

Evaluation Of Construction Project Time And Cost Control Based On Earned Value And Crash Project Method (A case study on the construction project of the State Junior High School 1 Surabaya)

Mohammad Irfandio Kurniawan , Diah Ayu Restuti Wulandari ,Julistyana Tistogondo

Faculty of Engineering, Department of Civil Engineering S1

Narotama University Surabaya

Jl. Arief Rahman Hakim No. 51, Surabaya 60117

irfandio@yahoo.com , diah.wulandari@narotama.ac.id , julistyana@yahoo.com

Abstract

Project development and how to control time and costs in the construction project of a public junior high school 1 Surabaya. This research was conducted with the aim of knowing and comparing the amount of duration and cost after acceleration by using the alternative Earned Value Analysis. The case study in this research takes the construction project of a public junior high school 1 Surabaya which is located in Surabaya. The data needed in this study include the S curve, recapitulation of project cost calculations, a list of budget plans (RAB), and a list of unit wage prices for workers. The research method used is to design network planning, calculate the cost variance and variance schedule for each activity that changes due to changes in the duration of implementation, acceleration of work duration, and determination of the optimum cost and duration due to the application of the Earned Value Analysis method. For the calculation of the variance Schedule on week 34 shows a positive result of Rp. 109,550,470. For the calculation of the cost variance from week 34 shows - Rp. 2,488,159. For the calculation of Estimate at completion (EAC) on week 34 of Rp. 6,663,998,229. For the calculation of Estimate temporary schedule, the evaluation week 34 experienced a delay of 53 days from the original schedule. So the work completion time is 233 calendar days

Keywords :

cost and schedule, Earned Value Engineering

1. Introduction

The concept of earned value is one of the tools used in project management that integrates cost and time. The concept of earned value presents three dimensions, namely the physical completion of the project (the percent complete) which reflects the cost absorption plan (budgeted cost), the actual cost that has been incurred or what is known as actual is called the earned value. Of the three dimensions, with the concept of earned value, it can be linked between cost performance and time derived from calculating the variance of cost and time (Fleming and Koppelman, 1994). Earned Value is able to present performance reporting, budget and remaining cost as well. The drawback is that the presentation is not graphic and is certainly not liked by practitioners in general. Lukas, (2008) there are four reasons why Earned Value analysis is not carried out, namely: undocumented requirements, incomplete requirements, not used or accepted WBS (Work Breakdown Structure), incomplete WBS.

The purpose of this research is how to implement EVA (Earned Value Analysis) in estimating the final time of project completion for each week, whether for 34 weeks of implementation is in accordance with the initial plan of the project schedule. In addition, to find out the project is experiencing delays and experiencing costs greater or less than the project budget plan.

2. Research Methodology

Data obtained from PT. Mitra Karya Mandiri Jaya in the form of primary and secondary data. The method used in this research is descriptive qualitative research that describes the conditions of the project by analyzing existing data. Data analysis used analytical and descriptive methods. Analysis means that existing data are processed in such a way as to produce a conclusive conclusion. Meanwhile, the meaning of descriptive is to describe the problems that already exist or appear. The Concept of Value Results (Earned Value Analysis) examines the trend of schedule variants and cost variants over a period of time during the project. However, this study will only discuss time variants.

2.1 Research Flowchart

The following is a research methodology flow chart.

