Vol. 06, No. 01, January 2022, pp. 61~73

INTERNATIONAL JOURNAL OF INNOVATION IN ENTERPRISE SYSTEM

Journal homepage: https://ijies.sie.telkomuniversity.ac.id
e-ISSN: 2580-3050, DOI: https://doi.org/10.25124/ijies.v6i01.139

The Project Performance Evaluation of PLBN Project Using Earned Value Management Method

Malsya Debrina Nur Salsabila[1*], Ika Arum Puspita[2], Sandhy Widyasthana[3*]

[1] School of Industrial and System Engineering
Telkom University, Bandung, Indonesia
malsyadn@student.telkomuniversity.ac.id

[2] School of Industrial and System Engineering
Telkom University, Bandung, Indonesia
ikaarumpuspita@telkomuniversity.ac.id

[3] School of Industrial and System Engineering
Telkom University, Bandung, Indonesia
widyasthana@gmail.com

[*]malsyadn@student.telkomuniversity.ac.id

ARTICLE INFO

Article history:
Received 19 July 2021
Accepted 28 July 2021
Published 31 January 2022

ABSTRACT

Process of monitoring and controlling projects requires data evaluation activities in the order to find out whether the project is in accordance with the plan to avoid an incompatibility between the planning and the actual time. The failure of construction project almost reached the figure of 20% - 40% which occurred in the project monitoring and controlling process. The purpose of this research is analysis project performance with earned value management method at PLBN Project. This research was carried out by several stages: data collection, data processing and analysis. From the results of the performance index analysis show that the project's performance on the construction project is still not good. At week 16 the CPI and SPI values are 0.94 and 0.85. Both values can be interpreted that the costs incurred are greater than planning and the implementation time is longer than planning. The result of EAC is Rp. 2.423.695.294 with an estimated completion time is 21 weeks which indicates that there is an additional 3 weeks of completion.

Keywords:
Project Monitoring and Controlling; Earned Value Management; CPI; SPI; Project Performance

1. INTRODUCTION

The project is an activity that is limited by time and resources in the form of humans, costs, materials and equipment that produces a product, service and result. Project need a good and correct project management to manage a project from the initial to the final stage [1]. A construction project is a project that has unique characteristics. The process carried out in each construction project will have various kinds of differences caused by conditions that occur during project implementations. This has resulted in the constructions project being one of the project with largest failure rate [2]. The failure of construction project almost reached the figure of 20% - 40% which occurred in the project monitoring and controlling process.

The process carried out in each construction project will have various kinds of differences caused by conditions that occur during project implementations. This has resulted in the constructions project being one of the project with largest failure. The factors that cause the process monitoring and controlling being the reason for the failure of construction projects are the use of systems that are still completely manual. Another factor is that some companies are currently ignoring the use of methods that can support the project management process, especially at the stage of project monitoring and controlling [3]. Project monitoring and controlling is a stage in project management process that is carried out after the project is successfully executed. The process of project monitoring and controlling is carried out to monitor project progress and manage each project activity by comparing plans with actual conditions. This is done the aim that the project can be completed in accordance with the plans that have been made [4]. Several components that need to be considered in the process of monitoring and controlling in achieving a goal are cost, time and scope of work [1].

In project implementation at one of the contractor company does not use the methods contained in project management and does not yet have an information system to carry out the monitoring and controlling process that caused the company often gets problems, one of which is an incompatibility between planning and actual time. In 2011, the company is working on a penstock project which has been delayed for 90 days and there is a penalty of Rp. 1.624.284.360 of the planned costs.

Currently, the company is working on a construction project (PLBN) with a limit of 18 weeks starting from January – May 2021. PLBN project undertaken by the company has entered the project monitoring and controlling phase where at this time the company has not used the method project management and does not have an information system to support the process of project monitoring and controlling which results in a lack of information regarding project performance that has been carried out to date.

The purpose of this research is to analysis project performance with earned value management at construction project using spreadsheet-based dashboard tools.

2. METHOD

Research method of this research is shown in the Figure 1.

