Cost Performance Analysis And Time Development Construction Project Bridge Chain Karanggeneng Nawacita Cs Using The Earned Value Method

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ABSTRACT

Cost, quality, and time are mandatory targets in construction management. The construction of the Karanggeneng Nawacita Cs Suspension Bridge is a JUDESA project APBN. It has a period of 19 years working days. Implementing the bridge construction is inseparable from several technical and non-technical constraints. the method obtained by value in this study used to determine Early Warning and integrate the concept in terms of time and cost from this method, the value can be seen from the progress and performance of the project with the Schedule Variance (SV), Cost Variance (CV), Schedule Performance Index (SPI), Cost Performance Index (CPI).), estimated suitability date (ECD), and Estimated time of completion (EAC). From this research, the results obtained Estimate To Complete (ETC) Rp. 3,322,492,617 and Estimate Temporary Schedule (ETS) review week 14 is 39 days. To complete the project, Estimate At Completion (EAC) is greater than Rp. 82,137,617. contract fee. Meanwhile, the time to complete the EAS project is 137 days, requiring an additional processing time of 12 days. Based on the analysis results carried out by service providers, they must take prompt and appropriate actions to prevent excessive over budgeting.

1. Introduction

Construction projects are jobs that have different problems between one and the other in the implementation of construction projects[1][2] that have the main objectives of cost, quality and time management[2][3]. Construction project work can be said to be successful if the project can be completed with the cost and quality time stipulated in the work contract, the construction of the Karanggeneng Nawacita Suspension Bridge Cs absorbed the state budget of Rp 8,213,826,000 (Eight Billion Two Hundred Thirteen Million Eight Hundred Twenty Six Thousand Rupiah) planned with a schedule of 19 Weeks or 125 working days Asymmetric

pedestrian suspension bridge 120 m span with bridge components made with high precision and assembled with bolts, each item of work division has the risk of delays which can have a financial, topography of rural locations which will reduce the effectiveness of work mobility starting from earthworks to the transportation of steel bridge material and weather factors can affect the bridge construction work. Seeing from the project conditions of the earned value methods used in managing the work of the Karanggeneng Nawacita Suspension Bridge in order to obtain time and cost value concepts such as Schedule Variance (SV), Cost Variance (CV), productivity index time (SPI), productivity index work (CPI), estimated project completion schedule (ECD) and estimated project completion costs (EAC)[4][5]. The results of the project performance evaluation obtained using the method Earned Value can be used as an Early Warning[4][6].

2. Literature Review

Previous research conducted by Agatha & Dani in 2018 entitled "Controlling Costs and Project Schedules Using Result Value (Rehabilitation Project for X Gresik Building)" [7]. Obtained the results of the analysis method (Earned Value Analysis) the value of the results of the last week is above the plan. From the analysis method, the value of the results of the last week can be seen that the Schedule Variance (SV) Rp. 185,792,583.94 and a Cost Variance (CV) Rp. 348,089,626.99. Meanwhile, productivity index time (SPI) value was 1.06 and productivity index work (CPI) was 1.12. The results of the study estimated that the final project time was 89 days and the final cost of the project was Rp. 4,254,837,523.80. so that the project profit is Rp. 368,781,573.68.

As for previous research conducted by Dwi Kartikasari in 2017 with the research title "Cost and Time Control Using the Earned Value Method (Case Study: Production Hall-02 Pandaan Structural and Architectural Project)" [8]. he results obtained from the data obtained from the executing contractor, calculating the value of ACWP (Actual Cost of Work Performance), BCWS (Budgeted Cost Work Schedule), and *BCWP* (Budgeted Cost for Work Performed). From these parameters, the cost and time aspects are estimated. Next analyzes the project acceleration at the critical work trajectory. Earned Value analysis was carried out at week 14 with an ACWP value of Rp. 10,468,012,258.01, the value of BCWS is Rp. 12,471,916,830.34 and the BCWP value of Rp. 9,729,793,225.00. The results of data analysis obtained an estimate of the final project value of Rp. 18,339,852,330.84 with the completion of the execution time of 170 days.

2.1. Assessment of Project Performance.

Assessment Project performance is divided into 6 (six) categories it as follows :

1. Cost Variance (CV).

   Cost variance is the difference between the value obtained after completing work packages with the actual costs incurred during project implementation[5][6].

2. Schedule Variance (SV).

   Schedule variance *is* used to calculate deviations between Planned Value (PV) with Earned Value (EV)[5][6].

3. Cost Performance Index (CPI).

   Cost efficiency factors that have been issued can be demonstrated by comparing the value of work by comparing the value of work that has been physically completed Earned Value (EV) with costs that have been incurred in the same period Actual Cost (AC)[9].