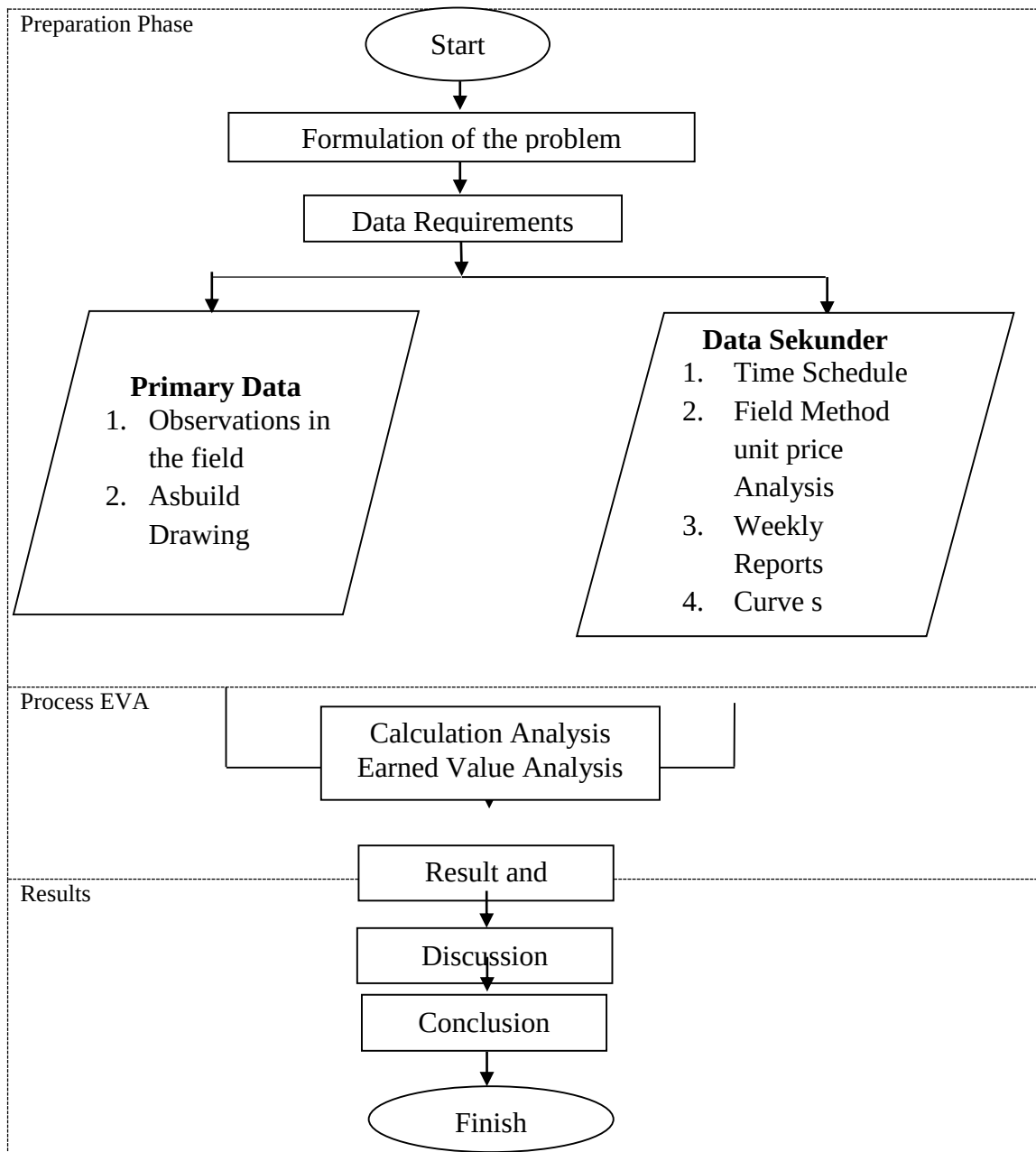


Figure 1. The following is a research methodology flow chart.

3. Discussion And Analysis

In accordance with the background of the writing of this final project, the concept of earned value is one of the tools used in project management that integrates cost and time. The concept of earned value presents three dimensions, namely the physical completion of the project (the percent complete), which reflects the cost absorption plan (budgeted cost), the actual costs that have been incurred or what is called the actual called earned value. So in writing this thesis, the author will take into account the concept of the value of the results in the construction of a project for junior high school 1 Surabaya.

3.1 Earned Value Analysis

Calculation of Variance Analysis and Result Value Concept, Using Microsoft Excel. PV (Planned value) and EV (Earned value) are calculated using data from weekly reports. The project for the construction of a state junior high school 1 surabaya was carried out within 34 weeks with a contract value of Rp. 6,661,509,141.00. There are 34 weekly reports which are reported every week for 34 weeks. One of the reports in the weekly report is work weight, namely the weight of the plan and the weight of work implementation. Planner weight and work execution weight function to determine the progress of project work.

