Analysis of Time and Cost Control in a 2-Storey Construction Project Using The Earned Value Method (Case Study: Puri Cempaka Serang Housing Development Project)

Dwi Novi Setaiwati[1*], Bambang Setyo P[2], Inggit Kurniawan[3]
[1,2,3]Department of Civil Engineering, Bina Bangsa University, Indonesia

Article Info

Article history:

Received March 29, 2023
Accepted April 22, 2023
Published April 30, 2023

Keywords:

Method Earned Value, Time, Cost Performance

ABSTRACT

Poor planning is a common factor in project delays. For this reason, a time and cost analysis method is needed to examine how much deviation occurs and the remaining time and costs to complete the project. This research aims to find out time and cost performance, what causes delays, and the estimated time and cost of project completion. For management activities, costs (Cost Management) and time management (Time Management) can be This is done by using one of the project control methods, namely the value concept method results (Earned Value). Earned Value (EV) method is one of the techniques for determining the real advantages and disadvantages of projects and provides a means to balance gains/losses and maximize profits. Week 1 to week nine cost performance saves job fees. However, from the 14th to the 20th week of experiencing expenditure is greater than the project budget with a CPI value of 0,748 and performance. The time from week 1 to week 9 is faster. However, from week 13 to week 20, time performance is slower, with an SPI value of 0,59. The result of the calculation of the estimated cost of completing the project is Rp. 5.245.556.910 with an estimated turnaround time of 41 weeks, showing the project was 17 weeks late from the planned 24 weeks. Causative factor delays are work drawings or shop drawings that are late coming out, their gradual submission, lack of fill land, and workers getting a portion of the Eid holiday of ± 1 month.

Available online at http://dx.doi.org/10.36055/fondasi

Corresponding Author:

Dwi Novi Setiawati,
Department of Civil Engineering,
Bina Bangsa University,
Jl. Raya Serang-Jakarta Km 03, Banten, 42124, Indonesia.
Email: *dwinovi72@gmail.com

1. INTRODUCTION

The construction industry has recently been growing rapidly in terms of technology, project capacity, and required funds, and there are various methods of construction implementation. This can be demonstrated by the large number of large-scale development projects built by the government or the private sector. This fact is a hope and a challenge for business actors, especially construction service companies. Poor planning is a common factor in the problem of project delays. Control management is needed to carry out the project so that it is completed on time as one of the functions and processes of activities in project management that greatly influences the outcome of the project is control which has

the main objective of minimizing any deviations that can occur during the project process[1]. Earned value is a tool for simultaneously controlling physical, cost, and schedule (time) performance in an integrated manner, cost progress, and information management related to the scope of procurement, quality, and risk in a broad method to evaluate, analyze and predict project cost performance[2]-[6]. Because the project manager can easily see what is planned, what is being done, and how much it costs, managing projects using the Earned Value method is known as "managing projects openly"[7]-[15]. A developer can do projects in the housing business sector to make a profitable investment. For this reason, a time and cost analysis method is needed to assess how much deviation has occurred and the remaining time and costs to complete the Puri Cempaka Serang housing project, namely by using the Earned Value method. The housing project reviewed in this study is the Puri Cempaka Serang housing development located on Jalan Kp. Baru, Panancangan, Cipocok Jaya Village, Serang City, Banten Province. This research was conducted with several objectives, such as to determine the cost and delay time of the Puri Cempaka Serang 2-story housing development project using the Earned Value method, to identify the factors causing time performance delays in the implementation of the 2-story Puri Cempaka Serang housing development project, and to estimate the time and final cost required to complete the 2-story Puri Cempaka Serang housing development project.
According to [1][4][5][15], The idea behind the earned value method is a planned price for the work done. In other words, this idea calculates the amount of the budget available for the job about the number of work units that have been finished at a particular period. For this reason, later, we can see the relationship between what has been achieved in terms of reality and the allocated budget amount.

a. CV (Cost Variance) is the difference in the value obtained after completing the work section with the actual value of the project implementation.

$$CV = BCWP - ACWP \quad (1)$$

CV (–) = cost is higher than budget, CV (0) = cost is according to plan, CV (+) = cost is less than budget

b. SV (Schedule Variance) is the difference between the work that can be done and the planned portion.

