

**EARNED VALUE ANALYSIS FOR COST AND TIME
EFFICIENCY ON THE BONDOWOSO POLIJE CAMPUS
ADMINISTRATION BUILDING PROJECT**

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Abstract

The problem in the implementation of the Bondowoso Polije Campus Administration Building Project is the limited cost and time available. With a 5 (five) storey building design with a reinforced concrete structure, each floor of which has an area of 240 m² with a total floor area of almost 1440 m², this building is a fairly complex building, in terms of the function of the building itself. The contract value of physical work amounted to Rp. 5,599,873,601.60 and was carried out within 120 days or 18 weeks. This research method uses Earned Value Method. From the analysis, results and discussion of the Bondowoso Polije Campus Administration Building project, the main conclusion is that there are variations in cost and time during the project period, with the lowest value of Cost Variation reaching (-) Rp 228,191,016.04 in week 7. Although the Cost Productivity Index (CPI) showed positive and negative variations, with a low of 0.672 in week 7, the Time Productivity Index (SPI) was always < 1, reaching a final value of 0.663. The estimated cost (EAC) to complete the project is IDR 5,993,156,919.70, while the estimated total work time (EAS) of the project is 20.543 weeks. Overall, the project is expected to experience a delay of 2.543 weeks and a cost loss of Rp 393,323,318.10.

Keywords: Earned Value Method, Cost Efficiency, Time, Building Project

1. INTRODUCTION

The implementation of construction projects often faces delays in work completion. Delays in project completion that exceed the time limit specified in the contract cause losses both from the contractor as the executor and the assignor. Project implementers pay more attention to the cost aspects incurred and often ignore the time control of project implementation so that project implementation often experiences delays in work (Pranowo, 2007).

For the smooth running of a project, good management is needed to manage or handle the project from the beginning until the project ends, namely project management (Santoso, 2003). Project management is an effort to use limited resources efficiently, effectively and on time in completing a project that has been determined or planned complete a project that has been determined or planned (Dimyati & Kadar, 2014). There are 3 activities from the basic functions of project management, namely planning, scheduling and controlling (Asnuddin et al., 2018).

Planning is one of the vital functions in project management activities (Soeharto, 1997). That's why to achieve goals, management must take proactive steps in conducting comprehensive planning so that goals and objectives can be achieved (Salsabila et al., 2022). Planning is said to be good if the entire process of activities in it can be implemented in accordance with the predetermined goals and objectives with a minimum level of deviation and maximum final results (Ariana & Lestari, 2023; Husein & Perencanaan, 2011).

Then the result of planning is the project scheduler, with project scheduling information can be known about the planned schedule and project progress, in terms of resource performance in the form of costs, labor, equipment, and materials as well as project duration plans and time progress for project completion (Marpaung et al., 2022). Control is defined as a systematic effort to determine standards in accordance with planning goals and objectives, design information systems, compare implementation with standards, analyze possible deviations, then take the necessary corrective actions so that resources can be used effectively and efficiently in order to achieve goals and objectives (Monica, 2013).

From the above definition, it can be concluded that control requires standards or benchmarks as a comparison, performance measurement tools and corrective actions that will be taken if there are deviations. Activities carried out in the control process can be in the form of supervision, inspection and corrective action, which are carried out during the implementation process (Ginting, 2020). Project control is a system that organizes all activities in the project with the aim that all are seen to function optimally (Pratiwi, 2012; Rahman, 2010), so that the implementation is on time in accordance with the project schedule (time schedule), and make it well coordinated in order to produce work of the appropriate quality as planned.

Time control includes activities related to monitoring and correcting so that the progress of project work is in accordance with the predetermined schedule (Ayudya et al., 2023). The output of this process is a revised master schedule, milestone, and field work schedule. The problem in the implementation of the Bondowoso Polije Campus Administration Building Project is the limited cost and time available. With a 5 (five) storey building design with a reinforced concrete structure, each floor of which has an area of 240 M² with a total floor area of almost 1440 M², this building is a fairly complex building, in terms of the function of the building itself. The contract value of physical work amounted to Rp. 5,599,873,601.60 and was carried out within 120 days or 18 weeks.