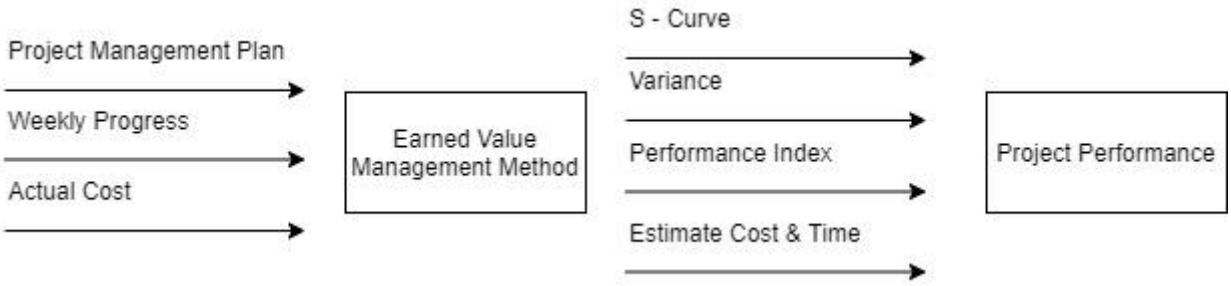

Figure 1 - Research Method

Research method is showed at Fig.1, the data needed in this research is a project management plan consisting of a project charter, work breakdown structure, project plan and budget plan, weekly progress and actual cost. After the data has been collected, the next step is to process the data using the spreadsheet-based dashboard which is carried out according to the earned value management equations with several calculations, namely the calculation of variance, calculation of performance index and calculation of estimated time and cost. the result of data processing from this research is project performance.

2.1. Project Charter

Project charter is a document that states and explains that there is a project. The project charter document contains the description, objectives, limits, deliverables and project milestones. Project charter of this research is shown on the Table 1.

Table 1 - Project Charter
PROJECT CHARTER

Project Name	PLBN Project
Company	Contractor Company
Project Time	18 Weeks (1 January - 16 May 2021)
Deliverables	Building
Project Manager	Lambok Manik

*malsyadn@student.telkomuniversity.ac.id

PROJECT IDENTIFICATION

Project Description	PLBN Project is construction project that build an area that has several buildings including bridge buildings, main buildings & guesthouses and dormitories, site development buildings, office buildings and water tower buildings.	
Project Goals	The purpose of this project is the construction of a National Border Post (PLBN) in the North Kalimantan area which is useful for cross-border security between Indonesia and foreign countries.	
Project Boundaries	The scope of work starts from material procurement, material fabrication, material delivery, installation in the field and other provisions that have been explained during clarification and negotiation.	
	The unit price of the work items that have been signed together is binding	
	Implementation time follows the schedule that has been made	
Deliverables	1.	Bridge Building
	2.	Main Building & Guesthouse and Dormitories
	3.	Site Development Building
	4.	Office Building
	5.	Water Tower Building
Risk	The discrepancy between actual project costs and planned costs	
	The discrepancy between the actual project implementation time and the planned implementation time	
	The discrepancy of the final product with the initial specifications	
Milestones	**Work Package**	**Duration (weeks)**
	Preparatory Work	1
	Shop Drawing Work	4
	Procurement Work	2
	Bridge Fabrication Work	4
	Main Building & Guesthouse and Dormitories Fabrication Work	1
	Site Development Fabrication Work	1
	Office Fabrication Work	1
	Water Tower Fabrication Work	1
	Delivery I	2
	Install / Erection I	4
	Delivery II	2
	Install / Erection II	2
	Finishing	1

*malsyadn@student.telkomuniversity.ac.id

2.2. Work Breakdown Structure

Work Breakdown Structure (WBS) is an organized list of activities of the overall scope of work to be carried out to achieve project objectives. WBS is used to break down or break down project work activities into more detailed processes so that they are easier to manage. WBS of this research is shown in Figure 2.