4. Schedule Performance Index (SPI).

   Performance efficiency factors in completing work can be shown by a comparison between the value of work that has been physically completed Earned Value (EV) with planned expenditure of costs incurred based on work plans Planned Value (PV)[9].

5. Estimate to Completion (ETC).

   Represents the estimated cost for the job remaining, assuming that the trend in project performance will remain until the end of the project[9][10].

6. Variance at Completion (EAC).

   Variance at Completion is the estimated total cost at the end of the project obtained from actual costs plus the ETC[9][10].

2.2. Method of Concept Value Result.

Concept Value Result is a chart of the Concept Analysis of Variance. Where analysis of variance shows differences in work results at the time of reporting compared to the budget or schedule,[11][12] the basic concept of the value of results can be used to analyze performance and make estimates of achievement of targets[2]. The indicators used are as follows :

1. Actual Cost (AC).

   Actual Cost (AC) or Actual Cost of Work Performed (ACWP) is the amount of cost the actual of work has been carried out in a particular reporting period [9]. These costs are obtained from project accounting or financial data at the reporting date. (for example, the end of the month), records all actual expenses incurred from a work package or accounting code including calculation of overhead and others [12][13]. So Actual Cost (AC) is the actual amount of budgeting or funds used to carry out work in a certain period of time.

2. Earned Value (EV).

   Earned Value (EV) or Budgeted Cost of Work Performance (BCWP) is the value of the completed works against the budget provided for the job[14]. If the AC figure is compared with the Earned Value (EV), you will see a comparison between the costs incurred for the work carried out and the costs that should have been incurred for this purpose.

3. Planed Value (PV).

   Planned Value (PV) or Budgeted Cost of Work Schedule (BCWS) shows the budget for a work package compiled and linked with the implementation schedule [14][15]. Here there is a combination of costs, schedules and scope of work, where in each element of work has been given an allocation of costs and schedules that can be used as a benchmark for reporting the implementation of work.

3. Research Method

Research was conducted on the Karanggeneng Nawacita Cs Suspension Bridge construction project, the source of data collection was obtained from the implementing contractor and also the supervisory consultant, the type of data used was secondary data andstudies literature, including the project implementation schedule (Time Schedule), budget plan project (RAB), weekly reports and actual costs.

following is a flowchart in this study.
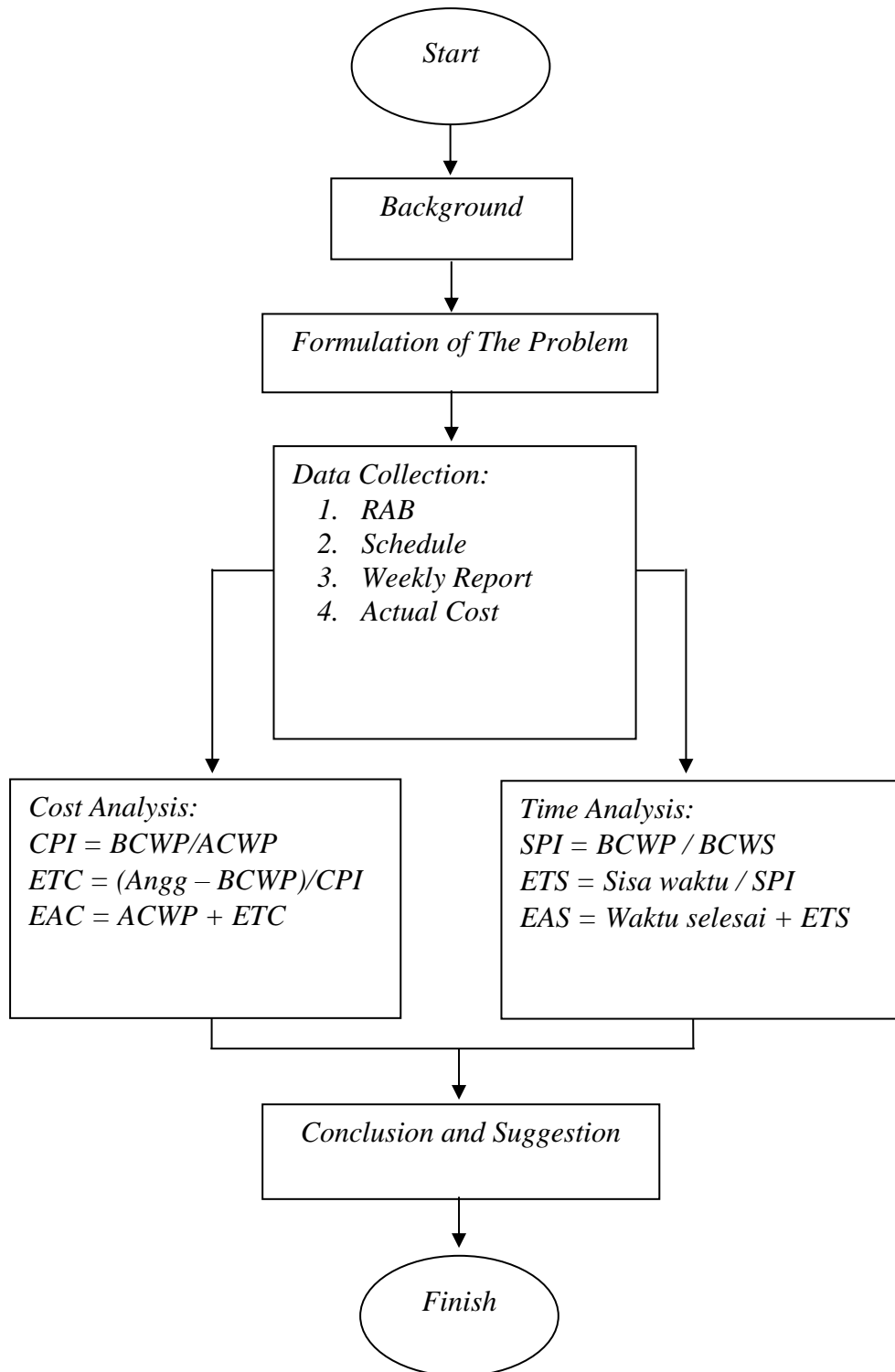
Source : Research Results.

