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Cost and Time Control of the Landikma Health Center Project Using Earned Value

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ABSTRACT

The construction project of the Landikma Community Health Centre in Yalimo Regency was scheduled to be completed within 23 weeks with a contract value of IDR 23,310,500,000.00. With time and cost constraints, good and thorough control was required. However, before control could be implemented, it was necessary to first determine the performance of the project that had been underway. The purpose of this study is to determine the cost and time performance, cost and time estimates at the end of the project completion, and the factors that cause project delays or progress. The method used in this study is the Earned Value Analysis method, which combines cost and time elements as well as physical work performance. The data obtained from the project included the project time schedule, budget plan (RAB), weekly project reports and actual costs. This was followed by an analysis of costs, schedules, variances and performance indices, highlighting the issues that arose during the research. The analysis results show that the costs incurred were lower than the budgeted costs, as indicated by a CPI value of 1.50, and the implementation time was slower than the planned schedule, as indicated by an SPI value of 0.81. The final project cost estimate was calculated at IDR 16,514,712,233.33 with an estimated completion time of 41 weeks, indicating that the project was 18 weeks behind the planned 23 weeks. This delay was caused by various factors, such as delays in the initial piling of the project by third parties, equipment damage, changes to the drawings by the planning consultant, design changes by the owner, the difficulty of the terrain leading to the location, limited availability of materials and equipment, and unfavourable field conditions due to riots.

Keywords: Earned Value Method (EVM), cost performance, time, Yalimo Regency.

INTRODUCTION

One form of health service provision to the community is carried out through primary health care facilities, namely Community Health Centres (Puskesmas). Puskesmas are community health development centres that provide comprehensive, equitable, and affordable health services with the active participation of the community. Along with increasing public awareness of the importance of quality health services, the demand for adequate health facilities has also increased. This is a result of developments in science and technology as well as national development that has encouraged improvements in the quality of health services for the community. Therefore, the development of adequate health facilities and infrastructure has become an important factor in improving the quality of health services for the community.

Health infrastructure development is currently experiencing rapid growth in various regions in Indonesia. This is in line with the government's efforts to improve access to health services for the community. One form of this development is the construction of Community Health Centres (*Puskesmas*) aimed at improving the quality of community health services at the regional level. However, construction projects often face various problems such as delays in completion and cost overruns caused by discrepancies between planning and implementation in the field [1], [2]. These problems indicate that the management of construction projects requires a good management system so that projects can be completed according to the planned time and budget.

One of the health facility development projects currently being implemented in Yalimo Regency, Papua Province, is the Landikma Community Health Centre Development Project in Abenaho

District under the auspices of the Yalimo Regency Health Office. In its implementation, construction projects such as the development of community health centres have a fairly high level of complexity because they involve various resources such as labour, materials, equipment, and costs that must be managed effectively. In addition, the geographical conditions of the area and limited access to transportation can also affect the implementation of construction projects in the region. Therefore, a good project management system is needed to ensure that project activities can run according to the established plan [3].

In the implementation of the Landikma Health Centre Construction Project, supervision was carried out by CV. Cahaya Rial Konsultan. Contractors need to be aware of the performance of ongoing projects to ensure that the work can be completed according to the planned schedule and budget. Information about project performance is very important because it can be used as a basis for evaluation and decision making in the event of deviations between the plan and the project realisation. Good project control can assist project management in detecting potential delays and cost overruns early on so that corrective action can be taken immediately [4], [5].

In practice, every construction project has limited resources, including labour, materials, equipment, and costs. These limitations require the implementation of effective project management so that all available resources can be optimally utilised to achieve project objectives. In addition, the increasing complexity of projects and limited implementation time also require an integrated project management system so that project activities can run efficiently and in a controlled manner. The construction industry is known to have a high level of uncertainty due to various risks such as design changes, delays in material delivery, and unexpected field conditions that can affect project performance [6], [7].

Cost and time planning and control are very important aspects of construction project management. The success of a project is not only determined by the quality of the work produced but also by the project's ability to meet the planned cost and time targets. Therefore, the costs incurred and the time spent in implementing the project need to be monitored continuously so that the project implementation remains on track. If there is a significant deviation between the plan and the actual results, this may indicate a problem in project management, requiring corrective action to bring the project back on track with the original plan [8].

One method that can be used to measure project performance in terms of cost and time is the Earned Value Management (EVM) or Earned Value Analysis method. This method is a project management technique that integrates the measurement of project cost and schedule performance simultaneously in a single project performance evaluation system. Earned Value Management works by comparing the planned value of the work, the earned value of the work completed, and the actual costs incurred during the project implementation [9], [10]. By using these indicators, the Earned Value method can provide information on the level of cost and time efficiency of project implementation through the Cost Performance Index (CPI) and Schedule Performance Index (SPI) parameters [11].

In addition to being used to evaluate project performance, the Earned Value method can also be used to predict future project conditions, such as the estimated final project cost (Estimate at Completion) and the estimated project completion time. Thus, this method can assist project management in making more appropriate decisions in project control when there are deviations from the established plan [12], [13]. Various studies show that the application of Earned Value Management can improve the effectiveness of project control because this method provides a more accurate and re al picture of the project's condition compared to conventional project control methods [14].

Although the Earned Value Management method has been widely applied in various construction projects, its application in health facility construction projects in remote areas such as Yalimo Regency is still relatively limited. Geographical conditions, resource constraints, and logistical constraints can affect the time and cost performance of construction projects [15]. Therefore, research is needed to analyse the cost and time performance of the Landikma Community Health Centre Development Project using the Earned Value Analysis method so that the level of project implementation efficiency and potential cost and time deviations that may occur during the project implementation process can be determined.