3.2 Calculation of Earned Value Analysis

After knowing what earned value analysis is, the next step is to start the calculation steps using Microsoft Excel and primary and secondary data such as budget plans and time schedules that have been obtained from the Surabaya 1 Public Junior High School project. So one example of calculations from Earned Value analysis.

3.3 Budget Cost Of Work Schedule (BCWS)

The project's budget corresponds to an inventory of activities calculated based on a percentage of total costs, according to 34 weeks of field data. BCWS is calculated using the formula 2.1, namely: Result Value = (% completion) x (Budget).

Example of Calculation of BCWS on week 1 is as follows:

% Weight of the week 1 = 0.02%

Contract Value = Rp. 6,232,056,155.00

So that:

BCWS = (% completion) x (Budget).

= 0.020% x Rp. 6.232.056.155,00

= Rp. 1.558.014,00

Tabel 1. Budget Value Of The Cost Of Work Schedule Every Week

BUDGET VALUE OF THE COST OF WORK SCHEDULE EVERY WEEK							
WEEK	% PROFESSION	CONTRACT VALUE		PV		PV KOM (Rp.)	
1	0,03%	Rp	6.232.056.155	Rp	1.558.014	Rp	1.558.014
2	0,28%	Rp	6.232.056.155	Rp	17.387.437	Rp	18.945.451
3	1,51%	Rp	6.232.056.155	Rp	94.291.010	Rp	113.236.460

3.4 Budget Cost Of Work Performance (BCWP)

The yield value is the budgeted cost of the work completed by the executor, BCWP using the formula 2.1. Result Value = (% completion) x (Budget).

Example of Calculation of BCWP in week 1 is as follows:

% Implementation weight week 1 = 0.0034%

Contract Value = Rp. 6,232,056,155.00

So that:

BCWP = (% completion) x (Budget).

= 0.0034% x Rp. 6,232,056,155.00

= Rp. 211,890.00

Tabel 2. Budget Value Of Cost Of Work Performance Every Week

BUDGET VALUE OF COST OF WORK PERFORMANCE EVERY WEEK							
WEEK	% PROFESSION	CONTRACT VALUE		EV		EV KOM (Rp.)	
1	0,00%	Rp	6.232.056.155	Rp	211.890	Rp	211.890
2	0,03%	Rp	6.232.056.155	Rp	1.869.617	Rp	2.081.507
3	0,03%	Rp	6.232.056.155	Rp	2.118.899	Rp	4.200.406

3.5 Schedule Varians (SV)

The schedule variance is calculated using Equation 2.3. Schedule Variance (SV) = EV - PV or SV = BCWP - BCWS

Example of calculating SV at week 1 is as follows:

Value of Week 1 BCWP = Rp. 211,890

1st Week BCWS Value = Rp. 1. 558,014.04

So that:

Schedule Variance (SV) = EV (BCWP) - PV (BCWS)

= Rp. 211,890 - Rp. 1. 558,014.04

= Rp. -1,346,124.13

The results of the calculation at week 1 show negative results, so that at week 1 it is delayed.

Tabel 3. Schedule Variants Value

Schedule Variants Value						
WEEK	EV KOM (Rp.)		PV KOM (Rp.)		SV(Rp.)	
1	Rp	211.890	Rp	1.558.014	-Rp	1.346.124
2	Rp	2.081.507	Rp	18.945.451	-Rp	16.863.944
3	Rp	4.200.406	Rp	113.236.460	-Rp	109.036.054

3.6 Cost Varians (CV)

The schedule variance is calculated using Equation 2.3. Cost Variance (CV) = EV - AV or SV = BCWP - ACWP.

Example of CV calculation in week 1 is as follows:

Value of Week 1 BCWP = Rp. 211,890

ACWP Value Week 1 = Rp. 209,000.00

So that:

Cost Variance (CV) = EV (BCWP) - AV (ACWP)

= Rp. 211,890.00 - Rp. 209,000.00

= Rp. 2,889.91

Calculation results on week 1 show positive results, so that on week 1 the costs are below the plan (Cost Underrun).