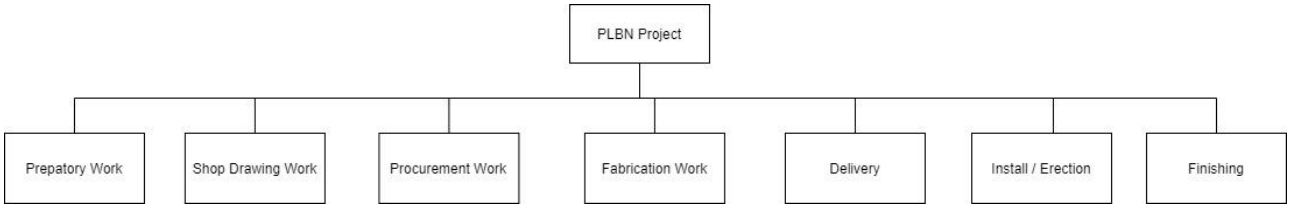

Figure 2 - Work Breakdown Structure

2.3. Project Schedule Plan

Table 2 is the schedule planning data owned by the construction project as a reference in project work. There is information about the duration planning for each activity in the construction project, besides that there is a predecessor activity in each project activity which is called a predecessor.

Table 2 - Project Schedule Plan

No	Work Description	Activity	Predecessor	Duration (weeks)
Project Planning				
1	Carry out the process of preparing project time planning	A	-	1
2	Carry out the process of preparing project cost planning	B	-	1
Project Shop Drawing				
3	Carry out the shop drawing process I	C	A,B	4
4	Carry out the shop drawing process II	D	A,B	4
Material Procurement				
5	Carry out the material procurement process I	E	A,B	2
6	Carry out the material procurement process II	F	A,B	2
Bridge Fabrication				
7	Carry out structural work for bridge buildings	G	A,B	4
8	Carry out architecture work for bridge buildings	H	A,B	4
Main Building & Guesthouse and Dormitories Fabrication				
9	Carry out structural work processes for main buildings & guesthouses and dormitories	I	E,F	1

*malsyadn@student.telkomuniversity.ac.id

10	Carry out architecture work processes for main buildings & guesthouses and dormitories	J	E,F	1
Site Development Fabrication				
11	Carry out the process of structural work for site development buildings	K	I,J	1
12	Carry out the process of architecture work for site development buildings	L	I,J	1
13	Carry out the process of working on the outer fence for the completeness of the site development building	M	I,J	1
Office Building Fabrication				
14	Carrying out the process of structural and roof work for office buildings	N	K,L,M	1
15	Carrying out the process of architecture and roof work for office buildings	O	K,L,M	1
Water Tower Fabrication				
16	Carry out the process of structural work for water tower buildings	P	N,O	1
17	Carry out the process of architecture work for water tower buildings	Q	N,O	1
Material Delivery				
18	Carry out the delivery process I from the workshop to Site	R	I,J	2
19	Carry out the delivery process II from the workshop to Site	S	I,J,T	2
Material Install / Erection				
20	Carry out the installation / erection I process in Site	T	K,L,M	4
21	Carry out the installation / erection I process in Site	U	S	2
Project Closing				
22	Carry out the project handover process between the project owner and the project manager	V	U	1
23	Carry out the process of archiving project documents for company needs	W	U	1

*malsyadn@student.telkomuniversity.ac.id

2.4. Budget Plan

Budget plan a document that contains an estimated budget that will be issued for all forms of needs during the implementation of the ABC project work. Budget plan of this research is shown in Table 3.