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Based on this description, the issues discussed in this study relate to the cost and time performance of the Landikma Health Centre Development Project, the estimated final cost of the project and the time required to complete the project if the project implementation conditions remain as they were at the time of review, as well as the factors that influence the progress or delays of the project during the implementation process.

This research was conducted as one of the requirements for obtaining a Bachelor's Degree (S1) in Civil Engineering at Cenderawasih University. This research focused on the analysis of cost and time control in the Landikma Health Centre Construction Project in Yalimo Regency using the Earned Value Analysis method. Observations of the project's progress were made over a period of six months, from week 1 to week 23, based on weekly progress reports from the implementing contractor. The analysis was conducted based on project data in the form of a Bill of Quantity (BQ), contract price, time schedule, and actual implementation costs obtained from the implementing contractor's weekly progress reports.

This research is expected to provide theoretical and practical benefits. Theoretically, this research is expected to improve understanding of the application of the Earned Value Analysis method in construction project control, particularly in relation to cost and time aspects. In addition, this research is also expected to provide information on systematic project cost planning and control in accordance with the project implementation schedule. In practical terms, this research is expected to serve as a reference for construction service providers in analysing the performance of ongoing projects by comparing the planned and actual costs and project implementation times.

RESEARCH METHODS

Research Location

The Landikma Community Health Centre building construction project. The project location is in Yalimo Regency, Abenaho, Papua, Indonesia. The research location map can be seen in Figure 3.

Figure 1. Research Location Map

Data Collection

Data collection is an important stage in the research because the data obtained will be used as a basis for analysing project performance using the Earned Value Analysis method. The data used in this study consists of primary and secondary data. Primary data was obtained directly from primary sources in the field through interviews with key informants ( ) involved in the project implementation. Meanwhile, secondary data was obtained from project documents related to the planning and implementation of the construction project [16].

The data used in this study includes:

1. The primary data in this study was obtained through direct interviews with respondents involved in the project implementation, namely the contractor, in this case the Site Manager and field implementers. The interviews were conducted to identify various factors that affect project performance, particularly factors that cause the project to progress or experience delays during the implementation process. The interview method is often used in project management research

to obtain information about field conditions and factors that influence construction project performance [17].

2. Secondary data in this study was obtained from project administration documents related to work planning and implementation. The secondary data included the Time Schedule, S Curve, contract Budget Plan (RAB), weekly project reports, and actual project implementation costs. These data were used as a basis for calculating Earned Value indicators such as Planned Value (PV), Earned Value (EV), and Actual Cost (AC) to evaluate project cost and time performance [18].

Research Steps

Based on the research methodology described above, the steps taken in this study began with the data collection stage and ended with the analysis and conclusion drawing stages. The research stages were carried out systematically so that the research process could run in a focused manner and produce analyses in line with the research objectives [19].

The research steps in this final project include several stages, namely project data collection, project data processing, calculation of Earned Value indicators, analysis of project cost and time performance, and drawing conclusions based on the results of the analysis that has been carried out. All of these stages are arranged in the form of a research flowchart to provide an overview of the research process that is carried out in a systematic and structured manner.

The research flowchart is used to explain the research stages, starting from problem identification, data collection, data analysis using the Earned Value Analysis method, to drawing research conclusions. With the research flowchart, the research process can be carried out in a more focused and systematic manner, making it easier to understand the research flow [20].

The stages of the research steps can be seen in Figure 4 Research Flowchart, which shows the flow of research implementation from the initial stage to the final stage of the research.

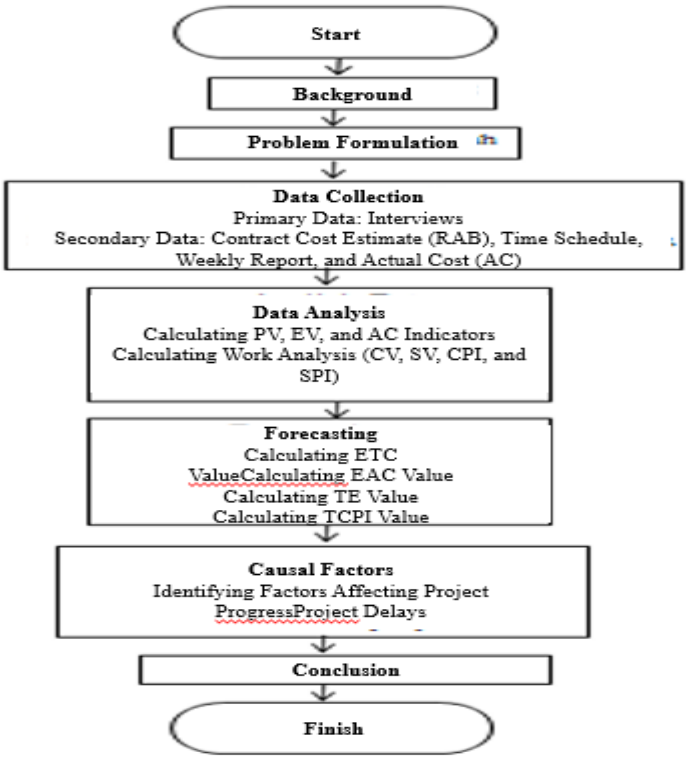

Figure 2. Research Flowchart

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RESULTS AND DISCUSSION

Project Performance Analysis During The Review Period

Earned Value Analysis (EVM) Week 1

In this Earned Value Analysis (EVM), the following will be calculated: Planned Value (PV), Earned Value (EV), Actual Cost (AC), Cost Variance (CV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Estimate to Complete (ETC), Estimate at Complete (EAC), To Complete Performance Index (TCPI), and Schedule Variance (SV) will be calculated.