Tabel 4. Variants Cost Value Every Week

VARIANTS COST VALUE EVERY WEEK						
WEEK	EV KOM (Rp.)		AC		CV	
1	Rp	211.890	Rp	209.000	Rp	2.890
2	Rp	2.081.507	Rp	2.030.000	Rp	51.507
3	Rp	4.200.406	Rp	4.143.000	Rp	57.406

3.7 Estimate At Completion (EAC)

The estimated total cost of project completion is calculated based on the costs that have been completed subtracted from the EAC results or using formula 2.7, namely:

$EAC = ACWP + ETC$

An example of calculating the EAC in week 1 is as follows:

ACWP Value Week 1 = Rp. 209,000.00

Week 1 ETC Value = Rp. 6,146,849,823.53

Then:

EAC = ACWP + ETC

= Rp. 209,000.00 + Rp. 6,146,849,823.53

= Rp. 6,147,058,824

Tabel 5. Estimate Value At Completion Every Week

ESTIMATE VALUE AT COMPLETION EVERY WEEK									
WEEK	EV KOM (Rp.)		AC		CPI		ETC		EAC
1	Rp	211.890	Rp	209.000	1,01	Rp	6.146.849.824	Rp	6.147.058.824
2	Rp	2.081.507	Rp	2.030.000	1,03	Rp	6.075.814.311	Rp	6.077.844.311
3	Rp	4.200.406	Rp	4.143.000	1,01	Rp	6.142.741.273	Rp	6.146.884.273

3.8 Estimate Temporary Schedule (ETS)

Based on the contract for the construction project of the Junior High School 1 Surabaya building, the project work time is 180 days. The ETS calculation uses the formula 2.8 where:

$ETS = (\text{remaining time}) / SPI$

An example of calculating the ETS in week 1 is as follows:

SPI Value Week 1 = 0.14

Project Implementation Plan Time = 180 Days

Finish Time = 4 Days

Remaining Time = 180 Days - 4 Days = 176 Days

So that:

Estimate temporary Schedule (ETS) = (Remaining Time) / SPI

= 176 / 0.14

= 1294,118

Completed Work Time

= 180 Days - (1294,118 days + 4 days)

= Implementation plan time - (ETS + End Time)

= -1118,12 days

= -1118,12 days

Table .6 Cumulative Estimate Temporary Schedule (ETS)

Cumulative Estimate Temporary Schedule (ETS)							
1 WEEK	2 EV KOM(Rp)	3 EV KOM(Rp)	4 SPI	5 Plan Time	6 Time's up	7 Remaining time	8 ETS(Hari)
1	Rp 211.890	Rp 1.558.014	0,14	180	4	176	1294,12
2	Rp 2.081.507	Rp 18.945.451	0,11	180	11	169	1538,20
3	Rp 4.200.406	Rp 113.236.460	0,04	180	18	162	4367,27

The project status when reporting (monitoring baseline) in June or week 14 shows the project performance is under budget, this is indicated by the positive CV (Cost Variance) indicator of Rp. 607,955.00 on the 14th week, between the difference in the value of the results (EV / BCWP) and the actual costs incurred (AC / ACWP). Project performance from this cost aspect can also be seen from the cost performance index indicator $CPI = 1.0010 > 1$. Meanwhile, from the schedule aspect, it shows that project performance is delayed, this is indicated by the Schedule Variant (SV) which is negative at -Rp. 1,148,516.02000 between the difference in yield value (BCWP) and the planned budget (PV / BCWS). Project performance from this time aspect can also be seen from the schedule performance index (SPI) whose value is $0.455 < 1$. As in the table below.