2. RESULTS AND DISCUSSION

This analysis will focus on evaluating the cost and time control of the Bondowoso Polije Campus Administration Building Project. From this analysis, the results of job performance will be obtained every week. The performance is used to find solutions to errors that may arise in a job in order to control costs and time. The analysis used data from the Bondowoso Polije Campus Administration Building Project with a cost budget plan of Rp 5,599,873,601.60 which was carried out for 120 days or equal to 18 weeks. Drawing and calculations were carried out using Microsoft Excel software.

a. ACWP (Actual Cost of Performance) ANALYSIS

The ACWP value is obtained from financial records by the contractor periodically. The following is a recapitulation of actual costs:

Table 1. Recapitulation of ACWP Results

No.	Month	Period	Spending	ACWP
		Weekly	(Rp)	(Rp)
1	September	Week 1	5.235.000,00	5.235.000,00
2		Week 2	26.208.323,51	31.443.323,51
3		Week 3	13.603.835,34	45.047.158,84

No.	Month	Period	Spending	ACWP
		Weekly	(Rp)	(Rp)
4	Oktober	Week 4	82.473.251,72	127.520.410,57
5		Week 5	90.441.386,04	217.961.796,60
6		Week 6	222.163.101,84	440.124.898,44
7		Week 7	255.487.567,12	695.612.465,56
8		Week 8	305.978.788,12	1.001.591.253,68
9		Week 9	286.328.388,26	1.287.919.641,93
10		Week 10	117.250.346,17	1.405.169.988,10
11	November	Week 11	139.497.272,46	1.544.667.260,56
12		Week 12	66.280.368,70	1.610.947.629,26
13		Week 13	236.622.785,95	1.847.570.415,20
14		Week 14		
15	Desember	Week 15		
16		Week 16		
17		Week 17		
18		Week 18		

Source: Recapitulation / Researcher data processing, 2023

b. BCWS (Budgeted Cost of Work Schedule) Analysis

The BCWS value per week is obtained based on the multiplication of the weekly work plan weight against the total project budget. The data is tan from the plan S curve.

Table 2. Recapitulation of BCWS Analysis Results

No.	Period	BAC	BCWS	BCWS
	Weekly	(Rp)	(%)	(Rp)
1	Week 1	5.599.873.601,60	0,577	32.311.270,68
2	Week 2	5.599.873.601,60	1,994	111.661.479,62
3	Week 3	5.599.873.601,60	3,043	170.404.153,70
4	Week 4	5.599.873.601,60	4,162	233.066.739,30
5	Week 5	5.599.873.601,60	6,082	340.584.312,45
6	Week 6	5.599.873.601,60	8,610	482.149.117,10
7	Week 7	5.599.873.601,60	8,610	482.149.117,10
8	Week 8	5.599.873.601,60	15,199	851.124.788,71
9	Week 9	5.599.873.601,60	21,058	1.179.221.383,02
10	Week 10	5.599.873.601,60	27,848	1.559.452.800,57
11	Week 11	5.599.873.601,60	34,699	1.943.100.141,02
12	Week 12	5.599.873.601,60	40,467	2.266.100.850,36
13	Week 13	5.599.873.601,60	46,507	2.604.333.215,90
14	Week 14	5.599.873.601,60	53,120	2.974.652.857,17
15	Week 15	5.599.873.601,60	60,164	3.369.107.953,67
16	Week 16	5.599.873.601,60	75,026	4.201.361.168,34
17	Week 17	5.599.873.601,60	99,376	5.564.930.390,33
18	Week 18	5.599.873.601,60	100,000	5.599.873.601,60

Source: Recapitulation / Researcher data processing, 2023

c. BCWP (Budgeted Cost of Work Performance) Analysis

The BCWP value per week is obtained from multiplying the weight of the weekly work progress that has been realized by the cost budget for the entire project (Ifeanyi, 2023). The data is tan from the weekly work report.

