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COST AND TIME STUDY ON THE REHABILITATION PROJECT OF THE DIR. POLDER TAMBAK HANYAR IRRIGATION NETWORK IN BANJAR REGENCY USING THE EARNED VALUE METHOD

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ABSTRACT

The implementation of construction projects often faces various issues that cause discrepancies between actual results and plans, both in terms of cost and time. Similar problems also occur in the Rehabilitation Project of the DIR. Polder Tambak Hanyar Irrigation Network in Banjar Regency, making it necessary to conduct an evaluation to ensure the project can return to running according to plan. One effective evaluation method that can be used is the earned value method, which allows for a comprehensive analysis of project performance by comparing the value of completed work with planned costs and timelines, enabling the project to identify issues and make appropriate decisions to address the discrepancies. In the earned value method, three indicators are used: planned value, earned value, and actual cost. This method also includes variance analysis, performance index analysis, and cost and time estimation analysis for project completion. The goal is to identify deviations related to costs and time, allowing for control measures to be implemented to manage costs and time effectively. The results of the analysis using the earned value method show that, in terms of time performance, delays occurred from the first week to the eighth week, with a Schedule Performance Index (SPI) below 1. Meanwhile, in terms of cost performance, the project experienced losses during the first, second, third, and fifth weeks, with a Cost Performance Index (CPI) below 1.

Keywords: earned value method, planned value, earned value, actual cost, cost and time evaluation.

1. INTRODUCTION

In the implementation of the Rehabilitation Project for the DIR. Polder Tambak Hanyar irrigation network, work progress on the site exhibited negative deviations from the first to the eighth week, indicating delays. To address this issue, an evaluation is necessary to ensure the projects proceed according to the planned schedule. The evaluation method employed is the Earned Value Method, which integrates measurements of cost, time, and work progress. By comparing the planned work budget with actual performance, this method identifies early performance variances that

contribute to delays, thereby enabling the stakeholders to anticipate issues and take necessary measures to prevent further losses or delays in the project.

2. THEORITICAL STUDY

Earned Value Concept

According to Flemming and Koppleman (1994), when comparing the earned value concept with traditional cost management, it was found that the earned value concept introduces a new element: the amount of physical work that has been completed. This additional element enables project managers to more accurately assess the level of performance achieved relative to the costs incurred.

There are three important indicators in the earned value concept used (Castollani, Puro, & Dewa, 2020), namely:

a. ACWP (Actual Cost of Work Performed) or Actual Cost

$$\text{Actual Cost} = \text{Direct Cost} + \text{Indirect Costs}$$

b. BCWP (Budgeted Cost of Work Performed) or Earned Value

$$\text{Earned Value} = \text{Realization Percentage} \times \text{Budgeted Cost Plan}$$

c. BCWS (Budgeted Cost of Work Scheduled) or Planned Value

$$\text{Planned Value} = \text{Planned Weight Percentage} \times \text{Budgeted Cost Plan}$$

Project Performance Evaluation Using the Earned Value Concept

Soemardi, Abduh, Wirahadikusumah, and Pujoartanto (2007) state that the use of the earned value concept in the project performance evaluation employs related terms such as cost variance, schedule variance, cost performance index, schedule performance index, estimate at completion, and variance at completion.

Using the three key indicators mentioned above, various factors that indicate the progress and performance of project implementation can be calculated as follows:

a. Cost Variance (CV)

$$CV = BCWP - ACWP$$

Explanation:

EV = BCWP = Earned Value

AC = ACWP = Actual Cost

CV = Cost Variance

b. Schedule Variance (SV)

$$SV = BCWP - BCWS$$

Explanation:

PV = BCWS = Planned cost

EV = BCWP = Cost planned based on actual progress

SV = Schedule Variance

c. Cost Performance Index (CPI)

$$CPI = \frac{BCWP}{ACWP}$$

Explanation:

AC = ACWP = Actual Cost

EV = BCWP = Cost planned based on actual progress

CPI = Cost Performance Index or cost efficiency factor

d. Schedule Performance Index (SPI)

$$SPI = \frac{BCWP}{BCWS}$$

Explanation:

PV = BCWS = Planned cost

EV = BCWP = Cost planned based on actual progress

SPI = Schedule Performance Index or performance efficiency factor

According to Soeharto (1999), the earned value method can also be used to estimate the project's final cost and completion time.