$$SV = BCWP - BCWS \quad (2)$$

SV (–): the actual schedule is late from the planned schedule; SV (0): the actual schedule is on time compared to the planned schedule, SV (+): the actual schedule is faster than the planned schedule

c. CPI (Cost Performance Index) compares the value received from doing a task with the actual expenses associated with finishing the task.

$$CPI = BCWP / ACWP \quad (3)$$

CPI < 1: cost performance is greater / extravagant, CPI = 1: cost performance is following the planned budget, CPI > 1: cost performance is smaller / economical

d. SPI (Schedule Performance Index) compares work completed in the field with a work plan for a certain period.

$$SPI = BCWP / BCWS \quad (4)$$

SPI < 1: project performance is slower than plan schedule, SPI = 1: project performance is the same as plan schedule, SPI > 1: project performance is faster than plan schedule

After knowing the project performance indicators, then cost predictions and project completion time can be calculated:

e. (ETC) Estimate to Complete estimates the remaining cost needed for the remaining work.

$$\text{For physical progress} < 50\%: \text{ETC} = \text{BAC} - \text{BCWP} \quad (5)$$
$$\text{For physical progress} > 50\% : \text{ETC} = ((\text{BAC} - \text{BCWP}))/\text{CPI} \quad (5)$$

f. EAC (Estimate At Complete) estimates the total cost required to complete all project work activities based on project cost performance at the time of evaluation with the assumption that project performance will remain (constant) until the end of the project.

$$\text{EAC} = \text{ACWP} + \text{ETC} \quad (6)$$

g. TE (Time Estimate) is the estimated time for project completion.

$$\text{TE} = \text{ATE} + ((\text{OD} - (\text{ATE} \times \text{SPI})) / \text{SPI}) \quad (7)$$

Information :
TE (Time Estimated): Estimated time of completion
ATE (Actual Time Expended): Time that has been taken
OD (Original Duration): Planned time

2. METHODS

In analyzing the performance of a project, four basic elements are used as a reference based on the value obtained, namely:[3]:

1. BCWS (Budgeted Cost For Work Scheduled) is allocated based on a work plan prepared over time.
2. BCWP (Budgeted Cost For Work Performed) is the value received from completing work over a certain period. BCWP is what is called earned value.
3. ACWP (Actual Cost For Work Performed) is the actual cost of the work.
4. BAC (Budget At Completion) is the contract's total value after deducting value-added tax (VAT).

Cumulative plan weight data in the calculation of Budget Cost for Work Schedule (BCWS) and Cumulative Realization Weight data in the calculation of Budget Cost for Work Performed (BCWP) week one and week 20 are in the S curve.

Several stages of work must be taken in doing this research. The steps in this study are shown in the research flowchart.