Figure 1.   Research Flow Chart.

3.1. Data Analysis.

Analysis techniques carried out on the Karanggeneng Nawacita Suspension Bridge Cs construction project using method is Earned Value divided into 2 (Two), namely project performance analysis and cost estimation analysis, the final time of work as follows:

1. Project Performance.

   a. Analysis Cost and Schedule.

      1) Planned Value (PV).

         Planned Value (PV) is the budgeted cost for work scheduled for a certain period and determined in the budget obtained by multiplying the percentage of the progress of the plan contained in the time schedule with the project implementation costs listed in the RAB [16][17].

         PV = (% plan progress) x (budget) …………….……………………… (1)

      2) Earned Value (EV).

         Earned Value (EV) is the budgeted cost for work that has been completed, obtained by multiplying between percentage of progress that has been carried out with the budget [16][17].

         EV = (% actual progress) x (budget) …..…………….………………….............(2)

      3) Actual Cost (AC).

         Actual Cost (AC) is the costs incurred for work that has been carried out, obtained from the real price for each cost incurred with the volume of work completed in the field [16][17].

         AC = Direct Cost + Indirect Cost …………….……………………….............(3)

   b. Analysis of Variance.

      1) Cost Variance (CV).

         Obtained from the reduction between EV and AC [18]

         CV = EV – AC…………….……….……………………….................................. (4)

      2) Schedule Variance (SV).

         Obtained from the reduction between EV and PV [18]

         SV = EV – PV…………….……….……………………….................................. (5)

c. Analysis of Performance Index .

1) Schedule Performance Index (SPI).

Obtained from the reduction between EV and PV [18].

SPI = EV / PV………………………………...**(6)**

2) Cost Performance Index (CPI).

Obtained from the reduction between EV and AC [18].

CPI = EV / AC……………………………….. **(7)**

2. Estimated Cost and End Time of Work.

a. Estimate to Complete (ETC).

ETC is an estimated cost for remaining work, assuming that the tendency of project performance will remain until the end of the project [18][19]. the estimate can be extrapolated in several ways :

1) ETC for progress < 50 %.

ETC = Total Budget –EV ………………………...… **(8)**

2) ETC for progress > 50 %.

TC = (Total Budget –EV) / CPI ....…………………………........... **(9)**

b. Estimate at Complete (EAC)

EAC is an estimate of the total cost at the end of the project obtained from the actual costs plus the ETC [18][19].

EAC = AC + ETC……………………….. **(10)**

c. Time Estimate (TE)

Time Esitamte TE is the estimated time of project completion. The assumption used to estimate completion time is the tendency for project performance to remain the same as at the time of review [18][19].

TE = ATE + (OD-(ATE x SPI) / SPI))...............…………………………........**(11)**

4. Results and Discussions

4.1. Planned Value (PV) / BCWS.

Planned Value (PV) is the cost budgeted according to the contract schedule implemented or also called the Budgeted Cost of Work Scheduled (BCWS).

Table 1. PV or BCWS.

