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COST AND TIME ANALYSIS WITH EARNED VALUE METHOD ON THE CONSTRUCTION PROJECT OF BPBD BUILDING COMPLEX PASURUAN DISTRICT

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Abstract

In the construction project of the Pasuruan Regency BPBD building complex which is currently still running, there have been problems related to the schedule for the implementation of its activities. The problem in question is the delay in the schedule for the implementation of its activities. where the results of the progress realization are not in accordance with the schedule plan, through this paper an evaluation is carried out related to performance in the field through an approach using the Earned Value Method. The data analysis process is carried out by calculating analysis indicators including BCWS, BCWP and ACWP. The results of the performance evaluation of the Pasuruan Regency BPBD building complex construction project using the Earned Value method show that the project has a negative deviation in the activity implementation schedule. The cost performance indicator on this project shows a Cost Performance Index (CPI) value of 1.137, which means that the costs incurred are greater than planned. While the time performance indicator shows a Schedule Performance Index (SPI) value of 0.949, which means the project is delayed from the planned schedule.

Keywords: *Earned Value Method, Cost, Project Time*

1. INTRODUCTION

In order to follow up on the potential for disaster in an area, the government through Law no.24 2007 on disaster management intends to organize disaster management efforts in a systematic, integrated and coordinated manner, the government and local governments are responsible for organizing disaster management. BPBD as the executor of disaster management activities in the region that are coordinated and integrated with other regional work units. BPBD is a non-departmental government agency that carries out disaster management tasks in the regions both provinces and districts / cities guided by policies set by the National Disaster Management Agency (BNPB).

The Pasuruan district government relocated the BPBD office and workshop from the Raci office complex, Pasuruan district to the Kraton sub-district in addition to considering the condition of the Raci office complex which is now quite crowded also with the hope that the mobilization of emergency equipment from the public kitchen, Damkar, boats from BPBD and Tagana and others can be faster to the disaster site, especially to the eastern Pasuruan district where the location of the new BPBD building is on the edge of the highway which is the main acces / road from the eastern region to the western region of Pasuruan district and vice versa, so that in the end the implementation of BPBD building construction activities was carried out.

In construction project activities, it is very necessary to have project management which is expected to help evaluate related to the implementation of the project activities themselves, both evaluations in terms of time, cost, and quality so that the activities of a project can take place in accordance with what has been planned from the start, and if there are obstacles or problems at the time of implementation, it is hoped that they can be immediately recognized and overcome so that losses due to delays can be minimized from the start. which is no less important and becomes the main thing that must be considered in the implementation of project activities is the schedule for implementing the project activities themselves, based on existing regulations as we all know that if a delay in the implementation of project activities occurs, of course there will be sanctions or fines that must be fulfilled / paid in accordance with the existing contract. this is where it is clear that construction management planning and project control efforts are needed.

Based on the results of previous research from journals written by B. Zakariyya, A. Ridwan, Suwarno with the title Cost Analysis and Schedule of the Trenggalek Regency Health Office Building Construction Project with the Earned Value Method, where the Trenggalek Regency Health Office Building is a construction project that includes a large scale. and as is generally the case in the implementation of large-scale project activities, problems often arise related to project performance. Of course there is a need for control efforts related to the costs incurred and also the time to be used so that it is hoped that the project can run according to the plan that has been compiled. In this study, the Earned Value Method is used with the intention of being able to determine the performance index, so that in the end it can be estimated the cost requirements and time requirements used for the completion of the project activities. which in turn can immediately be obtained improvement steps that must be taken for the progress of the ongoing project. based on existing data, the results of the study in week 12 are as follows: Budgeted Cost of Work Schedule (BCWS) of Rp1,946,626,471.64, Budgeted Cost of Work Performed (BCWP) of Rp1,319,204,394.05, Actual Cost of Work Performed (ACWP) of Rp1,181,554,085.52. Cost performance has an advantage, Cost Variant (CV) of IDR137,660,308.53 or Cost Performance Index (CPI) of 1.117>1. Schedule performance is delayed, Schedule Variant (SV) is - Rp627,422,077.59 or Schedule Performance Index (SPI) is 0.678 < 1. Estimate at Completion (EAC) is Rp3,483,730,479.63 with a profit of Rp405,885,332.51. Estimate All Schedule (EAS) for 29.707 weeks, slow 5.707 weeks (Zakariyya, Ridwan, and Suwarno 2020).