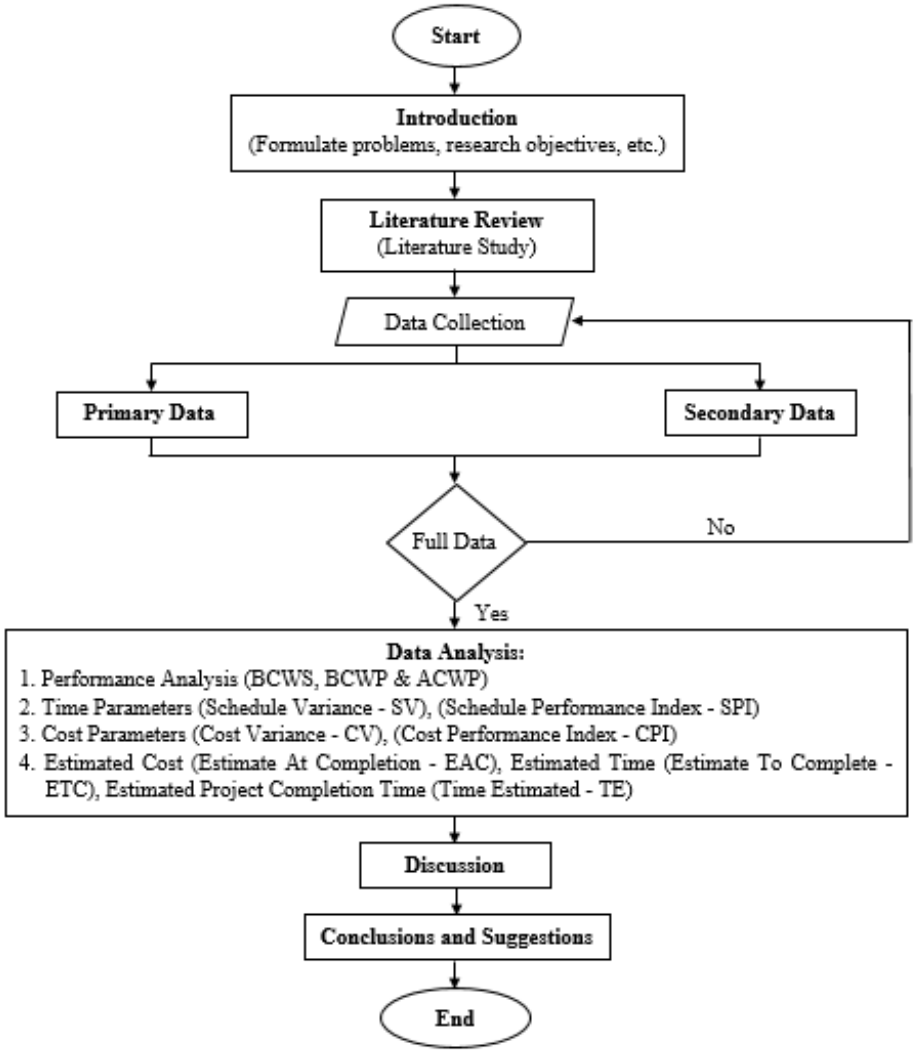

Figure 1. Research Flow

3. RESULTS AND DISCUSSION

The analysis used data from the Puri Cempaka 2-story housing development project with a budget of Rp. 4,546,850,000, which was carried out for 24 weeks. For this study, the review was carried out for 20 weeks, which was carried out from February 14, 2022, to July 3, 2022 (Week 1 to Week 20). Drawing and calculations are done with the help of Microsoft Excel 2016 software.

3.1 Calculation of Budget Cost For Work Schedule (BCWS)

The cumulative weekly percentage of plan progress and the BAC value is multiplied to create the Budget Cost For Work Schedule (BCWS) or Planned Value (PV). The Budget At Completion (BAC) value is the contract's overall value after deducting value-added tax (VAT). The BAC value is obtained from the Cost Budget Plan (RAB) recapitulation. BCWS calculations are as follows:

Week 1: BCWS = % (cumulative plan weight) × BAC
= 0.077% × Rp. 4,546,850,000
= Rp. 3,501,074

Week 20: BCWS = % (cumulative plan weight) × BAC
= 76.498 % × Rp. 4,546,850,000
= Rp. 3,478,249,313

The calculation of the next week can be calculated in the same way as the calculation above. Table 1 below shows the results of the Budget Cost For Work Schedule (BCWS) calculation from week 1 to week 20.

Table 1. Budget Cost For Work Schedule (BCWS) Value Week 1 to Week 20

Week	Plan Weight (%)	Cumulative Plan Weights (%)	BAC (Rp)	Value BCWS (Rp)
1	0,077%	0,077 %		Rp. 3.501.074
2	0,078%	0,155%		Rp. 7.047.617
3	0,077%	0,232%		Rp. 10.548.692
4	0,078%	0,310 %		Rp. 14.095.235
5	0,077%	0,387 %		Rp. 17.596.309
6	0,147%	0,534 %		Rp. 24.280.179
7	3,097%	3,631 %		Rp. 165.096.123
8	3,471%	7,102 %		Rp. 322.917.287
9	3.470%	10.572 %		Rp. 480.692.982
10	3,471 %	14.043 %		Rp. 638.514.145
11	0,000%	14.043 %		Rp. 638.514.145
12	0,000%	14.043 %	Rp. 4.546.850.000	Rp. 638.514.145
13	3,471 %	17.514 %		Rp. 796.335.309
14	5.646 %	23.160 %		Rp. 1.053.050.460
15	5,645 %	28.805 %		Rp. 1.309.720.142
16	9.567 %	38.372 %		Rp. 1.744.717.282
17	9.566 %	47.938 %		Rp. 2.179.668.953
18	9.566 %	57.504 %		Rp. 2.614.620.624
19	9,497 %	67.001 %		Rp. 3.046.434.968
20	9,497 %	76.498 %		Rp. 3.478.249.313
21	7.997 %	84.495 %		Rp. 3.841.860.907.
22	6.229 %	90.724 %		Rp. 4.125.084.194
23	6.229 %	96.953 %		Rp. 4.408.307.480
24	3.067 %	100.020 %		Rp. 4.547.759.370

From Table 1, it can be seen that there is an increase in the value of the Budget Cost For Work Schedule (BCWS) every week, meaning that the cost expenditure plan for each week of the project has increased.