Table 3 – Budget Plan

No	Work Description	Qty	Volume	Unit Price		Budget	
1	**Project Planning**						
	Project Time Planning	Ls	1	Rp	2.500.000	Rp	2.500.000
	Project Cost Planning	Ls	1	Rp	2.500.000	Rp	2.500.000
2	**Project Shop Drawing**						
	Shop Drawing I	Ls	1	Rp	10.000.000	Rp	10.000.000
	Shop Drawing II	Ls	1	Rp	10.000.000	Rp	10.000.000
3	**Material Procurement**						
	Material Procurement I	Ls	1	Rp	55.000.000	Rp	55.000.000
	Material Procurement II	Ls	1	Rp	95.000.000	Rp	95.000.000
4	**Bridge Fabrication**						
	Bridge Structural and Roofing Work	m	3500,00	Rp	150.000	Rp	525.000.000
	Bridge Architecture Work	m	2500,68	Rp	100.000	Rp	250.068.000
5	**Main Building & Guesthouse and Dormitories Fabrication**						
	Main Building & Guesthouse and Dormitory Structure Work	m	507,12	Rp	150.000	Rp	76.068.000
	Main Building & Guesthouse and Dormitory Architecture Work	m	125,12	Rp	100.000	Rp	12.512.000
6	**Site Development Fabrication**						
	Site Development Structure Work	m	70,18	Rp	150.000	Rp	10.527.000
	Portal Gate Work	Ls	1	Rp	12.230.250	Rp	12.230.250
	Outer Fence Work	Ls	1	Rp	204.482.500	Rp	204.482.500
7	**Office Fabrication**						
	Office Structural and Roofing Work	m	150,57	Rp	150.000	Rp	22.585.500
	Office Architecture Work	m	112,67	Rp	100.000	Rp	11.267.000
8	**Water Tower Fabrication**						
	Water Tower Structural Work	m	167,89	Rp	150.000	Rp	25.183.500
	Water Tower Architecture Work	m	136,89	Rp	100.000	Rp	13.689.000
9	**Material Delivery**						
	Delivery I	Kg	51777,93	Rp	500	Rp	25.888.965
	Delivery II	Kg	224373,89	Rp	500	Rp	112.186.943
10	**Material Install / Erection**						
	Install / Erection I	Kg	51777,93	Rp	2.500	Rp	129.444.825
	Install / Erection II	Kg	224373,89	Rp	2.500	Rp	560.934.715

*malsyadn@student.telkomuniversity.ac.id

13	**Project Closing**						
	Handover Project	Ls	1	Rp	2.500.000	Rp	2.500.000
	Project Document Archive	Ls	1	Rp	2.500.000	Rp	2.500.000
	Total Budget					Rp	2.172.068.198

3. RESULT AND DISCUSSION

The results of data processing using a spreadsheet-based dashboard with the concept of earned value management as a tool are as follows:

3.1. PV EV AC

Calculation of PV, EV and AC using the spreadsheet-based dashboard which is carried out according to the earned value management equations. Actual Cost value is obtained from direct costs and indirect costs over a certain period of time. Table 4 are the results of PV, EV and AC using a spreadsheet-based dashboard in the 1st week to 16th week period:

Table 4 – PV EV AC

Week	**PV**	**PV Cumulative**	**EV**	**EV Cumulative**	**AC**	**AC Cumulative**
1	Rp5.000.000	Rp5.000.000	Rp7.500.000	Rp7.500.000	Rp8.000.000	Rp8.000.000
2	Rp10.000.000	Rp15.000.000	Rp15.000.000	Rp22.500.000	Rp14.252.904	Rp22.252.904
3	Rp15.000.000	Rp30.000.000	Rp20.000.000	Rp42.500.000	Rp18.065.184	Rp40.318.088
4	Rp288.767.000	Rp318.767.000	Rp243.767.000	Rp286.267.000	Rp358.807.420	Rp399.125.508
5	Rp562.534.000	Rp881.301.000	Rp467.534.000	Rp753.801.000	Rp576.652.428	Rp975.777.936
6	Rp756.301.000	Rp1.637.602.000	Rp725.061.782	Rp1.478.862.782	Rp716.209.000	Rp1.691.986.936
7	Rp1.038.648.000	Rp2.676.250.000	Rp950.106.564	Rp2.428.969.346	Rp847.344.290	Rp2.539.331.226
8	Rp1.278.832.233	Rp3.955.082.233	Rp1.074.388.297	Rp3.503.357.643	Rp1.132.547.546	Rp3.671.878.772
9	Rp1.357.990.421	Rp5.313.072.654	Rp1.291.815.279	Rp4.795.172.922	Rp1.284.261.260	Rp4.956.140.032
10	Rp1.429.224.128	Rp6.742.296.781	Rp1.358.028.985	Rp6.153.201.907	Rp1.330.500.626	Rp6.286.640.658
11	Rp1.461.585.334	Rp8.203.882.115	Rp1.415.573.692	Rp7.568.775.599	Rp1.562.052.650	Rp7.848.693.308
12	Rp1.493.946.540	Rp9.697.828.655	Rp1.429.262.692	Rp8.998.038.290	Rp1.513.311.510	Rp9.362.004.818
13	Rp1.493.946.540	Rp11.191.775.195	Rp1.429.262.692	Rp10.427.300.982	Rp1.554.787.686	Rp10.916.792.504
14	Rp1.550.040.012	Rp12.741.815.207	Rp1.493.985.104	Rp11.921.286.086	Rp1.618.882.060	Rp12.535.674.564
15	Rp1.606.133.483	Rp14.347.948.690	Rp1.550.078.576	Rp13.471.364.662	Rp1.512.756.500	Rp14.048.431.064
16	Rp1.886.600.841	Rp16.234.549.530	Rp1.606.172.047	Rp15.077.536.709	Rp1.714.264.000	Rp15.762.695.064