a. Estimate to Complete (ETC)

ETC for progress > 50%:

$$\text{ETC} = \frac{(\text{Budgeted Cost Plan - EV})}{\text{CPI}}$$

Explanation:

ETC = Estimated cost for the remaining work

EV = Cost planned bases on actual progress

CPI = Cost performance index

b. Estimate at Completion (EAC)

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

Explanation:

EAC = Predicted final project cost

AC = ACWP = Actual cost

ETC = Estimated cost for the remaining work

c. Estimate Temporary Schedule (ETS)

$$\text{ETS} = \frac{\text{Remaining Time}}{\text{SPI}}$$

Explanation:

ETS = Estimated remaining time

SPI = Performance efficiency relative to the plan

d. Estimate as Schedule (EAS)

$$EAS = ATE + ETS$$

Explanation:

EAS = Estimated total project completion time

ATE = Time elapsed so far

ETS = Estimated remaining time

3. METHOD

Research Object

This research was conducted on the Rehabilitation Project for the DIR. Polder Tambak Hanyar Irrigation Network, executed by CV. Bima Karya Mandiri as the contracting party. The project was funded by the South Kalimantan Public Works and Housing Agency in 2022, with a budget of Rp 9.531.341.434,00 and a project duration of 180 calendar days.

Data Collection Techniques

This study employs two types of data: primary data and secondary data.

1. Primary Data

Primary data were obtained directly by the researcher through face-to-face interviews with relevant parties. These data encompass the project location, profit, and field observations of the project's performance.

2. Secondary Data

Secondary data were previously compiled and processed by other entities and provided by the relevant agencies. These include the project schedule (S-curve), budgeted cost plan, weekly project reports, monthly project reports, and the project payment system. Additionally, supporting literature such as journals and books were also utilized.

4. RESULT AND DISCUSSION

Planned Value (PV)

Planned Value (PV) is calculated based on the cumulative planned budget according to the predetermined time schedule data. In the DIR. Polder Tambak Hanyar Irrigation Network Rehabilitation project, the work is scheduled to last for 26 weeks. Below is an example of the planned value calculation for week 1:

PV = Planned Weight Percentage x Budgeted Cost Plan
= 0.163% x Rp 8,586,794,084.68
= Rp 13,996,474.36

Earned Value (EV)

Earned Value (EV) is calculated based on the cumulative amount of work completed according to the project progress report. The Rehabilitation Project of the Irrigation Network of DIR. Polder Tambak Hanyar took place over 25 weeks. Below is an example of the earned value calculation for week 1:

EV = Realization Weight Percentage x Budgeted Cost Plan
= 0.026% x Rp 8,586,794,084.68
= Rp 2,232,566.46

Actual Cost (AC)

Actual Cost (AC) is obtained from the project's expenditure and revenue data as of the reporting date. The determination of the direct cost for this project uses an assumption of 12% based on the research journal by Soemardi & Kusumawardini (2010). Below is an example of the actual cost calculation for week 1:

$$\text{AC Weight} = \frac{\text{Direct Cost+Indirect Cost}}{\text{Budgeted Cost Plan-Tax}} \times 100$$

$$= \frac{\text{Rp 1,719,076.18 + Rp 1,679,576.92}}{\text{Rp 7,642,246,735.37}} \times 100$$

$$= 0.044\%$$

AC for week 1 = 0.044% x Rp 7,642,246,735.37
= Rp 3,398,653.10

Schedule Variance (SV)

Schedule Variance (SV) is calculated by subtracting the Planned Value (PV) from the Earned Value (EV). Below is an example of the schedule variance calculation for the first week:

SV = EV – PV
= Rp 2,232,566.46 – Rp 13,996,474.36
= Rp -11,763,907.90

A negative SV value indicates that the actual schedule performance is lagging behind what was planned.

Cost Variance (CV)

Cost Variance (CV) is derived from the difference between the Earned Value (EV) and the Actual Cost (AC). Below is an example of the cost variance calculation for week 1:

CV = EV – AC
= Rp 2,232,566.46 – Rp 3,398,653.10
= Rp -1,166,086.64

A negative CV value indicates that the actual cost performance is higher than the budgeted cost.