The implementation of project monitoring and control activities can be carried out using various methods, ranging from conventional methods to scheduling methods that have been developed by many researchers, including Milestone Charts, Line of Balance, Gantt Chart, and network-based scheduling such as Program Evaluation and Review Technique (PERT), Arrow Diagram Method (ADM) or commonly called Critical Part Method (CPM) and so on. In order to increase the effectiveness of field monitoring and project control activities, on this occasion, we carried out a performance evaluation of project activities in the BPBD building complex construction project in Pasuruan Regency for the 2023 budget year, using one of the project activity performance measurement methods called Earned Value.

In the construction project of the BPBD building complex of Pasuruan Regency, which is used as a study material in the preparation of this thesis, an approach is taken

related to the performance evaluation of the implementation of project activities with the intention of obtaining information on problems that arise in the implementation of project activities. As with what has been said at the beginning, that the implementation of development activities / procurement of the new BPBD project aims to be able to provide maximum service to the community, with the location of the new building which has close access from the main road in the Pasuruan district area. supported by the readiness of equipment and mobilization that can more quickly reach the entire Pasuruan district area, in addition it is also due to the limited area of the old BPBD office which adjoins office buildings and other official facilities.

The location of the BPBD building is on the edge of Jalan Raya Wangonmas, Ds. Bendungan, Kec. Kraton, Kab. Pasuruan, with a total land area of ± 19,203.7 m2. The building consists of a BPBD office building with an area of 1516.5 m2 and a workshop building with an area of 1514.3 m2, each consisting of 2 floors. In the construction of this stage, apart from the 2 buildings that were carried out, land maturation work was also carried out at the beginning of the project implementation, where the existing land was previously still in the form of vacant land that had not been used, work on fencing around the area / in stages, GWT work and pump houses as well as infra and supporting work. the construction was carried out using APBD funds with a value of Rp. 18,898,770,576.77 with an implementation time of 210 calendar days.

In the implementation of its activities, the BPBD building construction project is currently experiencing a negative deviation, which means that it is delayed from the planned schedule. the negative deviation rate from the existing weekly progress data is indicated starting from the beginning of the week, namely in weeks 1, 2 and 3, and again experiencing negative deviations in weeks 16, 17, 18 and 19 / currently. this delay problem is in line with project performance in the early stages of implementation, where in the early stages of implementation the contractor must carry out preparatory work and structuring the project area first. starting from the procurement / manufacture of access to the project area, land compaction, construction of fences around the project area, directors' quarters and the construction of workers' barracks along with supporting facilities / facilities, procurement of electricity resources and also working water by making boreholes which certainly cannot immediately run optimally. seeing this in the implementation of its activities, an effort is needed which is called project control.

Earned Value Method is a project management technique used to measure the performance and progress of a project. in an integrated system, EVM is able to provide accurate estimates related to performance issues in a project activity (Priyo and Zhafira 2017). EVM's systematic work process serves to find variations / deviations in the project based on a comparison of the work that has been carried out in the field with the work that has been planned. Through this method, it can be known as early as possible the occurrence of cost overruns to delays that occur in the implementation of a project activity, so that in the end it is hoped that anticipatory steps can be taken by the parties involved to be able to complete the project activities on time and the remaining costs.

The level of achievement in an implementation of project activities or what is commonly referred to as project performance can be seen from the results of the implementation of the project activities themselves, project performance is said to be lacking, of course there are delays and will ultimately lead to additional operational costs of implementation. this is also the case with what is currently taking place in the BPBD

building construction project in Pasuruan Regency, which is experiencing delays in the middle of the implementation schedule that was previously planned and is feared to continue until the end of the implementation time. So in this project, analysis and research on the performance of construction work will be carried out using the Earned Value Method.