Table 4 shows the results of PV EV AC calculations using a dashboard obtained from the schedule plan, budget plan and weekly progress input processes. The PV EV AC value will be used as the basis for calculations in the next worksheet.

3.2. S Curve

The S curve is a graph or mathematical illustration that accurately represents the cumulative data that is appropriate for a project or job [8]. The data displayed will show the X and Y axes, where the X axis shows the time data (weeks) and the Y axis shows the cost data (rupiah). In this research, the S-Curve was obtained as shown in Figure 7 below:

*malsyadn@student.telkomuniversity.ac.id

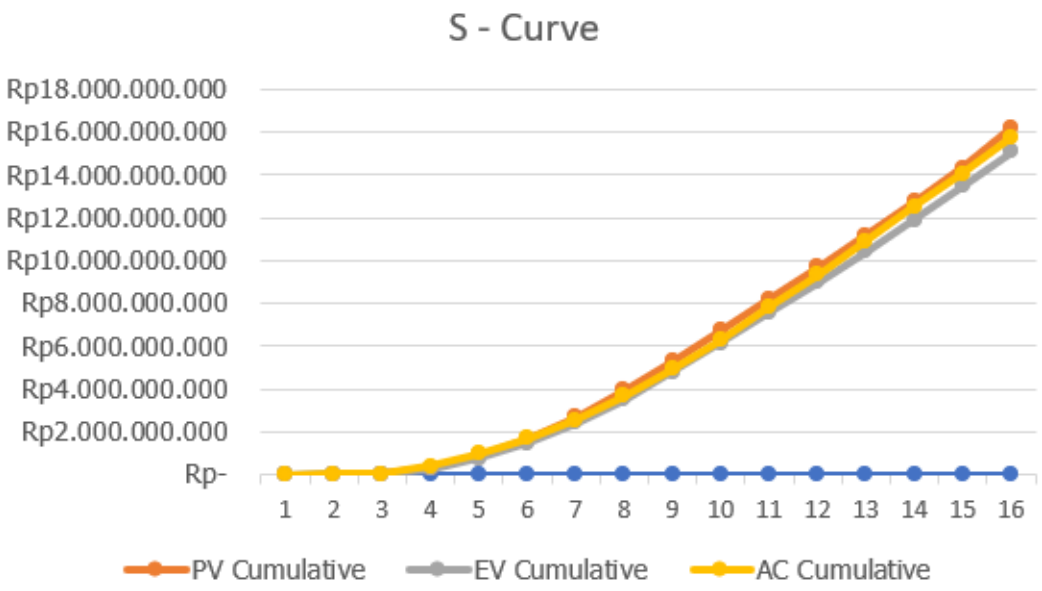

Figure 3 – S - Curve

Figure 3 shows the results of the S - Curve based on the PV EV AC value using the dashboard. It can be seen that the EV and AC values are not always below the PV value, this is caused by several factors, namely the planning process is less detailed, several times the image changes in the project shop drawing process and incompatibility in the material procurement process.