3.2 Calculation of Budget Cost For Work Performed (BCWP)

Budget Cost For Work Performed (BCWP) or Earned Value (EV) can be calculated by multiplying the cumulative percentage of realized progress by the amount of the cost budget plan on a job (BAC). The BAC value is the contract's total value after deducting value-added tax (VAT). The BAC value is obtained from the Cost Budget Plan (RAB) recapitulation. BCWP calculations are as follows:

Week 1: BCWP = % (cumulative realization weight) × BAC
= 1.261% × Rp. 4,546,850,000
= Rp. 57,335,778

Week 20: BCWP = % (cumulative realization weight) × BAC
= 45.516% × Rp. 4,546,850,000
= Rp. 2,069,544,246

The next week's calculation can be calculated in the same way as the calculation above. Table 2 below shows the results of the Budget Cost For Work Performed (BCWP) calculation from week 1 to week 20.

Table 2. Budget Cost For Work Schedule (BCWS) Value Week 1 to Week 20

Week	Weight Realization (%)	Cumulative Realization Weight (%)	BAC (Rp)	Value BCWP (Rp)
1	1,261%	1,261%		Rp. 57.335.778
2	1.260%	2,521%		Rp. 114.626.088
3	1,261%	3,782%		Rp. 171.961.867
4	1.260%	5,042%		Rp. 229.252.177
5	1,261%	6,303%		Rp. 286.587.955
6	1.260%	7,563%		Rp. 343.878.265
7	1,261%	8,824%		Rp. 401.214.044
8	1.260 %	10.084 %		Rp. 458.504.354
9	4,147%	14,231 %		Rp. 647.062.223
10	0,000%	14,231 %		Rp. 0
11	0,000%	14.231		Rp. 0
12	0,000%	14.231	Rp. 4.546.850.000	Rp. 0
13	1.834%	16.065 %		Rp. 730.451.452
14	1,835%	17.900%		Rp. 813.886.150
15	1.834%	19.734 %		Rp. 897.275.379
16	5,156%	24.890 %		Rp. 1.131.710.965
17	5.157 %	30.047 %		Rp 1.366.192.019
18	5.156 %	35.203 %		Rp 1.600.627.605
19	5,157%	40.360 %		Rp. 1.835.108.660
20	5.156 %	45.516 %		Rp 2.069.544.246
21	0,000%	0,000%		Rp. 0
22	0, 000%	0,000%		Rp. 0
23	0, 000%	0,000%		Rp. 0
24	0,000%	0,000%		Rp. 0

Table 2 shows an increase in the Budget Cost For Work Performed (BCWP) value every week, meaning that the planned cost expenditure for each week of the project has increased.

3.3 Calculation of Actual Cost For Work Performed (ACWP)

Actual Cost For Work Performed (ACWP) or Actual Cost (AC) is the actual cost incurred to complete the work during a certain period. Actual Cost For Work Performed (ACWP) consists of:

1. Direct Cost

Costs incurred and directly associated with ongoing project activities are referred to as direct costs. Direct costs include:

a. Material or material costs
   The cost of materials or materials is obtained by multiplying the unit price of the material by the volume.
b. Wage costs
   Wage costs are obtained by multiplying the unit price of wages by the volume of work done.
c. Tool cost
   Tool costs are obtained by summing the purchased tools and tool rental costs.

2. Indirect Cost

Indirect costs are required for each project activity but are not directly related to the activity concerned. In this project, the indirect cost is 0 rupiah. Table 5 summarizes the Actual Cost of Work Performed (ACWP) calculation from week 1 to week 9.

