR 156,750,000.00	IDR 928,496,469.17
Week 20	30,030	IDR 799,183,257.93	IDR 165,000,000.00	IDR 964,183,257.93
Week 21	31,071	IDR 826,872,772.93	IDR 173,250,000.00	IDR 1,000,122,772.93

Week 22	33,325	IDR 886,863,288.06	IDR 181,500,000.00	IDR 1,068,363,288.06
Week 23	34,620	IDR 921,340,876.11	IDR 189,750,000.00	IDR 1,111,090,876.11
Week 24	34,986	IDR 931,076,305.63	IDR 198,000,000.00	IDR 1,129,076,305.63
Week 25	37,371	IDR 994,543,070.01	IDR 206,250,000.00	IDR 1,200,793,070.01
Week 26	38,881	IDR 1,034,732,867.78	IDR 214,500,000.00	IDR 1,249,232,867.78
Week 27	39,122	IDR 1,041,135,098.03	IDR 222,750,000.00	IDR 1,263,885,098.03
Week 28	39,571	IDR 1,053,078,675.15	IDR 231,000,000.00	IDR 1,284,078,675.15
Week 29	40,574	IDR 1,079,779,989.68	IDR 239,250,000.00	IDR 1,319,029,989.68

Time and Cost Parameters Earned Value Concept

Analysis of project implementation performance on deviations that occur in time is carried out from BCWS, BCWP and ACWP indicators for week 29.

1. Schedule Variance

Table 4. Schedule Variance Calculation

Period	EV (BCWP)	PV (BCWS)	SV (BCWP-BCWS)
Week 1	IDR 13,141,568.45	IDR 6,634,000.00	IDR 6,507,568.45
Week 2	IDR 84,310,251.60	IDR 18,787,934.62	IDR 65,522,316.98
Week 3	IDR 125,884,876.72	IDR 39,005,014.57	IDR 86,879,862.15
Week 4	IDR 144,662,147.27	IDR 75,471,489.84	IDR 69,190,657.43
Week 5	IDR 185,834,957.35	IDR 113,801,709.92	IDR 72,033,247.43
Week 6	IDR 286,016,773.31	IDR 152,131,930.01	IDR 133,884,843.30
Week 7	IDR 329,330,193.02	IDR 232,673,452.01	IDR 96,656,741.00
Week 8	IDR 390,737,951.43	IDR 307,695,039.40	IDR 83,042,912.03
Week 9	IDR 438,459,086.81	IDR 407,905,667.20	IDR 30,553,419.61
Week 10	IDR 489,095,983.91	IDR 489,095,983.91	-
Week 11	IDR 540,519,572.25	IDR 589,637,289.41	-IDR 49,117,717.16
Week 12	IDR 581,170,950.92	IDR 675,032,466.84	-IDR 93,861,515.92
Week 13	IDR 620,534,432.15	IDR 723,651,937.51	- IDR 103,117,505.36
Week 14	IDR 692,360,422.21	IDR 815,326,639.52	- IDR 122,966,217.31
Week 15	IDR 734,740,167.37	IDR 886,578,288.48	- IDR 151,838,121.11
Week 16	IDR 755,229,175.01	IDR 957,829,937.44	- IDR 202,600,762.43
Week 17	IDR 782,431,093.86	IDR 1,029,081,586.40	-IDR 246,650,492.53
Week 18	IDR 882,075,192.16	IDR 1,100,333,235.35	- IDR 218,258,043.20
Week 19	IDR 907,937,022.55	IDR1,171,584,884.31	- IDR 263,647,861.76
Week 20	IDR 940,215,597.56	IDR 1,242,836,533.27	- IDR 302,620,935.71
Week 21	IDR 972,791,497.56	IDR 1,300,533,649.80	-IDR 327,742,152.24
Week 22	IDR 1,043,368,574.19	IDR 1,358,230,766.33	- IDR 314,862,192.14
Week 23	IDR 1,083,930,442.48	IDR 1,384,571,184.62	- IDR 300,640,742.14
Week 24	IDR 1,095,383,888.98	IDR 1,410,911,602.92	- IDR 315,527,713.94
Week 25	IDR 1,170,050,670.60	IDR 1,435,311,114.85	-IDR 265,260,444.26
Week 26	IDR 1,217,332,785.63	IDR 1,466,525,796.79	- IDR 249,193,011.17
Week 27	IDR 1,224,864,821.21	IDR 1,497,740,478.73	-IDR 272,875,657.52
Week 28	IDR 1,238,916,088.42	IDR 1,569,261,715.67	- IDR 330,345,627.25
Week 29	IDR 1,270,329,399.62	IDR 1,645,594,811.24	- IDR 375,265,411.62

Based on table 4 the calculation of Schedule Variance (SV) in week 29 amounted to - Rp 375,265,411.62, -. So it shows that the project is delayed from the planned schedule.