2. RESEARCH METHODS

In this study took the object of research on the Pasuruan Regency BPBD Building Complex Development Project, based on existing project contract data the project was carried out with a budget value of Rp. 18,898,770,576.77 (Eighteen Billion Eight Hundred Ninety Eight Million Seven Hundred Seventy Thousand Rupiah) managed by the Water Resources, Cipta Karya and Spatial Planning Office of Pasuruan Regency. The executing contractor on this project is PT.Konstruksi Bangun Persada with PT.Pilar Empat supervisory consultant with an implementation time of 210 calendar days.

EVM (Earned Value Method) data collection and analysis is designed in planning and continuously improved during the implementation, monitoring and control process (Muniroh, Kempa, and Buyang 2021). Data collection should be commensurate with the size, complexity, and importance of the project to the organization to ensure EVM is effective, efficient and can add value to the overall project management process. Primary Data consisting of Site Survey, Interview with the contractor. Secondary data consists of Time Schedule, weekly and monthly reports, RAB. The process of analyzing or managing data with the Earned Value Method.

3. RESULTS AND DISCUSSION

In this study, an assessment was carried out on the implementation of the project activities of the Pasuruan Regency BPBD Office Building Construction project, along with its supporting facilities in stages. as for the schedule for the implementation of the construction activities, the completion time of this project is scheduled for 210 calendar days, carried out in the period from the end of May 2023 to mid-December 2023 based on the existing contract documents.

Based on conditions in the field, the location of the implementation of this project activity is still a vacant land and is overgrown with shrubs that have never been prepared for the project activity plan. The existing land elevation is still in the form of uneven land contours with elevations that are still far below the planned elevation or the average elevation of the highway in front of the activity site. Likewise, with access to the location of activities there are still road channels / drainage that cannot be directly passed by vehicles to enter the project activity location area.

The project that is the object of research at this time is a project that is being worked on / in progress, by providing research limitations only on the evaluation of cost and time factors. As for the quality factor in the current study, no research was conducted, considering that the use of the Earned Value Concept Method only discusses the occurrence of project delays from the planned schedule to the actual schedule analyzed

so that the project can be completed as planned(Adinata and Alfa 2020); (Castollani, Puro, and Lesmana 2020).

3.1. Project Analysis Using Earned Value Method

In the calculation of the analysis of a project with the Earned Value method, the first time that is needed is the collection of indicators that must be met, including BCWS, BCWP, ACWP, CPI and SPI(Nugroho et al. 2019). on the occasion of making this thesis material, the review was carried out from August to November 2023 until the 25th week period. based on the existing progress report data up to the 25th week, it is known that the progress plan is 91.735% with the acquisition of progress realization in the field of 87.014% so that a deviation of -4.721% is still obtained.

3.1.1. Calculation of Budget Of Work Schedule (BCWS) Value

BCWS is obtained from the process of multiplying the percentage of the weight of the work plan by the total project cost budget or contract value of each job and then accumulated in each period, in this case the period used is a weekly period.

The calculation of BCWS in week 25 is:

- Cumulative plan weight: 91,735 %
- Contract value of work: Rp. 18,898,770,576.77

BCWS = % (plan weight) x Contract Value (RAB)
= 91.735% x Rp. 18,898,770,576.77
= Rp.17,336,755,690.65.

Table 1. Recapitulation of BCWS Calculation Results

Week To	Plan Weight %		BCWS	
	Weekly	Cumulative	Weekly	Cumulative
1	0,0310	0,031	5.864.918,47	5.864.918,47
2	0,0310	0,062	5.864.918,47	11.729.836,94
3	1,4320	1,494	270.636.694,25	282.366.531,19
4	1,4320	2,926	270.636.694,25	553.003.225,44
5	1,8190	4,745	343.774.936,38	896.778.161,82
6	1,9260	6,671	363.996.620,90	1.260.774.782,72
7	1,9670	8,638	371.745.116,84	1.632.519.899,55
8	2,4070	11,045	454.899.707,37	2.087.419.606,93
9	2,7440	13,789	518.588.564,22	2.606.008.171,14
10	3,4340	17,223	648.990.081,20	3.254.998.252,34
11	4,7910	22,014	905.446.397,92	4.160.444.650,26
12	4,6840	26,698	885.224.713,41	5.045.669.363,67
13	5,4550	32,153	1.030.934.234,55	6.076.603.598,22
14	5,8450	37,998	1.104.639.439,80	7.181.243.038,02
15	7,0980	45,096	1.341.441.035,13	8.522.684.073,15
16	7,0050	52,101	1.323.865.178,49	9.846.549.251,65
17	7,6680	59,769	1.449.164.027,42	11.295.713.279,06
18	6,5360	66,305	1.235.229.944,49	12.530.943.223,55
19	5,1810	71,486	979.151.603,17	13.510.094.826,72