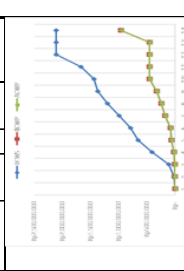
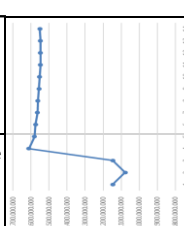
Table 1. Project Performance Status at Week 14						
Earned Value Method		Calculation	The calculation results	Information	S Earned Value Graph	
I. Cost Parameters						
1.	CV (Cost Variance) / Cost Variance	= BCWP - ACWP =Rp. 958.654.955,00 - Rp.958.047.000,00	= Rp. 607.955	= CV > 0, Cost Under run		
2.	Cost Performance Index (CPI)	= EV (BCWP) / CV (ACWP) =Rp. 958.654.955,00 - Rp.958.047.000,00	= 1,001	= CPI > 0, Cost Under run		
II. Time Parameters						
1.	SV (Schedule Varians)	= EV (BCWP) - PV (BCWS) =Rp. 958.654.955,00 - Rp.2.107.170.975,00	= -Rp. 1.148.516.020	= SV < 0, Schedule Overrun		
2.	Schedule Performance Indeks (SPI)	= EV (BCWP) / PV (BCWS) =Rp. 958.654.955,00 - Rp.2.107.170.975,00	= 0,455	= SV < 0, Schedule Overrun		
Table 2. Estimated Cost and Time Required to Complete the Project						
Earned Value Method		Calculation	The calculation results	Information	S Earned Value Graph	
I. Estimasi Biaya dan waktu minggu ke 14						
1.	ESTIMATE AT COMPLETION (EAC)	= ((BAC – BCWP) / CPI) + ACWP = ((Rp. 6.555.544.827 - Rp. 211.889,91) / 1,01) + Rp.958.047.000,00	= Rp. 6.550.888.179	The estimated cost is less than the planned project budget of Rp. 6,555,544,827		
2.	Estimate Temporary Schedule (ETS)	= ((Total time - End time) / SPI) + Job Time = ((180 - 7) / 0.45) + 7	= 95 days or 13 weeks	The estimated time is faster than the project plan time, 180 days		

Figure 2.

Table 7. Value Of Actual Cost For Work Performance Every Week

VALUE OF ACTUAL COST FOR WORK PERFORMANCE EVERY WEEK			
WEEK	BCWS	BCWP	ACWP
1	Rp 1.558.014	Rp 211.890	Rp 209.000
2	Rp 18.945.451	Rp 2.081.507	Rp 2.030.000
3	Rp 113.236.460	Rp 4.200.406	Rp 4.143.000
4	Rp 408.694.866	Rp 19.278.159	Rp 19.445.000
5	Rp 651.840.023	Rp 65.822.527	Rp 66.081.000
6	Rp 791.145.351	Rp 80.703.614	Rp 80.935.000
7	Rp 993.449.464	Rp 175.988.458	Rp 176.218.000
8	Rp 1.200.408.014	Rp 246.067.232	Rp 246.293.000
9	Rp 1.374.457.730	Rp 322.767.107	Rp 322.804.000
10	Rp 1.438.702.069	Rp 454.433.558	Rp 454.279.000
11	Rp 1.670.833.911	Rp 455.844.667	Rp 455.268.000
12	Rp 2.107.107.975	Rp 455.844.667	Rp 455.268.000
13	Rp 2.107.107.975	Rp 455.844.667	Rp 455.268.000
14	Rp 2.107.107.975	Rp 958.654.955	Rp 958.047.000
15	Rp 2.563.043.562	Rp 1.039.943.711	Rp 1.039.205.000
16	Rp 2.876.070.828	Rp 1.392.632.022	Rp 1.310.682.000
17	Rp 3.123.149.312	Rp 1.569.631.733	Rp 1.487.499.000
18	Rp 3.414.674.391	Rp 1.853.486.824	Rp 1.771.653.000
19	Rp 3.695.645.045	Rp 2.322.863.833	Rp 2.241.291.000
20	Rp 4.069.453.385	Rp 2.339.908.250	Rp 2.258.052.000
21	Rp 4.523.020.355	Rp 2.701.774.324	Rp 2.619.695.000
22	Rp 5.115.248.274	Rp 2.761.429.782	Rp 2.679.267.000
23	Rp 5.768.770.538	Rp 2.870.251.826	Rp 2.788.374.000
24	Rp 6.312.487.426	Rp 3.751.317.051	Rp 3.669.182.000
25	Rp 6.529.475.960	Rp 4.088.272.055	Rp 4.006.331.000
26	Rp 6.549.142.594	Rp 4.376.716.028	Rp 4.294.822.000
27	Rp 6.549.470.371	Rp 4.534.704.658	Rp 4.452.711.000
28	Rp 6.549.470.371	Rp 4.861.170.790	Rp 4.778.992.000
29	Rp 6.549.470.371	Rp 5.004.081.668	Rp 4.921.707.000
30	Rp 6.549.470.371	Rp 5.361.358.861	Rp 5.279.196.000
31	Rp 6.549.470.371	Rp 5.667.122.130	Rp 5.669.994.000
32	Rp 6.549.470.371	Rp 6.419.872.663	Rp 6.422.912.000
33	Rp 6.549.470.371	Rp 6.421.871.116	Rp 6.424.623.000
34	Rp 6.549.470.371	Rp 6.659.020.841	Rp 6.661.509.000