Based on the weekly report obtained, the weight of work realisation in Week 1 was 1.30%. Only one work activity (Pek.) was carried out during that week, namely land preparation for the Construction of a Health Centre Retaining Wall. The activities for the Construction of the Health Centre, Construction of the Health Centre Fence, Construction of the Health Centre Drainage, and Procurement of Furniture have not been carried out at all. According to the results of discussions or interviews with the field implementers, this was due to the difficult terrain to the location of the Health Centre Construction and the unfavourable situation. This resulted in delays in the delivery and installation of materials in the field.

The following are the steps to obtain the Earned Value Calculation Results for Week 1:

$$\text{PV} = \text{Cumulative Plan Weight (\%)} \times \text{BAC}$$

PV = 1,61% × IDR23.310.500.000

PV = IDR375.299.050,00

$$\text{EV} = \text{Cumulative Actual Weight (\%)} \times \text{BAC}$$

EV =1,30% × IDR23.310.500.000

EV =IDR303.036.500,00

$$\text{AC} = \text{Direct Costs} + \text{Indirect Costs}$$

AC =IDR202.024.333,33

$$\text{CV} = \text{EV} - \text{AC}$$

CV = IDR303.036.500,00 − IDR202.024.333,33

CV =IDR101.012.166,67

$$\text{CPI} = \frac{\text{EV}}{\text{AC}}$$

$$\text{CPI} = \frac{\text{IDR303.036.500,00}}{\text{IDR202.024.333,33}}$$

CPI = 1,50

$$\text{SPI} = \frac{\text{EV}}{\text{PV}}$$

$$\text{SPI} = \frac{\text{IDR303.036.500,00}}{\text{IDR375.299.050,00}}$$

SPI = 0,81

$$\text{ETC} = \text{BAC} - \text{EV}$$

ETC = IDR23.310.500.000 − IDR303.036.500,00

ETC =IDR23.007.463.500,00

$$\text{EAC} = \text{AC} + \text{ETC}$$

EAC = IDR202.024.333,33 + IDR23.007.463.500,00

EAC = IDR23.209.487.833,33

$$\text{TCPI} = \left(\frac{\text{BAC} - \text{EV}}{\text{EAC}}\right)$$

$$\text{TCPI} = \left(\frac{\text{IDR23.310.500.000} - \text{IDR303.036.500,00}}{\text{IDR23.209.487.833,33}}\right)$$

TCPI = 1,00

$$\text{SV} = \text{EV} - \text{PV}$$

SV =IDR303.036.500,00 − IDR375.299.050,00

SV = -IDR72.262.550,00

Based on the Earned Value Analysis calculations for Week 1, the results are as shown in Table 2.

Table 2. Earned Value Analysis Calculation Results for Week 1

VARIABLE	VALUE
% Plan	1.61
% Actual	1.30
PV	IDR 375,299,050.00
AC	IDR 202,024,333.33
EV	IDR 303,036,500.00
CV	IDR 101,012,166.67
CPI	1.50
SPI	0.81
ETC	IDR 23,007,463,500.00
EAC	IDR 23,209,487,833.33
TCPI	1
SV	- IDR 72,262,550.00

Project Completion Time Forecast Analysis: The total project implementation time is planned for 180 calendar days (OD). Reporting is conducted at the end of Week 1, which is on 4 July 2019 or on Day 4 of the project (ATE). The analysis results show a schedule performance index (SPI) value of 0.81.

The formula for estimating the project completion time (TE) is:

$$\text{TE} = \text{ATE} + \frac{\text{OD-(ATE}\times\text{SPI)}}{\text{SPI}}$$

$$\text{TE} = 4 + \frac{\text{180-(4}\times\text{0,81)}}{\text{0,81}}$$

TE = 222.2 days ≈ 222 days

From the above analysis, the project is estimated to be completed in 222 days, which is highly unlikely if the performance remains the same until the end of the implementation period because the planned progress is greater than the actual progress.

The relationship between PV (IDR 375,299,050.00), AC (IDR 202,024,333.33), and EV (IDR 303,036,500.00) can be seen in Figure 3.

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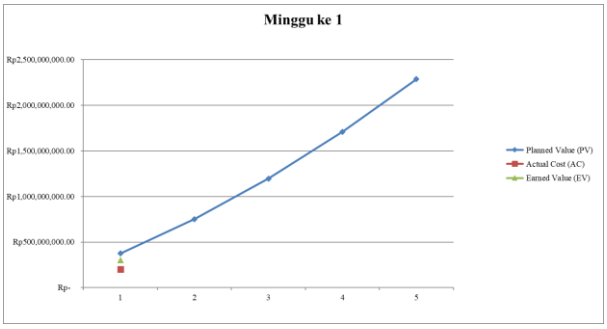

Figure 3. Graph of the Relationship between PV, AC, and EV up to Week 1

Discussion Week 1

If we look at the graph of the relationship between PV, AC, and EV up to Week 1 in Figure 5 above, the EV curve is below the PV curve. This illustrates that the work was completed later than the planned schedule. Meanwhile, the AC curve is also below the PV curve ( ), which means that the costs incurred to complete the work up to that period were lower than the allocated costs.