Week To	Plan Weight %		BCWS	
	Weekly	Cumulative	Weekly	Cumulative
20	3,7900	75,276	716.269.704,45	14.226.364.531,17
21	3,7350	79,011	705.875.380,63	14.932.239.911,81
22	2,9840	81,995	563.945.613,60	15.496.185.525,41
23	3,1960	85,191	604.011.007,22	16.100.196.532,63
24	3,3010	88,492	623.854.716,33	16.724.051.248,96
25	3,2420	91,734	612.704.441,69	17.336.755.690,65
26	3,1330	94,867	592.104.781,76	17.928.860.472,41
27	2,3460	97,213	443.371.457,32	18.372.231.929,73
28	1,6840	98,897	318.261.596,10	18.690.493.525,83
29	0,8950	99,792	169.150.296,25	18.859.643.822,09
30	0,2070	100,00	39.126.754,68	**18.898.770.576,77**

Source: Processed Researcher Data, 2023

Based on table 1, the BCWS value during week 1 is Rp.5,864,918.47, this shows that the amount of budget allocation that must be spent is Rp.5,864,918.47 to be able to meet the percentage of plan weight of 0.031%, as well as for calculations in the following weeks. Meanwhile, the planned cost budget until week 25 is Rp. 17,336,755,690.65 with a percentage of plan weight of 91.734%.

3.1.2. Calculation of Budgated Cost Of Work Performance (BCWP) Value

Taken for example the calculation of BCWP in week 25, the BCWP value can be calculated by multiplying the percentage of realization on the implementation schedule (S curve) in week 25 to be observed by the amount of the cost budget plan or the total value of the contract.

The calculation of BCWP at week 25 is:

- Cumulative realization weight: 87,076 %
- Contract value of work: Rp. 18,898,770,576.77

BCWP = % (realization weight) x Contract Value (RAB)
= 87.076% x Rp. 18,898,770,576.77
= Rp. 16,456,293,467.43

Table 2. Recapitulation of BCWP Calculation Results

Week To	Plan Weight %	BCWP	
	Weekly	Weekly	Cumulative
1	0	0,00	0,00
2	0	0,00	0,00
3	0,001	188.987,71	188.987,71
4	5,819	1.099.719.459,86	1.099.908.447,57
5	4,427	836.648.573,43	1.936.557.021,00
6	2,017	381.188.202,53	2.317.745.223,54
7	1,071	202.405.832,88	2.520.151.056,41

Week To	Plan Weight %	BCWP	
	Weekly	Weekly	Cumulative
8	0,847	160.072.586,79	2.680.223.643,20
9	3,443	650.684.670,96	3.330.908.314,16
10	3,775	713.428.589,27	4.044.336.903,43
11	9,617	1.817.494.766,37	5.861.831.669,80
12	2,041	385.723.907,47	6.247.555.577,27
13	4,533	856.681.270,24	7.104.236.847,51
14	3,411	644.637.064,37	7.748.873.911,89
15	9,249	1.747.947.290,65	9.496.821.202,53
16	0,579	109.423.881,64	9.606.245.084,17
17	3,568	674.308.134,18	10.280.553.218,35
18	5,527	1.044.535.049,78	11.325.088.268,13
19	3,275	618.934.736,39	11.944.023.004,52
20	7,869	1.487.144.256,69	13.431.167.261,20
21	3,291	621.958.539,68	14.053.125.800,89
22	2,962	559.781.584,48	14.612.907.385,37
23	3,966	749.525.241,07	15.362.432.626,44
24	3,804	718.909.232,74	16.081.341.859,19
25	1,984	374.951.608,24	16.456.293.467,43