Table 3. Recapitulation of Actual Cost For Work Performed (ACWP) Week 1 to Week 20

Week	BCWP (Rp)	ACWP (Rp)	Cost Variance (CV) (Rp)
1	Rp. 57,335,778	Rp. 5,674,654	Rp. 51.661.124
2	Rp. 114,626,088	Rp. 11.349.308	Rp. 103.276.780
3	Rp. 171.961.867	Rp. 17.023.962	Rp. 154.937.905
4	Rp. 229.252.177	Rp. 22,698,616	Rp. 206.553.561
5	Rp. 286.587.955	Rp. 28.373.270	Rp. 258.214.685
6	Rp. 343.878.265	Rp. 36,581,992	Rp. 307.296.273
7	Rp. 401.214.044	Rp. 180.020.677	Rp. 221.193.367
8	Rp. 458.504.354	Rp. 338,409,005	Rp. 120,095,349
9	Rp. 647.062.223	Rp. 496.797.333	Rp. 150,264,890
10	Rp. 0	Rp. 0	Rp. 0
11	Rp. 0	Rp. 0	Rp. 0
12	Rp. 0	Rp. 0	Rp. 0
13	Rp. 730.451.452	Rp. 655.185.661	Rp. 75.265.791
14	Rp. 813.886.150	Rp. 885.995.049	Rp. -72,108,899
15	Rp. 897.275.379	Rp. 1.116.804.437	Rp. -219.529.058
16	Rp. 1.131.710.965	Rp. 1.448.107.408	Rp. -316.396.443
17	Rp. 1.366.192.019	Rp. 1.779.410.379	Rp. -413.218.360
18	Rp. 1.600.627.605	Rp. 2.110.713.350	Rp. -510.085.745
19	Rp. 1.835.108.660	Rp. 2.439.482.253	Rp. -604.373.593
20	Rp. 2.069.544.246	Rp. 2.768.251.156	Rp. -698.706.910
21	-	-	-
22	-	-	-
23	-	-	-
24	-	-	-

From Table 3, it can be seen that there is an increase in the ACWP value every week, meaning that the cost expenditure for each week of the project has increased.

3.4 Calculation of Cost Variance (CV)

Calculation of Cost Variance (CV) in week one and week 20 as follows:

Week 1: CV = BCWP - ACWP
= Rp. 57,335,778 - Rp. 5,674,654
= Rp. 51,661,124

Week 20: CV = BCWP - ACWP
= Rp. 2,069,544,246 - Rp. 2,768,251,156
= Rp. -698,706,910

Table 4. Recapitulation of Cost Variance (CV) Calculation Week 1 to Week 20

Week	BCWP (Rp)	ACWP (Rp)	Cost Variance (CV) (Rp)
1	Rp. 57,335,778	Rp. 5,674,654	Rp. 51.661.124
2	Rp. 114,626,088	Rp. 11.349.308	Rp. 103.276.780
3	Rp. 171.961.867	Rp. 17.023.962	Rp. 154.937.905
4	Rp. 229.252.177	Rp. 22,698,616	Rp. 206.553.561
5	Rp. 286.587.955	Rp. 28.373.270	Rp. 258.214.685
6	Rp. 343.878.265	Rp. 36,581,992	Rp. 307.296.273
7	Rp. 401.214.044	Rp. 180.020.677	Rp. 221.193.367
8	Rp. 458.504.354	Rp. 338,409,005	Rp. 120,095,349
9	Rp. 647.062.223	Rp. 496.797.333	Rp. 150,264,890
10	Rp. 0	Rp. 0	Rp. 0
11	Rp. 0	Rp. 0	Rp. 0

12	Rp. 0	Rp. 0	Rp. 0
13	Rp. 730.451.452	Rp. 655.185.661	Rp. 75.265.791
14	Rp. 813.886.150	Rp. 885.995.049	Rp. -72,108,899
15	Rp. 897.275.379	Rp. 1.116.804.437	Rp. -219.529.058
16	Rp. 1.131.710.965	Rp. 1.448.107.408	Rp. -316.396.443
17	Rp. 1.366.192.019	Rp. 1.779.410.379	Rp. -413.218.360
18	Rp. 1.600.627.605	Rp. 2.110.713.350	Rp. -510.085.745
19	Rp. 1.835.108.660	Rp. 2.439.482.253	Rp. -604.373.593
20	Rp. 2.069.544.246	Rp. 2.768.251.156	Rp. -698.706.910
21	-	-	-
22	-	-	-
23	-	-	-
24	-	-	-

Cost Variance (CV) with a positive value (+) indicates that the costs incurred exceed the budget plan. At the same time, a negative value (-) Cost Variance (CV) shows that the costs incurred are higher than the budget plan.