Overall, the results of the Earned Value Analysis calculation for Week 1 show that the CV value is IDR101,012,166.67 and the SV is –IDR72,262,550.00. Meanwhile, the CPI value is 1.50 and the SPI is 0.81. This means that up to Week 1, the project has incurred lower costs than the allocated funds, but in terms of schedule, the project has experienced a delay in progress or is below the initial plan. The estimated cost of completion at the end of the project (EAC) is IDR 23,209,487,833.33, which is lower than the budgeted cost (BAC) of IDR 23,310,500,000.00. while the estimated cost to complete the remaining work for the entire project (ETC) is IDR 23,007,463,500.00. Since the TCPI value is 1.00, this means that the plan estimate is acceptable or may be delayed from the schedule.

Earned Value Analysis (EVM) for the Following Weeks (Week 2 to Week 10)

Using the same calculation method and formula as in Week 1, the following is the analysis table and graph for Weeks 2 to 10.

Earned Value Analysis (EVM) Week 2

Based on the Earned Value Analysis calculations for Week 2, the results are as shown in Table 3.

Table 3 Earned Value Analysis Calculation Results for Week 2

Variable	Value
% Plan	3.22
% Actual	3.09
PV	IDR 750,598,100.00
AC	IDR 480,196,300.00
EV	IDR 720,294,450.00
CV	IDR 240,098,150.00
CPI	1.50
SPI	0.96
ETC	IDR 22,590,205,550.00
EAC	IDR 23,070,401,850.00
TCPI	1.00
SV	- IDR 30,303,650.00

The relationship between PV (IDR 750,598,100.00), AC (IDR 480,196,300.00), and EV (IDR 720,294,450.00) can be seen in Figure 4.

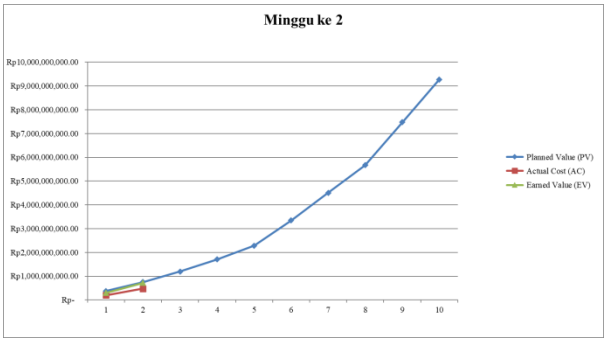

Figure 4. Graph of the Relationship between PV, AC, and EV up to Week 2

Week 2 Discussion

If we look at the graph of the relationship between PV, AC, and EV up to Week 2 in Figure 6 above, the EV curve is below the PV curve. This illustrates that the work is behind schedule. Meanwhile, the AC curve is also below the PV curve, which means that the costs incurred to complete the work up to that period are less than the allocated costs.

Overall, the results of the Earned Value Analysis calculation for Week 2 show that the CV value is IDR 240,098,150.00 and the SV is – IDR 30,303,650.00. Meanwhile, the CPI value is 1.50 and the SPI is 0.96. This means that up to Week 2, the project has incurred lower costs than the allocated funds, but in terms of schedule, the project has experienced a delay in progress or is below the initial plan. The estimated cost of completion at the end of the project (EAC) is IDR 23,070,401,850.00, which is lower than the budgeted cost (BAC) of IDR 23,310,500,000.00. while the estimated cost to complete the remaining work for the entire project (ETC) is IDR 22,590,205,550.00. Since the TCPI value is 1.00, this means that the plan estimate is acceptable or may be delayed from the schedule.

Earned Value Analysis (EVM) Week 3

Based on the Earned Value Analysis calculations for Week 3, the results are as shown in Table 4.

Table 4. Earned Value Analysis Calculation Results for Week 3

Variable	Value
% Plan	5.13
% Actual	7.89
PV	IDR 1,195,828,650.00
AC	IDR 1,226,132,300.00
EV	IDR 1,839,198,450.00
CV	IDR 613,066,150.00
CPI	1.50
SPI	1.54
ETC	IDR 21,471,301,550.00
EAC	IDR 22,697,433,850.00
TCPI	1.00
SV	IDR 643,369,800.00

The relationship between PV (IDR 1,195,828,650.00), AC (IDR 1,226,132,300.00), and EV (IDR 1,839,198,450.00) can be seen in Figure 5.

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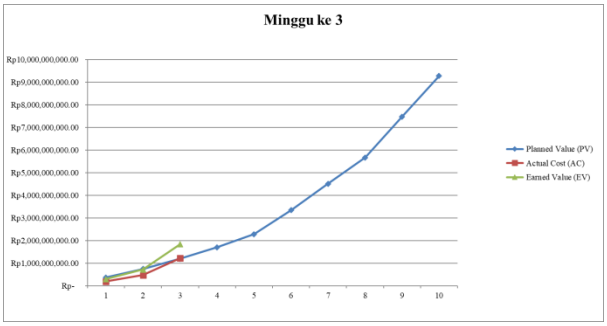

Figure 5. Graph of the Relationship between PV, AC, and EV up to Week 3

Week 3 Discussion

If we look at the graph of the relationship between PV, AC, and EV up to Week 3 in Figure 7 above, the EV curve is below the PV curve. This illustrates that the work was completed later than the planned schedule. Meanwhile, the AC curve is also below the PV curve, which means that the costs incurred to complete the work up to that period were lower than the allocated costs.

Overall, the results of the Earned Value Analysis calculation for Week 3 show that the CV value is IDR 613,066.150.00 and the SV is IDR 643,369.800.00. Meanwhile, the CPI value is 1.50 and the SPI is 1.54. This means that up to Week 3, the project has incurred lower costs than the allocated funds, but in terms of schedule, the project has experienced a delay in progress or is below the initial plan. The estimated cost of completion at the end of the project (EAC) is IDR 22,697,433,850.00, which is lower than the budgeted cost (BAC) of IDR 23,310,500,000.00. while the estimated cost to complete the remaining work of the entire project (ETC) is IDR 21,471,301,550.00. Since the TCPI value is 1.00, this means that the plan estimate is acceptable or may be delayed from the schedule.