Table 3. Recapitulation of BCWP Analysis Results

No.	Period	BAC	BCWP	BCWP
	Weekly	(Rp)	(%)	(Rp)
1	Week 1	5.599.873.601,60	0,000	-
2	Week 2	5.599.873.601,60	0,534	29.903.325,03
3	Week 3	5.599.873.601,60	0,806	45.134.981,23
4	Week 4	5.599.873.601,60	2,455	137.476.896,92
5	Week 5	5.599.873.601,60	4,214	235.978.673,57
6	Week 6	5.599.873.601,60	8,347	467.421.449,53
7	Week 7	5.599.873.601,60	8,347	467.421.449,53
8	Week 8	5.599.873.601,60	14,298	800.669.927,56
9	Week 9	5.599.873.601,60	20,132	1.127.366.553,47
10	Week 10	5.599.873.601,60	22,521	1.261.147.533,82
11	Week 11	5.599.873.601,60	25,008	1.400.416.390,29
12	Week 12	5.599.873.601,60	26,426	1.479.822.597,96
13	Week 13	5.599.873.601,60	30,828	1.726.329.033,90
14	Week 14	5.599.873.601,60		
15	Week 15	5.599.873.601,60		
16	Week 16	5.599.873.601,60		
17	Week 17	5.599.873.601,60		
18	Week 18	5.599.873.601,60		

Source: Recapitulation / Researcher data processing, 2023

2.1. VARIANT ANALYSIS

1. Cost Variance

The cost variation value (CV) is the difference between the BCWP value of the project realization and the planned BCWS value.

Table 4. Recapitulation of CV Analysis Results

No.	Period	BCWP	ACWP	CV
	Weekly	(Rp)	(Rp)	(Rp)
1	Week 1	-	5.235.000,00	-5.235.000,00
2	Week 2	29.903.325,03	31.443.323,51	-1.539.998,47
3	Week 3	45.134.981,23	45.047.158,84	87.822,39
4	Week 4	137.476.896,92	127.520.410,57	9.956.486,35
5	Week 5	235.978.673,57	217.961.796,60	18.016.876,97
6	Week 6	467.421.449,53	440.124.898,44	27.296.551,08
7	Week 7	467.421.449,53	695.612.465,56	228.191.016,04
8	Week 8	800.669.927,56	1.001.591.253,68	200.921.326,12

No.	Period	BCWP	ACWP	CV
	Weekly	(Rp)	(Rp)	(Rp)
9	Week 9	1.127.366.553,47	1.287.919.641,93	160.553.088,46
10	Week 10	1.261.147.533,82	1.405.169.988,10	144.022.454,28
11	Week 11	1.400.416.390,29	1.544.667.260,56	144.250.870,27
12	Week 12	1.479.822.597,96	1.610.947.629,26	131.125.031,30
13	Week 13	1.726.329.033,90	1.847.570.415,20	121.241.381,30
14	Week 14			
15	Week 15			
16	Week 16			
17	Week 17			
18	Week 18			

Source: Recapitulation / Researcher data processing, 2023

2. Schedule Variance

The schedule variation value (SV) is the difference between the BCWP value of the project realization and the planned BCWS value.

Table 5. Recapitulation of SV Analysis Results

No.	Period	BCWP	BCWS	SV
	Weekly	(Rp)	(Rp)	(Rp)
1	Week 1	-	-	-
2	Week 2	29.903.325,03	433.598,21	29.469.726,82
3	Week 3	45.134.981,23	1.484.489,53	43.650.491,70
4	Week 4	137.476.896,92	5.618.680,78	131.858.216,14
5	Week 5	235.978.673,57	17.561.532,89	218.417.140,68
6	Week 6	467.421.449,53	33.874.032,45	433.547.417,08
7	Week 7	467.421.449,53	56.160.687,16	411.260.762,37
8	Week 8	800.669.927,56	133.791.944,89	666.877.982,66
9	Week 9	1.127.366.553,47	229.610.745,95	897.755.807,53
10	Week 10	1.261.147.533,82	315.627.393,29	945.520.140,53
11	Week 11	1.400.416.390,29	384.330.274,15	1.016.086.116,14
12	Week 12	1.479.822.597,96	466.232.907,71	1.013.589.690,25
13	Week 13	1.726.329.033,90	627.693.236,73	1.098.635.797,17
14	Week 14			
15	Week 15			
16	Week 16			
17	Week 17			
18	Week 18			

Source: Recapitulation / Researcher data processing, 2023

2.2. PRODUCTIVITY INDEX ANALYSIS

1. Cost Productivity Index (CPI)

The project performance index (CPI) value for each period is a comparison between the realized BCWP and the planned ACWP (Mangkunegara & Prabu, 2005).