3.3. Calculation of Variance

The calculation of variance is a calculation to get the SV and CV values using the spreadsheet-based dashboard which is carried out according to the earned value management equations. The following are the results of the calculation of SV and CV in the 1st week to 16th week period:

Table 5 – Variance Calculation

Variance	
SV (Rp)	**CV (Rp)**
Rp 2.500.000	-Rp 500.000
Rp 5.000.000	Rp 747.096
Rp 5.000.000	Rp 1.934.816
-Rp 45.000.000	-Rp 115.040.420
-Rp 95.000.000	-Rp 109.118.428
-Rp 31.239.218	Rp 8.852.782
-Rp 88.541.436	Rp 102.762.274
-Rp204.443.936	-Rp 58.159.249
-Rp 66.175.142	Rp 7.554.019
-Rp 71.195.142	Rp 27.528.359
-Rp 46.011.642	-Rp 146.478.958
-Rp 64.683.848	-Rp 84.048.818
-Rp 64.683.848	-Rp 125.524.994
-Rp 56.054.907	-Rp 124.896.956
-Rp 56.054.907	Rp 37.322.076
-Rp280.428.793	-Rp 108.091.953

*malsyadn@student.telkomuniversity.ac.id

Table 5 shows the results of variance calculation consisting SV and CV values. It can be seen that the value of SV and CV at week 16 is negative where the SV value is -Rp.280.428.793 and CV value is -Rp.108.091.953, which means that the project time has been delayed and the project cost has increased.

3.4 Calculate of Performance Index

The calculation of the performance index is a calculation to get the SPI and CPI values using the spreadsheet-based dashboard which is carried out according to the earned value management equations. The following are the results of the calculation of SPI and CPI in the 1st week to 16th week period:

Table 6 – Performance Index Calculation

Performance Index	
SPI	**CPI**
1,50	0,94
1,50	1,05
1,33	1,11
0,84	0,68
0,83	0,81
0,96	1,01
0,91	1,12
0,84	0,95
0,95	1,01
0,95	1,02
0,97	0,91
0,96	0,94
0,96	0,92
0,96	0,92
0,97	1,02
0,85	0,94

Table 6 shows the results of performance index calculation consisting of the SPI and CPI values. It can be seen that the SPI and CPI values at week 16 are below one (<1) where the SPI value is 0.85 and the CPI value is 0.94, which means that the project time has been delayed and the project costs have increased.

3.5 Calculations of Project Costs and Time Estimated

Calculation of the estimated cost and project time using the spreadsheet-based dashboard which is carried out according to the earned value management equations for the 1st week to the 16th week got the following results:

1. Calculation of Second Assumption Cost Estimation
   The calculation of the estimated completion (EAC) of the first assumption is done by looking at the current CPI value. The following are the results of the estimated final project costs and the remaining costs of the first assumption project work:

Table 7 - EAC First Assumption Calculation

Cost Estimate	
EAC (Rp)	**ETC (Rp)**
Rp 2.316.872.745	Rp 2.308.872.745
Rp 2.063.885.301	Rp 2.049.632.397
Rp 1.961.940.583	Rp 1.943.875.399
Rp 3.197.127.528	Rp 2.838.320.108

*malsyadn@student.telkomuniversity.ac.id

Rp 2.679.010.297	Rp 2.102.357.869
Rp 2.145.547.911	Rp 1.429.338.911
Rp 1.937.140.164	Rp 1.089.795.874
Rp 2.289.647.528	Rp 1.157.099.982
Rp 2.159.366.812	Rp 875.105.552
Rp 2.128.038.597	Rp 797.537.971
Rp 2.396.826.746	Rp 834.774.096
Rp 2.299.798.227	Rp 786.486.717
Rp 2.362.830.085	Rp 808.042.399
Rp 2.353.652.810	Rp 734.770.750
Rp 2.119.770.144	Rp 607.013.644
Rp 2.318.243.755	Rp 603.979.755

Table 7 shows the results of the estimated cost calculations first assumptions consisting of EAC and ETC. It can be seen that if the actual conditions (week 16) are in accordance with the first assumption, the cost required to complete the project (EAC) is Rp. 2,318,243,755 and the cost required to complete the remaining project work (ETC) is Rp. 603.979.755.