Earned Value Analysis (EVM) Week 4

Based on the Earned Value Analysis calculations for Week 4, the results are as shown in Table 5.

Table 5. Earned Value Analysis Calculation Results for Week 4

Variable	Value
% Plan	7.3
% Actual	12.70
PV	IDR 1,708,659,650.00
AC	IDR 1,973,622,333.33
EV	IDR 2,960,433,500.00
CV	IDR 986,811,166.67
CPI	1.50
SPI	1.73
ETC	IDR 20,350,066,500.00
EAC	IDR 22,323,688,833.33
TCPI	1.00
SV	IDR 1,251,773,850.00

The relationship between PV (IDR 1,708,659,650.00), AC (IDR 1,973,622,333.33), and EV (IDR 2,960,433,500.00) can be seen in Figure 6.

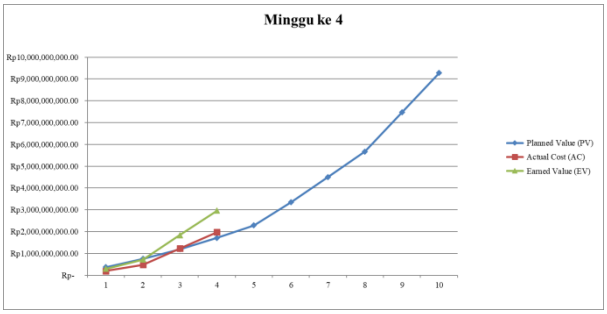

Figure 6. Graph of the Relationship between PV, AC, and EV up to Week 4

Week 4 Discussion

If we look at the graph of the relationship between PV, AC, and EV up to Week 4 in Figure 8 above, the EV curve is below the PV curve. This illustrates that the work was completed later than the planned schedule. Meanwhile, the AC curve is also below the PV curve, which means that the costs incurred to complete the work up to that period were lower than the allocated costs.

Overall, the results of the Earned Value Analysis calculation for Week 4 show that the CV value is IDR 986,811,166.67 and the SV is IDR 1,251,773,850.00. Meanwhile, the CPI value is 1.50 and the SPI is 1.73. This means that up to Week 4, the project has incurred lower costs than the allocated funds, but in terms of schedule, the project has experienced a delay in progress or is below the initial plan. The estimated cost of completion at the end of the project (EAC) is IDR 22,323,688,833.33, which is lower than the budget that has been set at (BAC) IDR 23,310,500,000.00. while the estimated cost to complete the remaining work of the entire project (ETC) is IDR 20,350,066,500.00. Since the TCPI value is 1.00, this indicates that the planned estimate is acceptable or may be delayed from the schedule.

Earned Value Analysis (EVM) Week 5

Based on the Earned Value Analysis calculations for Week 5, the results are as shown in Table 6.

Table 6. Earned Value Analysis Calculation Results for Week 5

Variable	Value
% Plan	9.81
% Actual	17.51
PV	IDR 2,286,760,050.00
AC	IDR 2,721,112,366.67
EV	IDR 4,081,668,550.00
CV	IDR 1,360,556,183.33
CPI	1.50
SPI	1.78
ETC	IDR 19,228,831,450.00
EAC	IDR 21,949,943,816.67
TCPI	1.00
SV	IDR 1,794,908,500.00

The relationship between PV (IDR 2,286,760,050.00), AC (IDR 2,721,112,366.67), and EV (IDR 4,081,668,550.00) can be seen in Figure 7.

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Figure 7. Graph of the Relationship between PV, AC, and EV up to Week 5

Week 5 Discussion

If we look at the graph of the relationship between PV, AC, and EV up to Week 5 in Figure 9 above, the EV curve is below the PV curve. This illustrates that the work was completed later than the planned schedule. Meanwhile, the AC curve is also below the PV curve, which means that the costs incurred to complete the work up to that period were lower than the allocated costs.

Overall, the results of the Earned Value Analysis calculation for Week 5 show that the CV value is IDR 1,360,556,183.33 and the SV is IDR 1,794,908,500.00. Meanwhile, the CPI value is 1.50 and the SPI is 1.78. This means that up to Week 5, the project has incurred costs lower than the allocated funds, but in terms of schedule, the project has experienced a delay in progress or is below the initial plan. The estimated cost of completion at the end of the project (EAC) is IDR 21,949,943,816.67, which is lower than the budgeted cost (BAC) of IDR 23,310,500,000.00. while the estimated cost to complete the remaining work for the entire project (ETC) is IDR 19,228,831,450.00. Since the TCPI value is 1.00, this means that the plan estimate is acceptable or may be delayed from the schedule.

Earned Value Analysis (EVM) Week 6

Based on the Earned Value Analysis calculations for Week 6, the results are as shown in Table 7.

Table 7. Earned Value Analysis Calculation Results for Week 6

Variable	Value
% Plan	14.3
% Actual	22.32
PV	IDR 3,342,725,700.00
AC	IDR 3,468,602,400.00
EV	IDR 5,202,903,600.00
CV	IDR 1,734,301,200.00
CPI	1.50
SPI	1.56
ETC	IDR 18,107,596,400.00
EAC	IDR 21,576,198,800.00
TCPI	1
SV	IDR 1,860,177,900.00

The relationship between PV (IDR 3,342,725,700.00), AC (IDR 3,468,602,400.00), and EV (IDR 5,202,903,600.00) can be seen in Figure 8.