Table 6. Recapitulation of CPI Analysis Results

No.	Period	BCWP	ACWP	CPI	T
	Weekly	(Rp)	(Rp)		
1	Week 1	0,00	5.235.000,00	0,000	<1
2	Week 2	29.903.325,03	31.443.323,51	0,951	<1
3	Week 3	45.134.981,23	45.047.158,84	1,002	>1
4	Week 4	137.476.896,92	127.520.410,57	1,078	>1
5	Week 5	235.978.673,57	217.961.796,60	1,083	>1
6	Week 6	467.421.449,53	440.124.898,44	1,062	>1
7	Week 7	467.421.449,53	695.612.465,56	0,672	<1
8	Week 8	800.669.927,56	1.001.591.253,68	0,799	<1
9	Week 9	1.127.366.553,47	1.287.919.641,93	0,875	<1
10	Week 10	1.261.147.533,82	1.405.169.988,10	0,898	<1
11	Week 11	1.400.416.390,29	1.544.667.260,56	0,907	<1
12	Week 12	1.479.822.597,96	1.610.947.629,26	0,919	<1
13	Week 13	1.726.329.033,90	1.847.570.415,20	0,934	<1
14	Week 14				
15	Week 15				
16	Week 16				
17	Week 17				
18	Week 18				

Source: Recapitulation / Researcher data processing, 2023

2. Time Productivity Index (SPI)

The value of the project performance index (SPI) for each period is the ratio between the realized BCWP and the planned BCWS.

Table 7. Recapitulation of SPI Analysis Results

No.	Period	BCWP	BCWS	SPI	T
	Weekly	(Rp)	(Rp)		
1	Week 1	0,00	32.311.270,68	0,000	<1
2	Week 2	29.903.325,03	111.661.479,62	0,268	<1
3	Week 3	45.134.981,23	170.404.153,70	0,265	<1
4	Week 4	137.476.896,92	233.066.739,30	0,590	<1
5	Week 5	235.978.673,57	340.584.312,45	0,693	<1
6	Week 6	467.421.449,53	482.149.117,10	0,969	<1
7	Week 7	467.421.449,53	482.149.117,10	0,969	<1
8	Week 8	800.669.927,56	851.124.788,71	0,941	<1
9	Week 9	1.127.366.553,47	1.179.221.383,02	0,956	<1
10	Week 10	1.261.147.533,82	1.559.452.800,57	0,809	<1
11	Week 11	1.400.416.390,29	1.943.100.141,02	0,721	<1
12	Week 12	1.479.822.597,96	2.266.100.850,36	0,653	<1
13	Week 13	1.726.329.033,90	2.604.333.215,90	0,663	<1

No.	Period	BCWP	BCWS	SPI	T
	Weekly	(Rp)	(Rp)		
14	Week 14		2.974.652.857,17		
15	Week 15		3.369.107.953,67		
16	Week 16		4.201.361.168,34		
17	Week 17		5.564.930.390,33		
18	Week 18		5.599.873.601,60		

Source: Recapitulation / Researcher data processing, 2023

2.3. COST ESTIMATE

1. Cost Estimate for Remaining Work (ETC)

ETC is the estimated time required to complete the remaining work. The ETC value is obtained from the comparison between the remaining plan time and the work performance index (CPI).

Table 8. Recapitulation of ETC Analysis Results

No.	Period	BCWP	CPI	ETC
	Weekly	(Rp)		
1	Week 1	-	0,000	
2	Week 2	29.903.325,03	0,951	5.856.819.505,147
3	Week 3	45.134.981,23	1,002	5.543.930.364,856
4	Week 4	137.476.896,92	1,078	5.066.793.665,422
5	Week 5	235.978.673,57	1,083	4.954.363.704,123
6	Week 6	467.421.449,53	1,062	4.832.726.406,733
7	Week 7	467.421.449,53	0,672	7.638.069.882,130
8	Week 8	800.669.927,56	0,799	6.003.523.123,697
9	Week 9	1.127.366.553,47	0,875	5.109.455.889,222
10	Week 10	1.261.147.533,82	0,898	4.834.206.540,915
11	Week 11	1.400.416.390,29	0,907	4.632.025.240,078
12	Week 12	1.479.822.597,96	0,919	4.485.123.018,055
13	Week 13	1.726.329.033,90	0,934	4.145.586.504,493
14	Week 14			
15	Week 15			
16	Week 16			
17	Week 17			
18	Week 18			