3.5 Schedule Variance (SV) Calculation

Schedule Variance (SV) calculations for week one and week 20 are as follows:

Week 1: SV = BCWP - BCWS
= Rp. 57,335,778 - Rp. 3,501,074
= Rp. 53,834,704

Week 20: SV = BCWP - BCWS
= Rp. 2,069,544,246 - Rp. 3,478,249,313
= Rp. -1,408,705,067

Table 5. Recapitulation of Schedule Variance (SV) Calculation Week 1 to Week 20

Week	BCWP (Rp)	BCWS (Rp)	Schedule Variance (SV) (Rp)
1	Rp. 57.335.778	Rp. 3.501.074	Rp. 53.834.704
2	Rp. 114.626.088	Rp. 7.047.617	Rp. 107.578.471
3	Rp. 171.961.867	Rp. 10.548.692	Rp. 161.413.175
4	Rp. 229.252.177	Rp. 14.095.235	Rp. 215.156.942
5	Rp. 286.587.955	Rp. 17.596.309	Rp. 268.991.646
6	Rp. 343.878.265	Rp. 24.280.179	Rp. 319.598.086
7	Rp. 401.214.044	Rp. 165.096.123	Rp. 236.117.921
8	Rp. 458.504.354	Rp. 322.917.287	Rp. 135.587.067
9	Rp. 647.062.223	Rp. 480.692.982	Rp. 166.369.241
10	Rp. 0	Rp. 0	Rp. 0
11	Rp. 0	Rp. 0	Rp. 0
12	Rp. 0	Rp. 0	Rp. 0
13	Rp. 730.451.452	Rp. 796.335.309	Rp. -65.883.857
14	Rp. 813.886.150	Rp. 1.053.050.460	Rp. -239.164.310
15	Rp. 897.275.379	Rp. 1.309.720.142	Rp. -412.444.763
16	Rp. 1.131.710.965	Rp. 1.744.717.282	Rp. -613.006.317
17	Rp. 1.366.192.019	Rp. 2.179.668.953	Rp. -813.476.934
18	Rp. 1.600.627.605	Rp. 2.614.620.624	Rp. -1.013.993.019
19	Rp. 1.835.108.660	Rp. 3.046.434.968	Rp. -1.211.326.308
20	Rp. 2.069.544.246	Rp. 3.478.249.313	Rp. -1.408.705.067
21	-	-	-
22	-	-	-
23	-	-	-
24	-	-	-

A positive value (+) Schedule Variance (SV) shows the time the work is carried out ahead of schedule. While a negative value (-) Schedule Variance (SV) shows the time the work is completed later than the schedule.

3.6 Cost Performance Index (CPI)

The calculation of the Cost Performance Index (CPI) for week 20 is as follows:

Week 20: CPI = BCWP / ACWP
= (Rp. 2,069,544,246)/(Rp. 2,768,251,156)
= 0,75

This value indicates that the CPI < 1 means the expenditure exceeds the budget. The next week's calculation can be calculated in the same way as the calculation above.

3.7 Schedule Performance Index (SPI) Calculation

The calculation of the Schedule Performance Index (SPI) for week 20 is as follows:

Week 20: SPI = BCWP/BCWS
= (Rp. 2,069,544,246)/(Rp. 3,478,249,313)
= 0,595

This value indicates that SPI < 1, meaning that the project implementation time is delayed from the planned schedule. The next week's calculation can be calculated in the same way as the calculation above. Table 6 summarizes the calculation results of the Cost Performance Index (CPI) and Schedule Performance Index (SPI) values from week 1 to week 20.

Table 6. Recapitulation of CPI and SPI Values Week 1 to Week 20

Week	CPI	SPI
1	10,104	16,38
2	10,100	16,26
3	10,101	16,30
4	10,100	16,26
5	10,101	16,29
6	9,4	14,16
7	2,229	2,43
8	1,355	1,42
9	1,302	1,35
10	0,000	0,00
11	0,000	0,00
12	0,000	0,00
13	1,115	0,92
14	0,919	0,77
15	0,803	0,69
16	0,782	0,65
17	0,768	0,63
18	0,758	0,61
19	0,752	0,60
20	0,748	0,59

3.8 Estimated Cost and Time of Project Completion (Week 1 to Week 20)

Three variants will be analyzed to estimate the final cost of the project, namely Estimate to Complete (ETC), Estimate at Completion (EAC), and Time Estimate (TE).