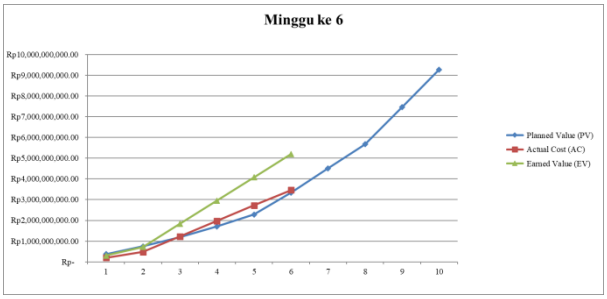

Figure 8. Graph of the Relationship between PV, AC, and EV up to Week 6

Week 6 Discussion

If we look at the graph of the relationship between PV, AC, and EV up to Week 6 in Figure 10 above, the EV curve is below the PV curve. This illustrates that the work was completed later than the planned schedule. Meanwhile, the AC curve is also below the PV curve, which means that the costs incurred to complete the work up to that period were lower than the allocated costs.

Overall, the results of the Earned Value Analysis calculation for Week 6 show that the CV value is IDR 1,734,301.20 and the SV is IDR 1,860,177.90. Meanwhile, the CPI value is 1.50 and the SPI is 1.56. This means that up to Week 6, the project has incurred lower costs than the allocated funds, but in terms of schedule, the project has experienced a delay in progress or is below the initial plan. The estimated cost of completion at the end of the project (EAC) is IDR 21,576,198,800.00, which is lower than the budgeted cost (BAC) of IDR 23,310,500,000.00. while the estimated cost to complete the remaining work for the entire project (ETC) is IDR 18,107,596,400.00. Since the TCPI value is 1.00, this means that the plan estimate is acceptable or may be delayed from the schedule.

Earned Value Analysis (EVM) Week 7

Based on the Earned Value Analysis calculations for Week 7, the results are as shown in Table 8.

Table 8. Earned Value Analysis Calculation Results for Week 7

Variable	Value
% Plan	19.34
% Actual	27.13
PV	Rp 4,508,250,700.00
AC	IDR 4,216,092,433.33
EV	IDR 6,324,138,650.00
CV	IDR 2,108,046,216.67
CPI	1.50
SPI	1.40
ETC	IDR 16,986,361,350.00
EAC	IDR 21,202,453,783.33
TCPI	1
SV	IDR 1,815,887,950.00

For the relationship between PV (IDR 4,508,250,700.00), AC (IDR 4,216,092,433.33), and EV (IDR 6,324,138,650.00), see Figure 9.

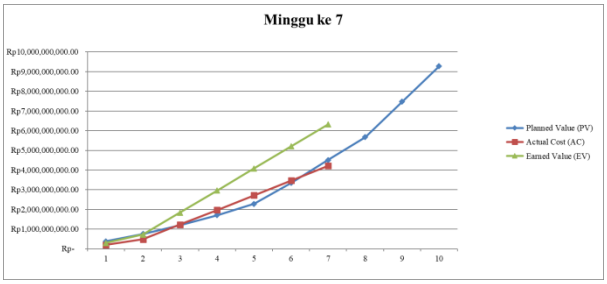

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Figure 9. Graph of PV, AC, and EV Relationships up to Week 7

Week 7 Discussion

If we look at the PV, AC, and EV relationship graph up to Week 7 in Figure 11 above, the EV curve is below the PV curve. This illustrates that the work was completed later than the planned schedule. Meanwhile, the AC curve is also below the PV curve, which means that the costs incurred to complete the work up to that period were lower than the allocated costs.

Overall, the results of the Earned Value Analysis calculation for Week 7 show that the CV value is IDR 2,108,046,216.67 and the SV is IDR 1,815,887,950.00. Meanwhile, the CPI value is 1.50 and the SPI is 1.40. This means that up to Week 7, the project has incurred lower costs than the allocated funds, but in terms of schedule, the project has experienced a delay in progress or is below the initial plan. The estimated cost of completion at the end of the project (EAC) is IDR 21,202,453,783.33, which is lower than the budgeted cost (BAC) of IDR 23,310,500,000.00. while the estimated cost to complete the remaining work for the entire project (ETC) is IDR 16,986,361,350.00. Since the TCPI value is 1.00, this means that the plan estimate is acceptable or may be delayed from the schedule.

Earned Value Analysis (EVM) Week 8

Based on the Earned Value Analysis calculations for Week 8, the results are as shown in Table 9.

Table 9. Earned Value Analysis Calculation Results for Week 8

Variable	Value
% Plan	24.3
% Actual	31.94
PV	IDR 5,671,444,650.00
AC	IDR 4,963,582,466.67
EV	IDR 7,445,373,700.00
CV	IDR 2,481,791,233.33
CPI	1.50
SPI	1.31
ETC	IDR 15,865,126,300.00
EAC	IDR 20,828,708,766.67
TCPI	1
SV	IDR 1,773,929,050.00

For the relationship between PV (IDR 5,671,444,650.00), AC (IDR 4,963,582,466.67), and EV (IDR 7,445,373,700.00), see Figure 10.