2. Calculation of Second Assumption Cost Estimation
The calculation of the estimated completion (EAC) of the second assumption is carried out by looking at the level of the budgeted value. The following are the results of the estimated final project costs and the remaining costs of the second assumption project work:

Table 8 - AC Second Assumption Calculation

Cost Estimate	
EAC (Rp)	**ETC (Rp)**
Rp 2.172.568.198	Rp 2.164.568.198
Rp 2.171.321.102	Rp 2.157.068.198
Rp 2.170.133.382	Rp 2.152.068.198
Rp 2.287.108.618	Rp 1.928.301.198
Rp 2.281.186.626	Rp 1.704.534.198
Rp 2.163.215.416	Rp 1.447.006.416
Rp 2.069.305.924	Rp 1.221.961.634
Rp 2.230.227.447	Rp 1.097.679.901
Rp 2.164.514.179	Rp 880.252.919
Rp 2.144.539.839	Rp 814.039.213
Rp 2.318.547.156	Rp 756.494.506
Rp 2.256.117.016	Rp 742.805.506
Rp 2.297.593.192	Rp 742.805.506
Rp 2.296.965.154	Rp 678.083.094
Rp 2.134.746.122	Rp 621.989.622
Rp 2.280.160.151	Rp 565.896.151

*malsyadn@student.telkomuniversity.ac.id

Table 8 shows the results of the estimated cost calculations second assumptions consisting of EAC and ETC. It can be seen that if the actual conditions (week 16) are in accordance with the second assumption, the cost required to complete the project (EAC) is Rp. 2,280,160,151 and the cost required to complete the remaining project work (ETC) is Rp. 565,896,151.

3. Calculation of the Third Assumption Cost Estimate
Estimated completion calculation (EAC) is carried out by considering the SPI and CPI value factors. In this method, the ratio of the SPI and CPI values will be used. In this calculation, the ratio is assumed to be 100% because it is not provided by the company. The following are the results of the estimated final project costs and the remaining costs of the third assumption project work:

Table 9 - EAC Third Assumption Calculation

Cost Estimate	
EAC (Rp)	**ETC (Rp)**
Rp 1.547.248.496	Rp 1.539.248.496
Rp 1.380.674.502	Rp 1.366.421.598
Rp 1.475.971.733	Rp 1.457.906.549
Rp 3.721.088.544	Rp 3.362.281.124
Rp 3.106.196.336	Rp 2.529.543.908
Rp 2.207.130.842	Rp 1.490.921.842
Rp 2.038.699.394	Rp 1.191.355.104
Rp 2.509.830.562	Rp 1.377.283.016
Rp 2.204.195.384	Rp 919.934.124
Rp 2.169.849.803	Rp 839.349.177
Rp 2.423.960.146	Rp 861.907.496
Rp 2.335.392.095	Rp 822.080.585
Rp 2.399.399.494	Rp 844.611.808
Rp 2.381.221.697	Rp 762.339.637
Rp 2.141.721.349	Rp 628.964.849
Rp 2.423.695.294	Rp 709.431.294

Table 9 shows the results of the estimated cost calculations third assumptions consisting of EAC and ETC. It can be seen that if the actual condition (week 16) is in accordance with the third assumption, the cost required to complete the project (EAC) is Rp. 2,423,695,294 and the cost needed to complete the remaining project work (ETC) is Rp. 709,431,294.

4. Calculation of Time Estimate
Time estimate calculation is a calculation carried out to find out the estimated time for project completion using a spreadsheet-based dashboard with an equation that has been determined at the time of dashboard design. The following is the result of the times estimate calculation in the 1st week to 16th week period:

*malsyadn@student.telkomuniversity.ac.id

Table 10 - Time Estimate Calculation

Time Estimate
12
12
14
21
22
19
20
21
19
19
19
19
19
19
19
21

Table 10 shows the results of the estimated time (TE). It can be seen that in the 16th week the estimated time obtained to complete the project is 21 weeks or there is an additional time of 3 weeks from the planning time.

4. CONCLUSION

This research proves that earned value management method can use to analyze project performance with cost and time aspect. The result of construction project performance using spreadsheet-based dashboard as a tool is still not good, the data shows that the project performance is in the poor project status, where at week 16 the CPI and SPI values are 0.94 and 0.85. Both values can be interpreted that the costs incurred are greater than planning and the implementation time is longer than planning. The result of construction project estimated completion costs or EAC at week 16 is Rp. 2.423.695.294 with the estimated completion time is 21 weeks or there is an additional 3 weeks of completion time. This delay was caused by various factors, namely project planning that was less detailed, changes to the project shop drawings and incompatibility of material delivery times.