3.8.1 Estimate To Complete (ETC)

ETC is an estimate of the cost required to complete the remaining work. Because the review in this study is up to week 20 and the physical progress value is 45.516%, where the physical progress is <50%, the ETC uses the BAC - BCWP formula. The Estimate To Complete (ETC) calculation for week 20 is as follows:

Week 20: ETC = BAC - BCWP
= Rp. 4,546,850,000 - Rp. 2,069,544,246
= Rp. 2,477,305,754

3.8.2 Estimate At Complete (EAC)

EAC is the total expenditure up to the reporting time plus the estimated cost for the remaining work. The calculation of Estimate At Complete (EAC) week 20 is as follows:

Week 20: EAC = ACWP + ETC
= Rp. 2,768,251,156 + Rp. 2,477,305,754
= Rp. 5,245,556,910

3.8.3 Estimate (TE)

TE is the estimated time of project completion. Where: ATE (Actual Time Expended) time taken, OD (Original Duration) planned time. The calculation of the Time Estimate (TE) for week 20 is as follows:

ATE = 20 weeks
OD = 24 weeks
Week 20: TE = ATE + ((OD - (ATE × SPI)) / SPI)
= 20 + ((24 - (20 × 0,59)) / 0,59)
= 41 weeks

Table 7 shows a recapitulation of the calculation results of Estimate To Complete (ETC), Estimate At Completion (EAC), and Time Estimate (TE) from week 60 to week 67.

Table 7. Recapitulation of ETC, EAC, and TE Values Week 1 to Week 20

Week	ETC	EACH	TE
1	Rp. 4.489.514.222	Rp. 4.495.188.876	1
2	Rp. 4.432.223.912	Rp. 4.443.573.220	1
3	Rp. 4.374.888.133	Rp. 4.391.912.095	1
4	Rp. 4.317.597.823	Rp. 4.340.296.439	1
5	Rp. 4.260.262.045	Rp. 4.288.635.315	1
6	Rp. 4.202.971.735	Rp. 4.239.553.727	2
7	Rp. 4.145.635.956	Rp. 4.325.656.633	10
8	Rp. 4.088.345.646	Rp. 4.426.754.651	17
9	Rp. 3.899.787.777	Rp. 4.396.585.110	18
10	Rp. 0	Rp. 0	-
11	Rp. 0	Rp. 0	-
12	Rp. 0	Rp. 0	-
13	Rp. 3.816.398.548	Rp. 4.471.584.209	26
14	Rp. 3.732.963.850	Rp. 4.618.958.899	31
15	Rp. 3.649.574.621	Rp. 4.766.379.058	35
16	Rp. 3.415.139.035	Rp. 4.863.246.443	37
17	Rp. 3.180.657.981	Rp. 4.960.068.360	38
18	Rp. 2.946.222.395	Rp. 5.056.935.745	39
19	Rp. 2.711.741.340	Rp. 5.151.223.593	40
20	Rp. 2.477.305.754	Rp. 5.245.556.910	41

Table 7 shows that the estimated project completion time (TE) is 41 weeks. This time is 17 weeks longer than the total project completion plan of 24 weeks, with an estimated final project cost (EAC) of Rp. 5,245,556,910.

3.9 Analysis of Project Delay Factors

The results of the analysis and calculation of project performance show that the project is delayed from the planned schedule. This is due to the following factors:

1. The efficient start of the project needs to be corrected with the schedule because the housing construction project is mass. The contractor is also working on a one-story house, so the implementation work in the field is divided.
2. Working or shop drawings that are late in coming out and their gradual submission, thus preventing the contractor from doing the next job.
3. Urugan soil has yet to be fulfilled because the original soil conditions are lacking.
4. The project time coincided with the month of Ramadan and, at the same time, the Eid al-Fitr 2022 holiday, where all elements of construction work were temporarily suspended, as well as workers who get part of the Eid holiday for ± 1 month.

4. CONCLUSION

From the results of the analysis of the 2-story Puri Cempaka Serang housing construction project with the Earned Value Method, the following conclusions were obtained:

a. As seen in the Schedule Variance (SV), the time performance of the project implementation in week 1 to week 9 in terms of project scheduling is faster than the initial planning, which shows the schedule variance (SV) is positive until week 9, amounting to Rp. 166,369,241 or Schedule Performance Index (SPI) of = 16.38 which is where the SPI value> 1. After the project returned to normal operations in week 13 to week 20 regarding scheduling, it experienced a delay which showed a negative schedule variance until week 20 of Rp. -1,408,705,067 or Schedule Performance Index (SPI) at week 20 review of = 0.59, which is SPI value < 1.
   While the cost performance of the project implementation in week 1 to week 9 of this project was issued less than the planned cost, this shows a positive value of cost variance (CV) of Rp. 150,264,890 or Cost Performance Index (CPI) = 1.302 which is the value of CPI> 1. After the project returns to normal operations in week 13 to week 20, the cost performance of the project implementation is greater than the planned cost; this shows a negative value in the cost variance indicator (CV) of Rp. Rp. -698,706,910 or Cost Performance Index (CPI) in the 20th week review of = 0.748, where the CPI value < 1.