Week	% Cumulative	Budget	PV or BCWS
1	0,24%	Rp 8.213.826.000	Rp 19.713.182
2	2,01%	Rp 8.213.826.000	Rp 165.097.903
3	2,40%	Rp 8.213.826.000	Rp 197.131.824
4	3,45%	Rp 8.213.826.000	Rp 283.376.997
5	5,50%	Rp 8.213.826.000	Rp 451.760.430
6	8,51%	Rp 8.213.826.000	Rp 698.996.593
7	11,82%	Rp 8.213.826.000	Rp 970.874.233
8	14,48%	Rp 8.213.826.000	Rp 1.189.362.005
9	22,10%	Rp 8.213.826.000	Rp 1.815.255.546
10	28,74%	Rp 8.213.826.000	Rp 2.360.653.592
11	39,25%	Rp 8.213.826.000	Rp 3.223.926.705
12	52,25%	Rp 8.213.826.000	Rp 4.291.724.085
13	67,87%	Rp 8.213.826.000	Rp 5.574.723.706
14	85,48%	Rp 8.213.826.000	Rp 7.021.178.465
15	90,14%	Rp 8.213.826.000	Rp 7.403.942.756
16	94,79%	Rp 8.213.826.000	Rp 7.785.885.665
17	97,72%	Rp 8.213.826.000	Rp 8.026.550.767
18	99,37%	Rp 8.213.826.000	Rp 8.162.078.896
19	100%	Rp 8.213.826.000	Rp 8.213.826.000

Source : Schedule.

The Planned Value (PV) / Budgeted Cost of Work Scheduled (BCWS) table can be seen on the expenses per week accordingly.

4.2. Earned Value (EV) or BCWP.

Earned Value (EV) or BCWP is budgeted costs for work that has been completed.

Table 2. EV or BCWP.

Week	% Cumulative	Budget	EV or BCWP
1	0,24%	Rp 8.213.826.000	Rp 19.713.182
2	2,01%	Rp 8.213.826.000	Rp 165.097.903
3	2,30%	Rp 8.213.826.000	Rp 188.917.998
4	3,00%	Rp 8.213.826.000	Rp 246.414.780
5	4,23%	Rp 8.213.826.000	Rp 347.444.840
6	6,74%	Rp 8.213.826.000	Rp 553.611.872
7	9,20%	Rp 8.213.826.000	Rp 755.671.992
8	12,50%	Rp 8.213.826.000	Rp 1.026.728.250
9	16,34%	Rp 8.213.826.000	Rp 1.342.139.168
10	20,77%	Rp 8.213.826.000	Rp 1.706.011.660
11	24,45%	Rp 8.213.826.000	Rp 2.008.280.457
12	30,70%	Rp 8.213.826.000	Rp 2.521.644.582
13	47,98%	Rp 8.213.826.000	Rp 3.940.993.715
14	59,55%	Rp 8.213.826.000	Rp 4.891.333.383

Source : Weekly Report.

In the table Earned Value (EV) / Budgeted Cost of Work Performance (BCWP) it can be seen that the movement of work progress is quite slow in the 5th week, only reaching 4.23%

4.3. Actual Cost (AC).

Actual Cost (AC) or also known as Actual Cost of Work Performed (ACWP) is the cost used in actual conditions (Real Cost).

Table 3. ACWP.

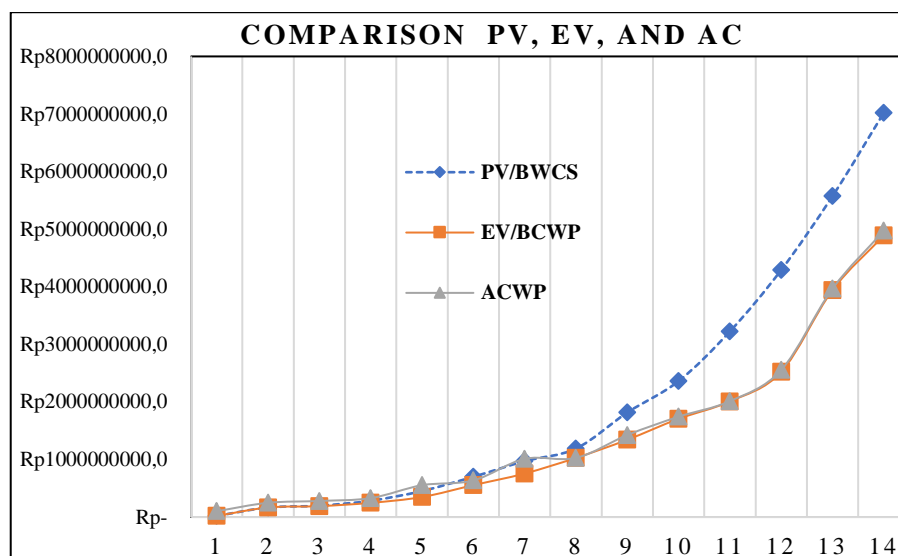| Week	ACWP
1	Rp. 101.851.000
2	Rp. 247.236.000
3	Rp. 279.270.000
4	Rp. 328.553.000
5	Rp. 552.790.000
6	Rp. 635.750.000
7	Rp. 1.010.300.000
8	Rp. 1.026.728.000
9	Rp. 1.424.277.000
10	Rp. 1.742.973.000
11	Rp. 2.013.208.000
12	Rp. 2.554.499.000
13	Rp. 3.967.277.000
14	Rp. 4.973.471.000