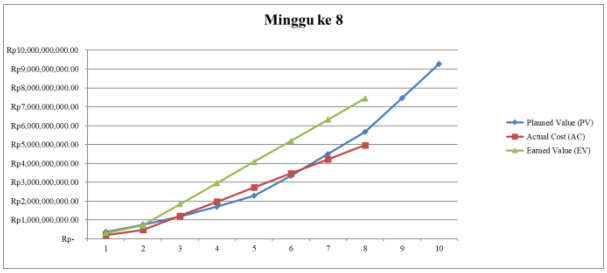

Figure 10. Graph of PV, AC, and EV relationships up to Week 8

Week 8 Discussion

If we look at the graph of the relationship between PV, AC, and EV up to Week 8 in Figure 12 above, the EV curve is below the PV curve. This illustrates that the work is behind schedule. Meanwhile, the AC curve is also below the PV curve, which means that the costs incurred to complete the work up to that period are less than the allocated costs.

Overall, the results of the Earned Value Analysis calculation for Week 8 show that the CV value is IDR 2,481,791,233.33 and the SV is IDR 1,773,929,050.00. Meanwhile, the CPI value is 1.50 and

the SPI is 1.31. This means that up to Week 8, the project has incurred lower costs than the allocated funds, but in terms of schedule, the project has experienced a delay in progress or is below the initial plan. The estimated cost of completion at the end of the project (EAC) is IDR 20,828,708,766.67, which is lower than the budgeted cost (BAC) of IDR 23,310,500,000.00. while the estimated cost to complete the remaining work for the entire project (ETC) is IDR 15,865,126,300.00. Since the TCPI value is 1.00, this means that the plan estimate is acceptable or may be delayed from the schedule.

Earned Value Analysis (EVM) Week 9

Based on the Earned Value Analysis calculations for Week 9, the results are as shown in Table 10.

Table 10. Earned Value Analysis Calculation Results for Week 9

Variable	Value
% Plan	32.06
% Actual	34.48
PV	IDR 7,473,346,300.00
AC	IDR 5,358,306,933.33
EV	IDR 8,037,460,400.00
Limited Liability Company	IDR 2,679,153,466.67
CPI	1.50
SPI	1.08
ETC	IDR 15,273,039,600.00
EAC	IDR 20,631,346,533.33
TCPI	1
SV	IDR 564,114,100.00

For the relationship between PV (IDR 7,473,346,300.00), AC (IDR 5,358,306,933.33), and EV (IDR 8,037,460,400.00), see Figure 11.

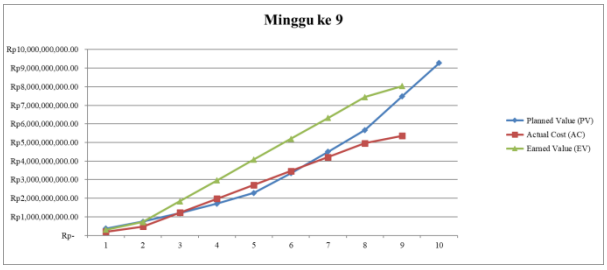

Figure 11. Graph of PV, AC, and EV relationships up to Week 9

Week 9 Discussion

If we look at the graph of the relationship between PV, AC, and EV up to Week 9 in Figure 13 above, the EV curve is below the PV curve. This illustrates that the work is behind schedule. Meanwhile, the AC curve is also below the PV curve, which means that the costs incurred to complete the work up to that period are less than the allocated costs.

Overall, the results of the Earned Value Analysis calculation for Week 9 show that the CV value is IDR 2,679,153,466.67 and the SV is IDR 564,114,100.00. Meanwhile, the CPI value is 1.50 and the SPI is 1.08. This means that up to Week 9, the project has incurred lower costs than the allocated funds, but in terms of schedule, the project has experienced a delay in progress or is below the initial plan. The estimated cost of completion at the end of the project (EAC) is IDR 20,631,346,533.33, which is lower than the budgeted cost (BAC) of IDR 23,310,500,000.00. while the estimated cost to complete the remaining work for the entire project (ETC) is IDR 15,273,039,600.00. Since the TCPI value is 1.00, this means that the plan estimate is acceptable or may be delayed from the schedule.

Earned Value Analysis (EVM) Week 10

Based on the Earned Value Analysis calculations for Week 10, the results are as shown in Table 11.

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Table 11. Earned Value Analysis Calculation Results for Week 10

Variable	Value
% Plan	39.79
% Actual	36.13
PV	IDR 9,275,247,950.00
AC	IDR 5,614,722,433.33
EV	IDR 8,422,083,650.00
Limited Liability Company	IDR 2,807,361,216.67
CPI	1.50
SPI	0.91
ETC	IDR 14,888,416,350.00
EAC	IDR 20,503,138,783.33
TCPI	1
SV	-IDR 853,164,300.00

The relationship between PV (IDR 9,275,247,950.00), AC (IDR 5,614,722,433.33), and EV (IDR 8,422,083,650.00) can be seen in Figure 12.

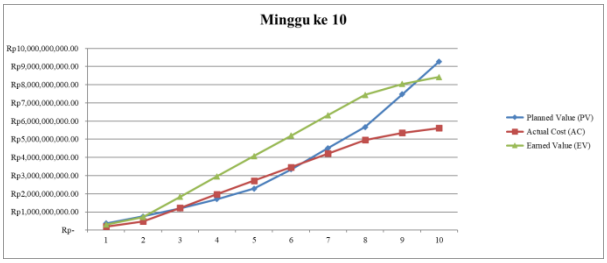

Figure 12 Graph of the Relationship between PV, AC, and EV up to Week 10

Discussion of CPI and SPI
Cost Performance Index (CPI)

The cost performance index (CPI) in this final project research, which was calculated during the project implementation from Week 1 to Week 10, shows a stagnant CPI value of 1.50 or equal to 1 (one). This means that from Week 1 to Week 10, the actual costs incurred were less than the budgeted funds. This means that the contractor still has sufficient savings from the costs planned or agreed upon by the owner and contractor in the work contract. This could be due to the contractor's good analysis of the unit price of the work during the bidding or tender process. The CPI graph can be seen in Figure 13.