Schedule Performance Index (SPI)

Schedule Performance Index (SPI) is the ratio between the value of physically completed work (EV) and the planned cost expenditure based on the work plan (PV). Below is an example of the schedule performance index calculation for week 1:

SPI = EV : PV
= Rp 2,232,566.46 : Rp 13,996,474.36
= 0.16

A schedule performance index value below 1 indicates that the project's actual performance is lagging behind the planned schedule.

Cost Performance Index (CPI)

Cost Performance Index (CPI) is used to measure the cost efficiency of the funds expended. Below is an example of the cost performance index calculation for week 1:

CPI = EV : AC
= Rp 2,232,566.46 : Rp 3,398,653.10
= 0.66

A cost performance index value below 1 indicates that the actual cost of the project is higher than the budgeted cost.

Estimate to Complete (ETC)

Estimate to Complete (ETC) is the estimated cost for the remaining work, assuming that the project control measures will remain consistent until the project is completed. Below is an example of the ETC calculation for week 1:

ETC = (Budgeted Cost Plan – EV) : CPI
= (Rp 8,586,795,084.68 – Rp 2,232,566.46) : 0.66
= Rp 13,068,344,034.28

Estimate at Completion (EAC)

Estimate at Completion (EAC) is the estimated total cost at the end of the project, calculated by adding the Actual Cost (AC) to the Estimate to Complete (ETC). Below is an example of the EAC calculation for week 1:

EAC = ETC + AC
= Rp 13,068,344,034.28 + Rp 3,398,653.10
= Rp 13,071,742,687.38

Estimate Temporary Schedule (ETS)

Estimate Temporary Schedule (ETS) is used to estimate the remaining time required to complete the project. Below is an example of the ETS calculation for week 1:

ETS = Remaining Time : SPI
= 25 : 0.16
= 156.73 weeks

Estimate as Schedule (EAS)

Estimate as Schedule (EAS) is the estimated total time required to complete the project, calculated by adding the time already spent (ATE) to the Estimate Temporary Schedule (ETS). Below is an example of the EAS calculation for week 1:

EAS = ATE + ETS

= 1 + 156.73

= 157.73 weeks

Table 1. Recapitulation of Project Cost and Time Performance

Weekly	PV	EV	SV	SPI	ETS	EAS	AC	EV	CV	CPI	ETC	EAC
1	13,996,474.36	2,232,566.46	-11,763,907.90	0.16	156.73	157.73	3,398,653.10	2,232,566.46	-1,166,086.64	0.66	13,068,344,034.28	13,071,742,687.38
2	36,751,478.68	4,551,000.86	-32,200,477.82	0.12	193.81	195.81	7,914,448.11	4,551,000.86	-3,363,447.24	0.58	14,925,006,510.11	14,932,920,958.21
3	46,883,895.70	18,118,135.52	-28,765,760.18	0.39	59.52	62.52	19,577,031.83	18,118,135.52	-1,458,896.31	0.93	9,258,637,107.35	9,278,214,139.18
4	57,016,312.72	30,912,458.70	-26,103,854.02	0.54	40.58	44.58	30,644,550.73	30,912,458.70	267,907.98	1.01	8,481,730,651.89	8,512,375,202.62
5	307,321,360.29	56,157,633.31	-251,163,726.98	0.18	114.92	119.92	80,119,940.89	56,157,633.31	-23,962,307.57	0.70	12,170,635,546.35	12,250,755,487.24
6	549,812,425.24	390,613,262.91	-159,199,162.33	0.71	28.15	34.15	366,749,703.47	390,613,262.91	23,863,559.44	1.07	7,695,455,253.04	8,062,204,956.51
7	792,303,490.19	705,920,341.70	-86,383,148.49	0.89	21.33	28.33	638,635,081.93	705,920,341.70	67,285,259.77	1.11	7,129,703,099.96	7,768,338,181.90
8	1,067,166,768.84	1,024,919,741.95	-42,247,026.90	0.96	18.74	26.74	917,248,213.56	1,024,919,741.95	107,671,528.39	1.12	6,767,472,074.32	7,684,720,287.88
9	1,342,030,047.50	1,456,921,352.35	114,891,304.85	1.09	15.66	24.66	1,282,873,047.01	1,456,921,352.35	174,048,305.34	1.14	6,278,116,208.65	7,560,989,255.66
10	1,584,521,112.45	1,872,951,525.75	288,430,413.30	1.18	13.54	23.54	1,632,315,208.32	1,872,951,525.75	240,636,317.43	1.15	5,851,249,839.92	7,483,565,048.24
11	1,827,012,177.40	1,914,511,609.12	87,499,431.72	1.05	14.31	25.31	1,693,415,400.31	1,914,511,609.12	221,096,208.81	1.13	5,901,737,991.83	7,595,153,392.14
12	2,069,503,242.35	1,997,717,643.80	-71,785,598.55	0.97	14.50	26.50	1,786,582,974.81	1,997,717,643.80	211,134,668.99	1.12	5,892,690,503.85	7,679,273,478.66
13	2,553,712,560.79	2,600,167,116.78	46,454,556.00	1.02	12.77	25.77	2,308,574,187.22	2,600,167,116.78	291,592,929.57	1.13	5,315,263,160.35	7,623,837,347.57
14	3,037,921,879.22	3,211,976,195.32	174,054,316.10	1.06	11.35	25.35	2,837,772,295.90	3,211,976,195.32	374,203,899.42	1.13	4,748,637,092.70	7,586,409,388.60
15	3,524,363,764.12	4,229,081,954.65	704,718,190.53	1.20	9.17	24.17	3,679,316,756.77	4,229,081,954.65	549,765,197.87	1.15	3,791,225,479.47	7,470,542,236.25
16	4,043,177,862.71	4,746,264,562.37	703,086,699.65	1.17	8.52	24.52	4,139,805,056.55	4,746,264,562.37	606,459,505.82	1.15	3,349,801,370.61	7,489,606,427.16
17	4,561,991,961.31	5,199,217,950.34	637,225,989.02	1.14	7.90	24.90	4,550,836,857.12	5,199,217,950.34	648,381,093.22	1.14	2,965,120,230.72	7,515,957,087.84
18	5,048,433,846.21	5,863,664,076.61	815,230,230.40	1.16	6.89	24.89	5,120,833,400.53	5,863,664,076.61	742,830,676.07	1.15	2,378,153,815.97	7,498,987,216.50
19	5,534,875,731.11	6,984,584,176.42	1,449,708,445.32	1.26	5.55	24.55	6,042,314,903.58	6,984,584,176.42	942,269,272.84	1.16	1,386,060,581.82	7,428,375,485.40
20	6,021,317,616.00	7,496,271,235.93	1,474,953,619.93	1.24	4.82	24.82	6,494,686,965.59	7,496,271,235.93	1,001,584,270.34	1.15	944,817,004.16	7,439,503,969.74
21	6,510,593,142.95	7,711,284,559.81	1,200,691,416.86	1.18	4.22	25.22	6,718,960,288.21	7,711,284,559.81	992,324,271.60	1.15	762,844,852.11	7,481,805,140.31
22	6,999,868,669.89	7,810,204,427.67	810,335,757.77	1.12	3.58	25.58	6,853,841,649.69	7,810,204,427.67	956,362,777.98	1.14	681,495,930.78	7,535,337,580.47
23	7,538,432,394.89	8,086,183,989.55	547,751,594.66	1.07	2.80	25.80	7,130,973,559.34	8,086,183,989.55	955,210,430.21	1.13	441,473,673.69	7,572,447,233.02
24	8,076,996,119.88	8,572,711,742.39	495,715,622.51	1.06	1.88	25.88	7,570,227,576.02	8,572,711,742.39	1,002,484,166.36	1.13	12,435,567.56	7,582,663,143.58
25	8,552,446,908.35	8,586,794,084.68	34,347,176.34	1.00	0.00	25.00	7,642,246,735.37	8,586,794,084.68	944,547,349.32	1.12	0.00	7,642,246,735.37
26	8,586,794,084.68	-	-	-	-	-	-	-	-	-	-	-

5. CONCLUSION

Based on the study conducted using the earned value method, it can be concluded that the project's schedule performance experienced delays from weeks 1 to 8, as indicated by an SPI value below 1, and that the cost performance experienced overspending in weeks 1, 2, 3, and 5, as indicated by a CPI value below 1. One of the actions that can be taken by the executing party is to change the work method to be more effective.

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