Source : Mutual Check (MC).

In the Actual Cost of Work Performed (ACWP) table, you can see the actual tactical expenditure. Obtained comparative data between PV, EV, AC as shown in the **Table 4.**

Table 4. Comparison of PV, EV, and ACWP.

Week	PV or BCWS	EV or BCWP	ACWP
1	Rp 19.713.182	Rp 19.713.182	Rp 101.851.000
2	Rp 165.097.903	Rp 165.097.903	Rp 247.236.000
3	Rp 197.131.824	Rp 188.917.998	Rp 279.270.000
4	Rp 283.376.997	Rp 246.414.780	Rp 328.553.000
5	Rp 451.760.430	Rp 347.444.840	Rp 552.790.000
6	Rp 698.996.593	Rp 553.611.872	Rp 635.750.000
7	Rp 970.874.233	Rp 755.671.992	Rp 1.010.300.000
8	Rp 1.189.362.005	Rp 1.026.728.250	Rp 1.026.728.000
9	Rp 1.815.255.546	Rp 1.342.139.168	Rp 1.424.277.000
10	Rp 2.360.653.592	Rp 1.706.011.660	Rp 1.742.973.000
11	Rp 3.223.926.705	Rp 2.008.280.457	Rp 2.013.208.000
12	Rp 4.291.724.085	Rp 2.521.644.582	Rp 2.554.499.000
13	Rp 5.574.723.706	Rp 3.940.993.715	Rp 3.967.277.000
14	Rp 7.021.178.465	Rp 4.891.333.383	Rp 4.973.471.000

Source : Research Results.

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Source : Research Results

Figure 2. Comparison graphs of PV, EV, and AC.

Comparison Chart of Planned Value (PV), Earned Value (EV), Actual Cost (AC)

1. In week 3 to week 14 the project experiences delays in work, this is indicated by the value of EV or BCWP that is smaller than the value of PV or BCWS.

2. For actual costs or ACWP in the first week to week 7, the expenditure is greater with the marked ACWP graph being higher than EV / BCWP.

4.4. Calculation Analysis of Time and Cost Variants.

Table 5. Time Variant (SV) and Variant Cost (CV).

Week	SV	CV
1	Rp -	Rp 82.137.818
2	Rp -	Rp 82.138.097
3	Rp 8.213.826	Rp 90.352.002
4	Rp 36.962.217	Rp 82.138.220
5	Rp 104.315.590	Rp 205.345.160
6	Rp 145.384.720	Rp 82.138.128
7	Rp 215.202.241	Rp 254.628.008
8	Rp 162.633.754	Rp 250
9	Rp 473.116.377	Rp 82.137.832
10	Rp 654.641.932	Rp 36.961.340
11	Rp1.215.646.248	Rp 4.927.543
12	Rp1.770.079.503	Rp 32.854.418
13	Rp1.633.729.991	Rp 26.283.285
14	Rp2.129.845.081	Rp 82.137.617

Source : Research Results.
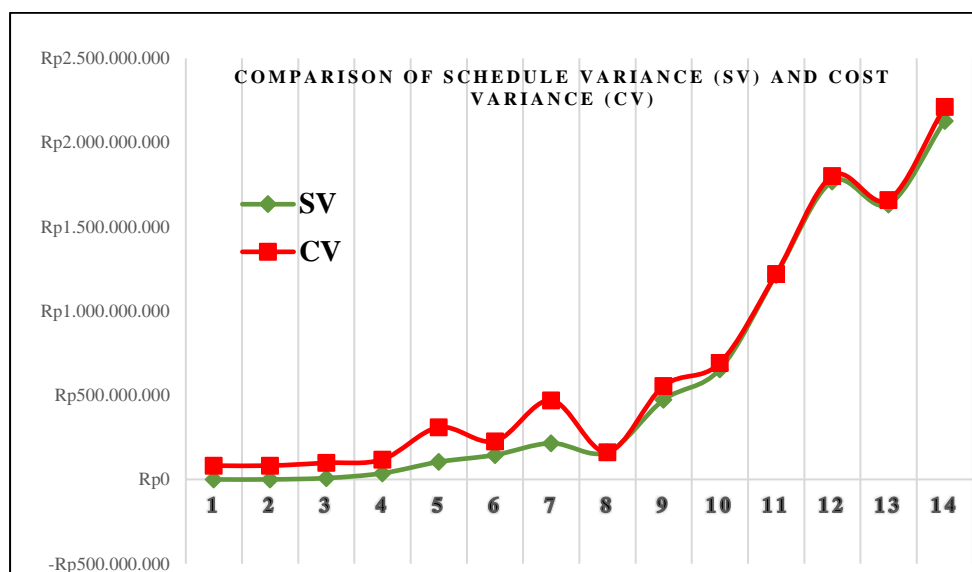
Source : Research Results.