Source: Processed Researcher Data, 2023

Based on table 2, the BCWP value or cost budget for work realized up to week 25 with a cumulative weight percentage of 87.076% is Rp. 16,456,293,467.43. so that the realization of the achievements that have been done by the implementing contractor is still below the percentage of the plan weight, as previously stated in the 25th week period the percentage of the plan weight is 91.735% with a cost budget value of Rp. 17,336,755,690.65, so the calculation of the BCWP value in the 25th week period and for each week is done in the same way.

3.1.3. Calculation of Actual Cost For Work Performed (ACWP) Value

ACWP (Actual Cost Work Performance) is a collection of costs incurred to complete the work in a certain period by the implementing contractor. Actual Cost is calculated based on the accumulated costs incurred by the implementing contractor for the completion of the work which includes payments, both in the form of direct cost payments and indirect cost payments.

Direct costs are costs related to the needs of the project directly in the implementation of a project activity, including the cost of worker wages, purchase of materials / materials, the cost of using equipment / tools and also the costs incurred for partners / subcontractors. While indirect costs are costs that are incurred and not directly related to the implementation of activities in the field but must be held to support the implementation / operation of activities in the field, if not held / not fulfilled will interfere / hinder the implementation of activities in the field. work cannot be done which ultimately triggers delays.

In table 3 below is a recapitulation of the amount of expenditure / Cash flow (ACWP) of the implementing contractor in each week until week 25.

Table 3. Recapitulation of ACWP Calculations Up to Week 25

No	Period	ACWP	
		Weekly	Cumulative
1	Friday, May 26 - Sunday, May 28	0,00	0,00
2	Monday, May 29 - Sunday, June 4	7.093.288,79	7.093.288,79
3	Monday, June 5 - Sunday, June 11	24.898.891,26	31.992.180,05
4	Monday, June 12 - Sunday, June 18	547.920.368,78	579.912.548,84
5	Monday, June 19 - Sunday, June 25	523.310.999,51	1.103.223.548,35
6	Monday,June 26 - Sunday,July 2	456.720.941,48	1.559.944.489,84
7	Monday,July 3 - Sunday,July 9	429.071.591,30	1.989.016.081,14
8	Monday,July 10 - Sunday,July 16	332.516.007,16	2.321.532.088,30
9	Monday,July 17 - Sunday,July 23	517.375.798,69	2.838.907.886,99
10	Monday,Jui 24 - Sunday,July 30	587.150.598,62	3.426.058.485,61
11	Monday,July 31 - Sunday,August 6	997.837.543,47	4.423.896.029,08
12	Monday, August 7 - Sunday, August 13	605.680.006,08	5.029.576.035,16
13	Monday, August 14 - Sunday, August 20	863.499.339,45	5.893.075.374,60
14	Monday, August 21 - Sunday, August 27	734.951.575,25	6.628.026.949,85
15	Monday, August 28 - Sunday, September 3	1.047.345.804,01	7.675.372.753,86
16	Monday, September 4 - Sunday, September 10	448.614.325,72	8.123.987.079,58
17	Monday, September 11 - Sunday, September 17	492.476.907,43	8.616.463.987,01
18	Monday, September 18 - Sunday, September 24	953.685.439,78	9.570.149.426,78
19	Monday, September 25 - Sunday, October 1	795.606.432,46	10.365.755.859,24
20	Monday, September 25 - Sunday, October 1	918.942.800,81	11.284.698.660,04
21	Monday, October 2 - Sunday, October 8	688.483.295,63	11.973.181.955,67
22	Monday, October 9 - Sunday, October 15	565.725.971,26	12.538.907.926,93
23	Monday, October 16 - Sunday, October 22	708.315.552,04	13.247.223.478,96
24	Monday, October 23 - Sunday, October 29	681.100.484,84	13.928.323.963,81
25	Monday, October 30 - Sunday, November 5	547.775.607,79	14.476.099.571,60

Source: Processed Researcher Data, 2023

From Table 3, the results of the ACWP calculation conveyed above, the expenditure by the contractor began in week 2 where in the first week there was still no activity. In the middle period there was an increase in cash flow along with an increase in needs / activities in the field with a cumulative cash flow expenditure value up to week 25 amounting to Rp.14,476,099,571.60.