Source: Recapitulation / Researcher data processing, 2023

2. Cost Required to Complete the Project (EAC)

EAC is an estimate of the cost of completing the project by summing the reporting ACWP with the time required to complete the remaining work (ETC).

Table 9. Recapitulation of EAC Analysis Results

No.	Periode Mingguan	ACWP	ETC	EAC
		(Rp)	(Rp)	(Rp)
1	Week 1	5.235.000,00		5.235.000,00
2	Week 2	31.443.323,51	5.856.819.505,15	5.888.262.828,65
3	Week 3	45.047.158,84	5.543.930.364,86	5.588.977.523,70
4	Week 4	127.520.410,57	5.066.793.665,42	5.194.314.075,99
5	Week 5	217.961.796,60	4.954.363.704,12	5.172.325.500,72
6	Week 6	440.124.898,44	4.832.726.406,73	5.272.851.305,18
7	Week 7	695.612.465,56	7.638.069.882,13	8.333.682.347,69
8	Week 8	1.001.591.253,68	6.003.523.123,70	7.005.114.377,37
9	Week 9	1.287.919.641,93	5.109.455.889,22	6.397.375.531,15
10	Week 10	1.405.169.988,10	4.834.206.540,92	6.239.376.529,01
11	Week 11	1.544.667.260,56	4.632.025.240,08	6.176.692.500,64
12	Week 12	1.610.947.629,26	4.485.123.018,06	6.096.070.647,31
13	Week 13	1.847.570.415,20	4.145.586.504,49	5.993.156.919,70
14	Week 14			
15	Week 15			
16	Week 16			
17	Week 17			
18	Week 18			

Source: Recapitulation / Researcher data processing, 2023

2.4. ESTIMATED TIME

1. Estimated Schedule for Remaining Work (ETS)

ETS is an estimate of the time required to complete the remaining work. The ETS value is obtained from the comparison between the remaining plan time and the work performance index (SPI).

Table 10. Recapitulation of ETS Analysis Results

No.	Period	SPI	ETS
	Weekly		(Week)
1	Week 1	0,000	
2	Week 2	0,268	59,745
3	Week 3	0,265	56,632
4	Week 4	0,590	23,734
5	Week 5	0,693	18,763
6	Week 6	0,969	12,378
7	Week 7	0,969	11,347
8	Week 8	0,941	10,630
9	Week 9	0,956	9,414
10	Week 10	0,809	9,892
11	Week 11	0,721	9,713
12	Week 12	0,653	9,188
13	Week 13	0,663	7,543

No.	Period	SPI	ETS
	Weekly		(Week)
14	Week 14		
15	Week 15		
16	Week 16		
17	Week 17		
18	Week 18		

Source: Recapitulation / Researcher data processing, 2023

2. Time Required to Complete the Project

ETS is an estimated project completion schedule by summing the reporting time with the time required to complete the remaining work (ETS) (Wijanarko & Oetomo, 2019).

Table 11. Recapitulation of EAS Analysis Results

No.	Period	ETS	EAS
	Weekly	(Week)	(Week)
1	Week 1		1
2	Week 2	59,745	61,745
3	Week 3	56,632	59,632
4	Week 4	23,734	27,734
5	Week 5	18,763	23,763
6	Week 6	12,378	18,378
7	Week 7	11,347	18,347
8	Week 8	10,630	18,630
9	Week 9	9,414	18,414
10	Week 10	9,892	19,892
11	Week 11	9,713	20,713
12	Week 12	9,188	21,188
13	Week 13	7,543	20,543
14	Week 14		
15	Week 15		
16	Week 16		
17	Week 17		
18	Week 18		

Source: Recapitulation / Researcher data processing, 2023

Based on the analysis that has been carried out on the cost of implementing the Bondowoso Polije Campus Administration Building Project, it shows the inability of the provider / less capability to provide the cost of implementing the project. While the analysis of time shows the lack of motivation from the provider to pursue delays in project completion time, seen since the beginning of the implementation of the work which has always experienced negative progress growth.