Figure 3. Comparison of Schedule Variance (SV) and Cost Variance (CV).

The tables and graphs Schedule Variance (SV) and Cost Variance (CV) show that in the first week to the 7th week the cost of project expenses is greater than the plan.

4.5.   Calculation of Achievement Index .

4.5.1.   Calculation of Time Performance Index (SPI).

At the 1st week of review, the SPI value was obtained from a comparison between Earned Value and Planned Value.

SPI = EV / PV

SPI = Rp19.713.182 / Rp 19.713.182 = 1

The SPI value of the week gets a value of 1 (one) indicating that the work time performance is in accordance with the contract implemented [20].

A.   Calculation of Cost Performance Index (CPI)

At the 1st week review, the CPI value was obtained from a comparison between Earned Value and Actual Cost.

CPI = EV / AC

CPI = Rp 19.713.182 / Rp 101.851.000 = 0.194

CPI value of less than 1 indicates that the cost performance (AC) is greater than the value obtained (EV) [20]. SPI and CPI values can be seen in the **Table 6.**

Table. 6   Time Performance Index (SPI) and the Cost Performance Index (CPI).

Week	PV or BCWS		EV orBCWP		ACWP		SPI	CPI
1	Rp	19.713.182	Rp	19.713.182	Rp	101.851.000	1	0,194
2	Rp	165.097.903	Rp	165.097.903	Rp	247.236.000	1	0,668
3	Rp	197.131.824	Rp	188.917.998	Rp	279.270.000	0,958	0,676
4	Rp	283.376.997	Rp	246.414.780	Rp	328.553.000	0,870	0,750
5	Rp	451.760.430	Rp	347.444.840	Rp	552.790.000	0,769	0,629
6	Rp	698.996.593	Rp	553.611.872	Rp	635.750.000	0,792	0,871
7	Rp	970.874.233	Rp	755.671.992	Rp	1.010.300.000	0,778	0,748
8	Rp	1.189.362.005	Rp	1.026.728.250	Rp	1.026.728.000	0,863	1
9	Rp	1.815.255.546	Rp	1.342.139.168	Rp	1.424.277.000	0,739	0,942
10	Rp	2.360.653.592	Rp	1.706.011.660	Rp	1.742.973.000	0,723	0,979
11	Rp	3.223.926.705	Rp	2.008.280.457	Rp	2.013.208.000	0,623	0,998
12	Rp	4.291.724.085	Rp	2.521.644.582	Rp	2.554.499.000	0,588	0,987
13	Rp	5.574.723.706	Rp	3.940.993.715	Rp	3.967.277.000	0,707	0,993
14	Rp	7.021.178.465	Rp	4.891.333.383	Rp	4.973.471.000	0,697	0,983

Source : Research Results.
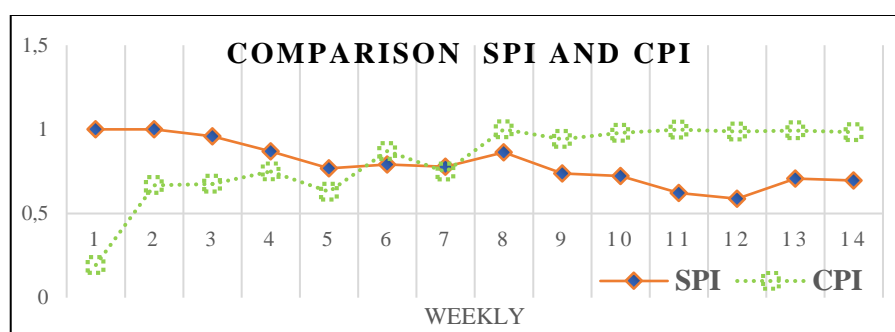
Source : Research Results.

Figure 4.   Comparison graph of SPI and CPI.