EARNED VALUE GRAPHICS

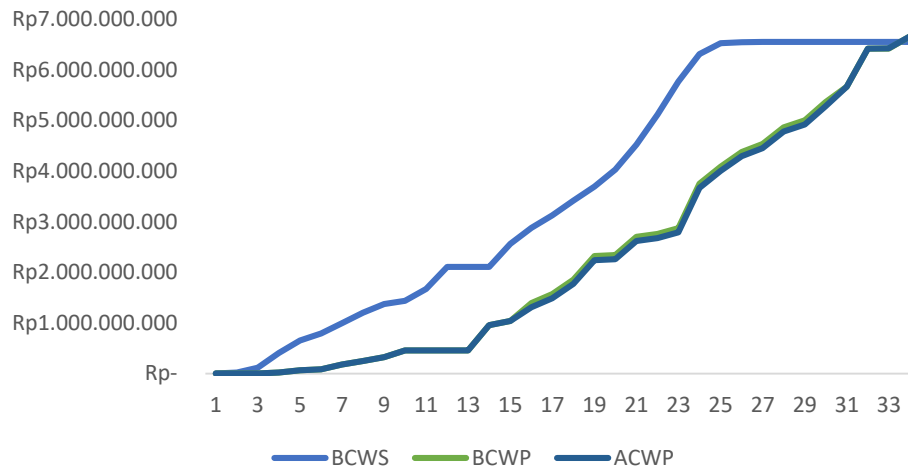


Figure 3.

4. Conclusions And Suggestions

4.1 Conclusion

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

1. Earned Value Analysis can predict the cost and time of project completion well and can predict early in each reporting period if there is a deviation in cost and implementation time.
2. Evaluation of the Sechedule variance at week 1 shows a negative result of - Rp. 1.346.124 So that at week 1 there was a delay. Whereas at week 34 shows a positive result of Rp. 109,550,470 so that at week 34 experienced a speed.
3. Evaluation of Cost Variance at week 1 shows a positive result of Rp. 2.890 So that in week 1 experience lower costs. While at week 34 it shows - Rp. 2,488,159 so that at week 34 so it costs above budget
4. Cost Evaluation
 - Budget plan for building rehabilitation construction type B2 (SMP Negeri 1 Surabaya) is Rp. 6,661,509,000 (six billion six hundred sixty-one million five hundred and nine thousand rupiah)
 - Estimate at completion (EAC) cost at week 34 is Rp. 6,663,998,229
5. Evaluation of Time
 - The planned construction time for type B2 (SMP Negeri 1 Surabaya) is 180 calendar days
 - Estimate time of project completion or Estimate temporary schedule which is influenced by the implementation of project work. In the evaluation week 34 experienced a delay of 53 days from the original schedule. So the work completion time is 233 calendar days
6. Value of Results (Earned value) in this evaluation is the project work is delayed and costs higher than the budget

4.2 SUGGESTION

1. In the next research, acceleration can be done using the Crashing method, Earned Value Analysis, and can be compared using the Microsoft Project program so that the comparison between the three methods can be seen.
2. For subsequent research, other methods can be used so that comparisons can be made to accelerate and cost a project.
3. Subsequent research can carry out regular checks so that you can find out the duration of the project in order to know the changes in data precisely and accurately.

References

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