The Bondowoso Polije Campus Administration Building was built on solid land which was previously an elementary school building that was quite old and in a condition that was no longer suitable for use as a teaching facility. The construction of the

Bondowoso Polije Campus Administration Building was planned to be built within 120 days but was constrained by the procurement of resources, both labor and materials.

Based on the analysis, the value of cost deviation or CV in each period of the Bondowoso Polije Campus Administration Building project has never been positive in all reporting periods from week 1 to week 13. This shows that the costs incurred are lower than the budget costs. In contrast to the value of schedule deviation or SV which has a positive variation in the period from week 1 to 13. Experienced a decrease in the 6th week period and the 7th week period.

When viewed from the productivity index, the Bondowoso Polije Campus Administration Building Construction project has a cost productivity level that exceeds one only in the reporting period from week 1 to week 6 (Marleno et al., 2018). In the 5th period the cost productivity value or CPI is at the highest ratio of 1.083. While the schedule productivity experienced a fairly sharp fluctuation starting from week 1 rising to 1.083 in week 5 as well as being the highest peak ratio of the entire period. From week 5, it decreased until week 13, the schedule productivity index value decreased until it touched the lowest value in the 12th period with a value of 0.653. Then the next period there was little progress until in week 13 the SPI figure was at 0.663. This shows that there is still a delay in the work schedule in week 13.

Then the total cost projection needed to complete the Bondowoso Polije Campus Administration Building Construction project is at Rp 5,993,156,919.70 in the 13th period. And the total estimated duration of the Pharmacy Warehouse project took 20.543 weeks in the 13th period.

Alternative corrective action on this project is to discuss with the physical work provider of the Administration Building to increase the duration of work and construction labor (Barrientos-Orellana et al., 2023; Danang Prihandoko et al., 2022; Soemardi et al., 2007). In addition, the construction provider must continue to carry out work outside the work items that are hampered due to lack of material supply such as shifting the work schedule to making perimeter fences, completing painting work and working on paving block pairs while waiting for the main material supply to be fulfilled.

3. CONCLUSIONS and SUGGESTIONS

3.1 CONCLUSIONS

Based on the analysis of the Bondowoso Polije Campus Administration Building project, several conclusions can be drawn. First, the Cost Variation (CV) value shows positive and negative variations in each period, with the lowest value of (-)Rp 228,191,016.04 in week 7. In contrast, the Time Variation (SV) value did not experience negative variations in all periods. Secondly, the Cost Productivity Index (CPI) experienced positive and negative variations in all periods, with the lowest value of 0.672 in week 7. Meanwhile, the Time Productivity Index (SPI) was always <1 in all periods, with a final value of 0.663. Third, the estimated cost (EAC) to complete the project reaches Rp 5,993,156,919.70, assuming the cost productivity index of the remaining period is the same as the end of the reporting period. The estimated total work time (EAS) of the project is 20.543 weeks, assuming the time productivity index of the remaining period is the same as the end of the reporting period. In general, the project is expected to experience a delay of 2.543 weeks and a cost loss of Rp 393,323,318.10 from the deduction of the total contract minus the total financing. This conclusion indicates the

challenges in project cost and time management, emphasizing the need for evaluation and improvement to achieve the set objectives.

3.2 SUGGESTIONS

Based on the results of this study, the researcher provides a number of suggestions that can be developed for further research related to project performance analysis on the Bondowoso Polije Campus Administration Building construction project. First, it is recommended to conduct further analysis in the time span starting from week 13 to the end of project completion to ensure maximum results in project performance analysis. Second, it is recommended to analyze project performance based on the quality of work, so that the project is not only appropriate in terms of cost and time, but also ensures the quality of the work performed. Finally, in the process of analyzing project performance using the Earned Value Method, it is recommended to utilize the Microsoft Project program to facilitate supervision and control of work. This is because some of the work included in critical activities can be more visible and well monitored through the help of this technology.

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