It can be seen in the comparison table and graph of SPI and CPI. In week 1 and 2, the values of SPI 1 and CPI <1, this shows that in weeks 1 and 2 the project performance goes on according to schedule and costs less, but week 3 to week 7, the value of SPI and CPI is <1, this shows if there is a schedule delay and have spent more.

4.6.   Calculation of Estimated Time and Cost of Project.

Completion of cost or project schedule based on indicators obtained at the time of reporting, will be known the amount of cost at the end of the project (estimate at completion= EAC) and estimated project completion time (estimated all schedule = EAS) [21][22].

A.   Calculation of Estimated End of Project Time

At the end of the 14th week review, estimated work time remaining, Estimate Temporary Schedule (ETS) as follows :

ETS = (remaining time) / SPI.

ETS = (125 – 98) / 0,697 = 38,7 = 39 days.

While the estimated time to complete all work, (EAS) can be seen as follows :

EAS = completion time + ETS.

EAS = 98 + 39 = 137 days.

From the calculation above, the 14th week review obtained time workmanship that is 12 days longer than the planned 125 days.

B. Calculation of Estimated Final Project Cost.

At the end of the review, which is in the 14th week, the estimated time remaining work, Estimate Temporary Cost (ETC) as follows:

ETC = Budget – BCWP.

ETC = Rp8.213.826.000 – Rp4.891.333.383 = Rp3.322.492.617.

EAC = ACWP + ETC.

EAC = Rp4.973.471.000 + Rp3.322.492.617 = Rp8.295.963.617.

From the above calculation, the final cost value is greater than the contract fee of Rp82.137.617.

5. Conclusion and Suggestion

5.1. Conclusion.

Based on the analysis that has been done, the things that can be concluded from this study are :

1. The cost obtained by Estimate Temporary Cost (ETC) is Rp 3,322,492,617, and the time required for Estimate Temporary Schedule (ETS) at the end the review week 14 is 39 days.

2. The change in costs to complete the project Estimate All Cost (EAC) is Rp. 82,137,617 than the contract costs. While the time to complete the project Estimate All Schedule (EAS)is 137 days. With an additional 12 days.

5.2. Suggestion.

Based on the results of the analysis of the research carried out, the researcher provides the following suggestions Construction service providers who carry out work with consistent supervision.In future studies, it is expected to be able to use data analysis with the CPM Method, or the Ms. Program. Project so that the analysis results will be even better.

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References

[1] I. Purwanto and D. Pujotomo, "Analisis Performansi Pekerjaan Proyek Pembangunan Mechanical – Electrical – Pumbling Gedung Sentraland Semarang Menggunakan Metode Earned Value Analysis," *Ind. Eng. Online J.*, vol. 5, p. 3.

[2] J. Colin and M. Vanhoucke, "Setting tolerance limits for statistical project control using earned value management," *Omega (United Kingdom)*, vol. 49, pp. 107–122, 2014, doi: 10.1016/j.omega.2014.06.001.

[3] S. Stanek and D. Kuchta, "Increasing earned value analysis efficiency for IT projects," *J. Decis. Syst.*, pp. 1–9, 2020, doi: 10.1080/12460125.2020.1783882.

[4] A. Abdi, S. Taghipour, and H. Khamooshi, "A model to control environmental performance of project execution process based on greenhouse gas emissions using earned value management," *Int. J. Proj. Manag.*, vol. 36, no. 3, pp. 397–413, 2018, doi: 10.1016/j.ijproman.2017.12.003.

[5] T. Khesal, A. Saghaei, M. Khalilzadeh, M. Rahiminezhad Galankashi, and R. Soltani, "Integrated cost, quality, risk and schedule control through earned value management (EVM)," *J. Eng. Des. Technol.*, vol. 17, no. 1, pp. 183–203, 2019, doi: 10.1108/JEDT-07-2018-0119.

[6] M. Sutrisna, E. Pellicer, C. Torres-Machi, and M. Picornell, "Exploring earned value management in the Spanish construction industry as a pathway to competitive advantage," *Int. J. Constr. Manag.*, vol. 20, no. 1, pp. 1–12, 2020, doi: 10.1080/15623599.2018.1459155.

[7] K. Agatha and D. H. Dani, "Pengendalian Biaya dan Jadwal Proyek dengan Menggunakan Nilai Hasil (Proyek Rehabilitasi Gedung X Gresik)," 2018.

[8] D. Kartika, "PENGENDALIAN BIAYA DAN WAKTU DENGAN METODE EARNED VALUE (Studi Kasus : Proyek Struktur dan Arsitektur Production Hall-02 Pandaan)," *Tek. Sipil Untag Surabaya*, vol. 7, no. 2, pp. 107–114, 2014.