By doing this research, will provide many benefits for contractor companies in assisting the process of project monitoring and controlling by knowing the project performance. By knowing the performance of the project the company can find out the actual condition of the project and by knowing the estimated time and cost of project completion, the company can easily make decisions to evaluate improvements in project completion.

Disclaimer

The authors whose names are written certify that they have no conflict of interest.

REFERENCES

[1] PMI. (2017). Project Management Body of Knowledge. Newtown Square, Pennsylvania: 14 Campus Boulevard.
[2] Putu, I. A., Wirahaji, I. B., & Wijaya, I. H. (2019). Pengendalian Proyek dengan Earned Value Management (EVM) pada Proyek Pemeliharaan Jalan Provinsi Denpasar - Simpang Pesanggaran. Jurnal Widya Teknik Vol 13 No 02.
[3] Wiyana, Y. E. (2012). Analisis Kegagalan Konstruksi dan Bangunan dari Perspektif Faktor Teknis. Wahana Teknik Sipil Vol. 17, 77 - 78.
[4] Mulcahy, R. (2018). PMP Exam Prep Ninth Edition. United State of America: RMC Publications.
[5] Widiningrum, A., Haryono, I., & Pratami, D. (2018). Analisis Kinerja Proyek dengan Metode Earned Value Management pada Proyek Shutdown STO Tanjungsari. e-Proceeding of Engineering : Vol.5, No.3.
[6] Maromi, M. I., & Indryani, R. (2015). Metode Earnd Value untuk Analisa Kinerja Biaya dan Waktu Pelaksanaan pada Proyek Pembangunan Condotel De Vasa Surabaya. Jurnal Teknik ITS Vol 4 No 1, 55 - 56.
[7] Sediyanto, & Hidayat, A. (2017). Analisa Kinerja Biaya dan Waktu pada Pelaksanaan Proyek Konstruksi dengan Metode Earned Value (Studi Kasus Proyek Konstruksi Mall dan Hotel X di Pekanbaru). Jurnal Ilmu Teknik dan Komputer.
[8] Priyo, M., & Indraga, K. F. (2015). Analisis Kinerja Biaya dan Jadwal Terpadu dengan Konsep Earned Value Method (Studi Kasus: Proyek Pembangunana Gedung). JURNAL ILMIAH SEMESTA TEKNIKA Vol. 18, No. 2.

*malsyadn@student.telkomuniversity.ac.id

[9] Briandhito, C., Puspita, I. A., & Widyasthana, S. (2019). Analisis Kinerja Biaya dan Waktu Menggunakan Metode Earned Value Manajemen dan TCTO untuk Mengoptimalkan Biaya dan Waktu pada Proyek Summarecon Bandung. e-Proceeding of Engineering : Vol.6, No.2.
[10] Hafizh, A. (2018). Analisa Biaya dan Waktu Proyek dalam Proses Kinerja dengan Menggunakan Metode Earned Value. 11 - 17.
[11] Hidayatullohi, T. (2019). Earned Value Pelaksanaan Proyek Pembangunan Kantor Denma Seskoad TNI AD Ditinjau dari Kinerja Waktu Menggunakan Ms. Project. Jurnal IKRA-ITH Teknologi Vol 3 No 1.
[12] Mualim, P. P., Pratami, D., & Bay, A. F. (2020). Monitoring Proyek Ducting FO Kawasan Tahap III Summarecon Bandung Menggunakan Metode Earned Value Management. Seminar Nasional Teknik Industri Universitas Gadjah Mada.
[13] Nicholas, J. M., & Steyn, H. (2012). Project Management for Engineering, Business and Technology. London and New York: Routledge.
[14] Rani, H. A. (2016). Manajemen Proyek Konstruksi. Yogyakarta: Deepublish.
[15] Wahyuni, E., & Hendrawan, B. (2018). Analisis Kinerja Proyek "Y" Menggunakan Metode Earned Value Management (Studi Kasus di PT Asian Sealand Engineering). Journal of Applied Business Administration Vol 2, No 1.