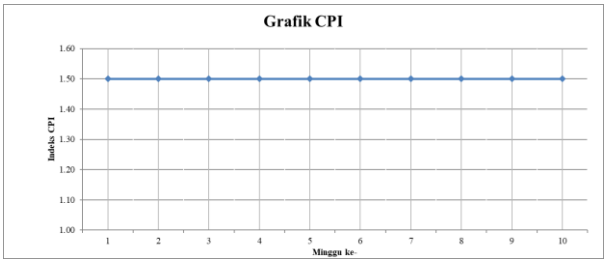

Figure 13. CPI Graph During the Review Period

Schedule Performance Index (SPI)

The schedule performance index (SPI) at the beginning of this final project research, namely in Week 1, reached a value of 0.81 or below 1 (one), meaning that during that week there was a deterioration or delay in performance. This was due to one work item that was minimally carried out based on a mutual agreement in the PCM (Pre-Construction Meeting) between the owner, supervision consultant and implementing contractor, namely the procurement of furniture. In Week

5, the curve rose above 1.00 due to the addition of labour and adequate heavy equipment at the site. At the end of this final project research, namely in Week 10, the SPI value was 0.91, meaning that with this level of performance, the contractor, through the Site Manager, should immediately take preventive measures or accelerate work activities so that there would be no delays. Since the construction of this health centre has the largest weight of work out of the total overall work weight and is also included in the critical path activities, any delays or accelerations will significantly affect the overall completion schedule of the project. The SPI graph can be seen in Figure 14.

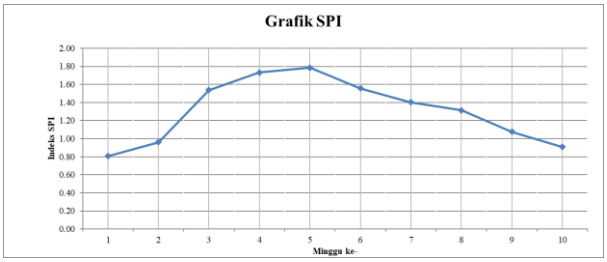

Figure 14. SPI Graph During the Review Period

Discussion of CV and SV
Cost Variation (CV)

The cost variance (CV) graph at the beginning of the study, namely in Week 1, until the end of this final project study, namely in Week 10, tended to increase. This means that the difference between the actual costs incurred and the budgeted funds always increased. At the beginning of the study, there was a cost difference of IDR 101,012,166.67, while in Week 10, there was a cost difference of IDR 2,807,361,216.67. Based on information from the Site Manager, the cause was the increasing number of work activities that had been carried out, so that cumulatively each week there was an increase in the cost difference. The CV graph can be seen in Figure 17.

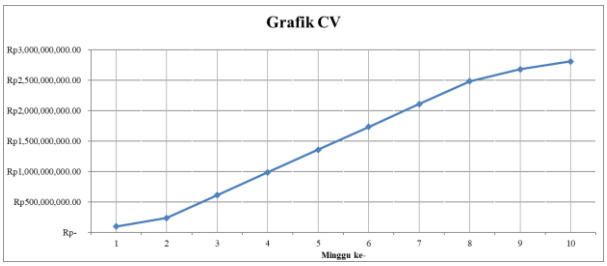

Figure 15. CV Graph During the Review Period

Schedule Variance (SV)

In terms of form and principle, the schedule variance (SV) graph is essentially the same as the schedule performance index (SPI) graph. The difference between the two graphs is that SV illustrates project delays or accelerations in terms of cost, while SPI illustrates project delays or accelerations in terms of index values. The SV graph can be seen in Figure 16.

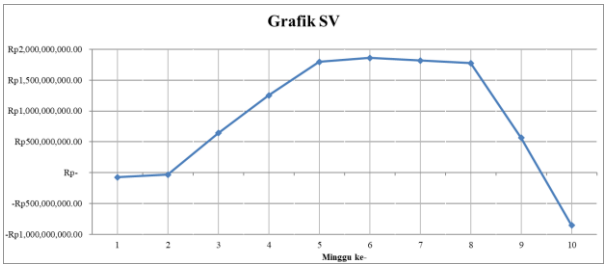

Figure 16. SV Graph During the Review Period

CONCLUSION

Based on the results of the performance analysis and project forecast using the Earned Value Analysis method discussed in Chapter IV, it can be concluded that the cost performance of the Landikma Health Centre Construction Project has a value of IDR 23,310,500,000.00 with a cumulative plan weight of 100%, while the project implementation period was set at 180 calendar days with a work realisation weight of 87.46%. The analysis also shows that the project cost performance, as indicated by the Cost Performance Index (CPI) in week 10, was 1.50, which means that the use of project costs was efficient or better than planned. However, in terms of time, the project performance as indicated by the Schedule Performance Index (SPI) in week 23 or at the end of the 180-calendar-day project implementation period showed a value of 0.87, indicating that the project implementation was delayed compared to the planned schedule. In addition, based on interviews with relevant parties, it was found that during the reporting period until near the end of the project implementation, work activity in the field tended to decline or slow down. This was influenced by several factors, such as high rainfall, difficult terrain at the work site, and the contractor's division of labour with other ongoing projects. Apart from these factors, the security situation at the project site, which was marred by riots and unrest, also affected the productivity of the workforce in the field, resulting in suboptimal results and delays in the completion of the project.

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