2. Schedule Performance Index

Table 5. Schedule Performance Index Calculation

Period	EV (BCWP)	PV (BCWS)	SPI (EV/PV)
Week 1	IDR 13,141,568.45	IDR 6,634,000.00	1,981
Week 2	IDR 84,310,251.60	IDR 18,787,934.62	4,487
Week 3	IDR 125,884,876.72	IDR 39,005,014.57	3,227
Week 4	IDR 144,662,147.27	IDR 75,471,489.84	1,917
Week 5	IDR 185,834,957.35	IDR 113,801,709.92	1,633
Week 6	IDR 286,016,773.31	IDR 152,131,930.01	1,880
Week 7	IDR 329,330,193.02	IDR 232,673,452.01	1,415
Week 8	IDR 390,737,951.43	IDR 307,695,039.40	1,270
Week 9	IDR 438,459,086.81	IDR 407,905,667.20	1,075
Week 10	IDR 489,095,983.91	IDR 489,095,983.91	1,000
Week 11	IDR 540,519,572.25	IDR 589,637,289.41	0,917
Week 12	IDR 581,170,950.92	IDR 675,032,466.84	0,861
Week 13	IDR 620,534,432.15	IDR 723,651,937.51	0,858
Week 14	IDR 692,360,422.21	IDR 815,326,639.52	0,849
Week 15	IDR 734,740,167.37	IDR 886,578,288.48	0,829
Week 16	IDR 755,229,175.01	IDR 957,829,937.44	0,788
Week 17	IDR 782,431,093.86	IDR 1,029,081,586.40	0,760
Week 18	IDR 882,075,192.16	IDR 1,100,333,235.35	0,802
Week 19	IDR 907,937,022.55	IDR 1,171,584,884.31	0,775
Week 20	IDR 940,215,597.56	IDR 1,242,836,533.27	0,757
Week 21	IDR 972,791,497.56	IDR 1,300,533,649.80	0,748
Week 22	IDR 1,043,368,574.19	IDR 1,358,230,766.33	0,768
Week 23	IDR 1,083,930,442.48	IDR 1,384,571,184.62	0,783
Week 24	IDR 1,095,383,888.98	IDR 1,410,911,602.92	0,776
Week 25	IDR 1,170,050,670.60	IDR 1,435,311,114.85	0,815
Week 26	IDR 1,217,332,785.63	IDR 1,466,525,796.79	0,830
Week 27	IDR 1,224,864,821.21	IDR 1,497,740,478.73	0,818
Week 28	IDR 1,238,916,088.42	IDR 1,569,261,715.67	0,789
Week 29	IDR 1,270,329,399.62	IDR 1,645,594,811.24	0,772

Based on table 5, the calculation of the Schedule Performance Index (SPI) in week 29 is 0.772. Then the time performance is not good, meaning that the work is late from the planned schedule.

3. Cost Variance

Table 6. Cost Variance Calculation

Period	AC (ACWP)	EV (BCWP)	CV (BCWP-ACWP)
Week 1	IDR 19,420,333.18	IDR 13,141,568.45	- IDR 6,278,764.73
Week 2	IDR 88,163,713.86	IDR 84,310,251.60	- IDR 3,853,462.26
Week 3	IDR 131,752,145.21	IDR 125,884,876.72	- IDR 5,867,268.49
Week 4	IDR 155,962,825.18	IDR 144,662,147.27	- IDR 11,300,677.91
Week 5	IDR 199,209,713.75	IDR 185,834,957.35	- IDR 13,374,756.40
Week 6	IDR 292,614,257.31	IDR 286,016,773.31	-IDR 6,597,484.00
Week 7	IDR 337,680,664.06	IDR 329,330,193.02	-IDR 8,350,471.05
Week 8	IDR 398,127,258.72	IDR 390,737,951.43	- IDR 7,389,307.28
Week 9	IDR 446,940,223.78	IDR 438,459,086.81	- IDR 8,481,136.98
Week 10	IDR 498,231,586.32	IDR 489,095,983.91	- IDR 9,135,602.41