b. Factors causing delays in working drawings or shop drawings that are late to come out and their gradual submission, poor backfill soil because where the original soil conditions are lacking, and project time that coincides with the month of Ramadan and at the same time Eid al-Fitr 2022 where all elements of construction work are temporarily suspended and workers who get part of the Eid holiday for ± 1 month.

c. The estimated time and cost of completing the project required is 41 weeks for Rp. 5,245,556,910, meaning that the realization cost exceeds the budget plan of Rp. 4,546,850,000. These results show that the project is 17 weeks late from the planned 24 weeks.

REFERENCES

[1] A. Husen, *Manajemen Proyek*. 2010.
[2] A. B. Siswanto and M. A. Salim, *Manajemen Proyek*. CV. Pilar Nusantara, 2019.
[3] A. Husen, *Manajemen Proyek (edisi revisi)*. 2011.
[4] N. I. Hayati and D. Lugi, "EVALUASI BIAYA DAN WAKTU DENGAN METODE EARNED

VALUE MANAGEMENT (Studi Kasus: Ruko Damara Village, Kel. Ciparigi, Kota Bogor)," *J. Komposit*, vol. 4, no. 2, p. 61, 2022, doi: 10.32832/komposit.v4i2.3760.
[5] Nurhayati, *Manajemen Proyek*. Yogyakarta: Graha Ilmu, 2020.
[6] F. Ramdhani, "Analisis Biaya dan Waktu dengan Metode Earned Value Concept pada Proyek BJDM Area Rl Construction At Well 3S-21B Area 9 PT. Adhi Karya CS Work Unit Rate Packagea – Duri," *J. RACIC*, vol. 1, no. 1, pp. 17–35, 2016.
[7] R. Auzan, D. Rizky, and F. Kistiani, "Pengendalian Biaya Dan Waktu Proyek Dengan Metode Konsep Nilai Hasil (Earned Value)," *J. Tek.*, vol. 7, no. 4, pp. 671–675, 2015.
[8] S. H. Kim, "Free-electron two-quantum stark radiation driven by the electric wiggler associated with density modulation in a hydrodynamic free-electron laser," *J. Korean Phys. Soc.*, vol. 60, no. 5, pp. 674–679, 2012.
[9] E. Susanti and N. Runiawati, *Manajemen Proyek*. Tangerang Selatan, 2021.
[10] C. A. P. Soares, "the Use of Earned Value Analysis (Eva) in the Cost Management of the Use of Earned Value Analysis (Eva) in the Cost," no. August, 2017.
[11] I. A. P. S. Mahapatni, *Metode Perencanaan dan Pengendalian Proyek Konstruksi*. 2019.
[12] M. I. Maromi and R. Indryani, "Metode Earned Value untuk Analisa Kinerja Biaya dan Waktu Pelaksanaan pada Proyek Pembangunan Condotel De Vasa Surabaya," *J. Tek. ITS*, vol. 4, no. 1, pp. D54–D59, 2015.
[13] H. A. Rani, "Manajemen Proyek Konstruksi," 2016.
[14] M. Pastiarsa, "Manajemen Proyek Konstruksi Bangunan Industri: Perspektif Pemilik Proyek," *Penerbit Teknosain, Yogjakarta*, 2015.
[15] D. Asmaroni and A. Setiawan, "Penggunaan Metode Nilai Hasil (Earned Value Analysis) Terhadap Biaya Dan Waktu Pada Proyek Konstruksi Bangunan Perumahan (Studi Kasus Proyek Konstruksi Bangunan Perumahan PT. Graha Praja Kencana Di Desa Ceguk Kecamatan Tlanakan Kabupaten Pamekasan)," *Ge-STRAM J. Perenc. dan Rekayasa Sipil*, vol. 3, no. 1, pp. 31–39, 2020, doi: 10.25139/jprs.v3i1.2439.