[9] D. Bryde, C. Unterhitzenberger, and R. Joby, "Conditions of success for earned value analysis in projects," *Int. J. Proj. Manag.*, vol. 36, no. 3, pp. 474–484, 2018, doi: 10.1016/j.ijproman.2017.12.002.

[10] 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," *RACIC J. Tek. Sipil Univ. Abdurrab*, vol. 1, no. 01, pp. 17–35, 2016.

[11] Sambowo, F. N. Kharina, and K. Adi, "Analisis Keterlambatan Proyek Serta Dampaknya Terhadap Biaya Dan Waktu Pelaksanaan Proyek," *infrastruktur*, vol. 5, pp. 13–19, 2019.

[12] Romadhonnia, N. Aulady, M. F. Noor, and F. T. Nuciferani, "Pengukuran Kinerja Waktu Dan Biaya Proyek Pembangunan Jetty Menggunakan Metode Earned Value," *waktu*, vol. 16, pp. 11–18, 2018.

[13] Mahapatni Ida, A. P. Sri, Wirahaji, Bagus, Ida Wijaya, and Harta I Made, "Pengendalian Proyek dengan Earned Value Method (Evm) pada Proyek Pemeliharaan Jalan Provinsi Denpasar- Simpang Pesanggaran," *Widya Tek.*, vol. 13, no. 02, pp. 37–46, 2019, doi: 10.32795/widyateknik.v13i02.508.

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Ukarst : Universitas Kadiri Riset Teknik Sipil.
Volume 4 Number 2, (2020).

[14] Alfian, "Evaluasi Pengendalian Biaya Dan Waktu Pada Proyek Pembangunan Jalan Strategis Matang Sijuek-Trieng Pantang Dengan Menggunakan," *Tek. Sipil Portal*, vol. 8, no. 2, pp. 14–20, 2016.

[15] A. Bakhtiar, "Proyek Peningkatan Jalan Menggunakan Metode Earned Value," *Teras J.*, vol. 8, no. 2, pp. 401–408, 2018, doi: http://dx.doi.org/10.29103/tj.v8i2.172.

[16] E. Sari Ayu, "PENERAPAN EARNED VALUE ANALYSIS (Studi Kasus: Proyek Pembangunan Intake dan Jaringan Pipa Transmisi Air Baku Batang Mahat Kabupaten Lima Puluh Kota)," *J. REKAYASA*, vol. 07, no. 02, pp. 75–87, 2017.

[17] B. Susanti, M. Melisah, and I. Juliantina, "Penerapan Konsep Earned Value Pada Proyek Konstruksi Jalan Tol (Studi Kasus Ruas Jalan Tol Kayuagung - Palembang -Betung)," *J. Rekayasa Sipil*, vol. 15, no. 1, p. 12, 2019, doi: 10.25077/jrs.15.1.12-20.2019.

[18] S. Prasetya, N. W. Setyanto, C. Farela, and M. Tantrika, "PENERAPAN KONSEP EARNED VALUE METHOD SEBAGAI ALAT UKUR KINERJA BIAYA DAN JADWAL PADA PEKERJAAN BEKISTING (Studi kasus : Proyek Pembangunan The Rimba Ayana Hotel oleh PT Anda Jaya Perkasa) APPLICATION of EARNED VALUE METHOD CONCEPT for COST and SCHEDULE," *J. Rekayasa dan Manaj. Sist. Ind.*, no. 2008, pp. 24–35, 2011.

[19] L. L. Willems and M. Vanhoucke, "Classification of articles and journals on project control and earned value management," *Int. J. Proj. Manag.*, vol. 33, no. 7, pp. 1610–1634, 2015, doi: 10.1016/j.ijproman.2015.06.003.

[20] A. Susanty, A. L. Pekerti, and D. P. Sari, "Analisis Kinerja Proyek Pembangunan Rumah Sakit Banyumanik Ii Dengan Menggunakan Earned Value Analysis (Eva) Dan Project Evaluation Review Technique (Pert)," *undip J. Tek. Ind.*, vol. 11, no. 2, p. 61, 2016, doi: 10.14710/jati.11.2.61-72.

[21] A. Ridwan and R. Ajiono, "Pengendalian Biaya Dan Jadual Terpadu Pada Proyek Konstruksi," *UKaRst*, vol. 1, no. 1, pp. 74–83, 2017.

[22] A. Mishakova, A. Vakhrushkina, V. Murgul, and T. Sazonova, "Project Control Based on a Mutual Application of Pert and Earned Value Management Methods," *Procedia Eng.*, vol. 165, pp. 1812–1817, 2016, doi: 10.1016/j.proeng.2016.11.927.

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