Week 11	IDR 550,191,636.41	IDR 540,519,572.25	- IDR 9,672,064.16
Week 12	IDR 592,995,308.29	IDR 581,170,950.92	- IDR 11,824,357.36
Week 13	IDR 634,704,267.33	IDR 620,534,432.15	- IDR 14,169,835.18
Week 14	IDR 704,006,358.88	IDR 692,360,422.21	- IDR 11,645,936.67
Week 15	IDR 748,279,142.27	IDR 734,740,167.37	- IDR 13,538,974.89
Week 16	IDR 773,944,798.76	IDR 755,229,175.01	-IDR 18,715,623.75
Week 17	IDR 805,316,429.78	IDR 782,431,093.86	-IDR 22,885,335.92
Week 18	IDR 898,263,913.33	IDR 882,075,192.16	- IDR 16,188,721.18
Week 19	IDR 928,496,469.17	IDR 907,937,022.55	-IDR 20,559,446.62
Week 20	IDR 964,183,257.93	IDR 940,215,597.56	- IDR 23,967,660.37
Week 21	IDR 1,000,122,772.93	IDR 972,791,497.56	- IDR 27,331,275.37
Week 22	IDR 1,068,363,288.06	IDR 1,043,368,574.19	-IDR 24,994,713.87
Week 23	IDR 1,111,090,876.11	IDR 1,083,930,442.48	- IDR 27,160,433.63
Week 24	IDR 1,129,076,305.63	IDR 1,095,383,888.98	- IDR 33,692,416.65
Week 25	IDR 1,200,793,070.01	IDR 1,170,050,670.60	- IDR 30,742,399.41
Week 26	IDR 1,249,232,867.78	IDR 1,217,332,785.63	- IDR 31,900,082.16
Week 27	IDR 1,263,885,098.03	IDR 1,224,864,821.21	- IDR 39,020,276.82
Week 28	IDR 1,284,078,675.15	IDR 1,238,916,088.42	- IDR 45,162,586.74
Week 29	IDR 1,319,029,989.68	IDR 1,270,329,399.62	-IDR 48,700,590.06

Based on table 6, the calculation of Cost Variance (CV) in week 29 amounted to -Rp 48,700,590.06, -. So it shows that the cost used in completing the project is greater than the planned cost.

4. Cost Performance Index

Table 7. Calculation of Cost Performance Index

Period	AC (ACWP)	EV (BCWP)	CPI (EV/AC)
Week 1	IDR 19,420,333.18	IDR 13,141,568.45	0,677
Week 2	IDR 88,163,713.86	IDR 84,310,251.60	0,956
Week 3	IDR 131,752,145.21	IDR 125,884,876.72	0,955
Week 4	IDR 155,962,825.18	IDR 144,662,147.27	0,928
Week 5	IDR 199,209,713.75	IDR 185,834,957.35	0,933
Week 6	IDR 292,614,257.31	IDR 286,016,773.31	0,977
Week 7	IDR 337,680,664.06	IDR 329,330,193.02	0,975
Week 8	IDR 398,127,258.72	IDR 390,737,951.43	0,981
Week 9	IDR 446,940,223.78	IDR 438,459,086.81	0,981
Week 10	IDR 498,231,586.32	IDR 489,095,983.91	0,982
Week 11	IDR 550,191,636.41	IDR 540,519,572.25	0,982
Week 12	IDR 592,995,308.29	IDR 581,170,950.92	0,980
Week 13	IDR 634,704,267.33	IDR 620,534,432.15	0,978
Week 14	IDR 704,006,358.88	IDR 692,360,422.21	0,983
Week 15	IDR 748,279,142.27	IDR 734,740,167.37	0,982
Week 16	IDR 773,944,798.76	IDR 755,229,175.01	0,976
Week 17	IDR 805,316,429.78	IDR 782,431,093.86	0,972
Week 18	IDR 898,263,913.33	IDR 882,075,192.16	0,982
Week 19	IDR 928,496,469.17	IDR 907,937,022.55	0,978
Week 20	IDR 964,183,257.93	IDR 940,215,597.56	0,975
Week 21	IDR 1,000,122,772.93	IDR 972,791,497.56	0,973
Week 22	IDR 1,068,363,288.06	IDR 1,043,368,574.19	0,977
Week 23	IDR 1,111,090,876.11	IDR 1,083,930,442.48	0,976
Week 24	IDR 1,129,076,305.63	IDR 1,095,383,888.98	0,970

Week 25	IDR 1,200,793,070.01	IDR 1,170,050,670.60	0,974
Week 26	IDR 1,249,232,867.78	IDR 1,217,332,785.63	0,974
Week 27	IDR 1,263,885,098.03	IDR 1,224,864,821.21	0,969
Week 28	IDR 1,284,078,675.15	IDR 1,238,916,088.42	0,965
Week 29	IDR 1,319,029,989.68	IDR 1,270,329,399.62	0,963

Based on table 7, the calculation of the Cost Performance Index (CPI) in week 29 is 0.963. So it shows poor cost performance, because the costs incurred (ACWP) are greater than the value obtained (BCWP) or in other words there is waste.

CONCLUSION

Based on the results of the analysis, the time performance according to the calculation of Schedule Variance (SV) in week 29 amounted to -Rp 375,265,411.62, indicating that the project is delayed from the planned schedule, with a Schedule Performance Index (SPI) of 0.772, which reflects poor time performance and delays in work progress. Furthermore, the cost performance analysis showed that the Cost Variance (CV) in week 29 was -Rp 48,700,590.06, indicating that the cost used in completing the project exceeded the planned budget. The Cost Performance Index (CPI) in week 29 was calculated at 0.963, demonstrating poor cost performance, as the costs incurred (ACWP) were higher than the value obtained (BCWP), leading to inefficiencies and waste.

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