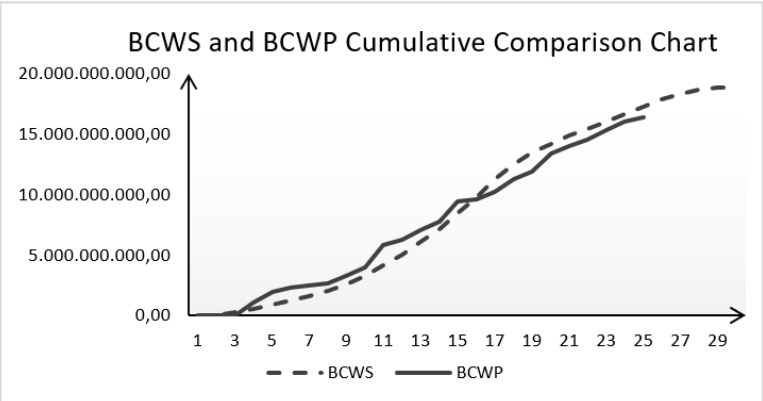

Figure 1. Comparison Chart of BCWS and BCWP Cumulative
Source: Processed by Researchers, 2023

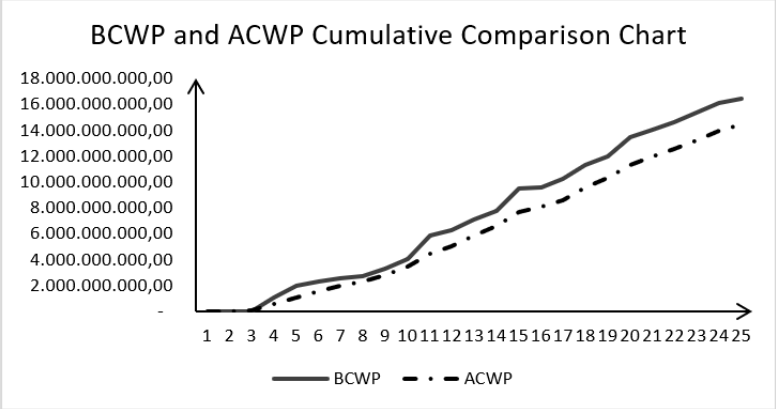

Figure 2. Comparison Chart of BCWP and ACWP Cumulative
Source: Processed by Researchers, 2023

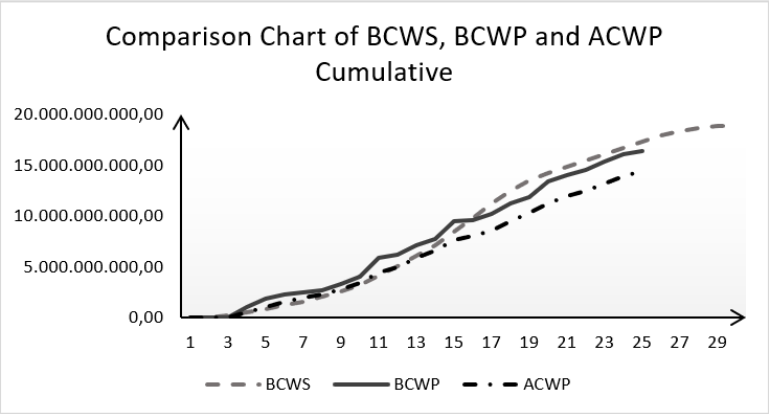

Figure 3. Comparison Chart of BCWS, BCWP and Cumulative ACWP
Source: Processed by Researchers, 2023

4. CONCLUSION and SUGGESTIONS

4.1 CONCLUSION

Based on the results of the analysis calculation using the Earned Value (EV) method on the BPBD Pasuruan Regency building complex construction project, the following conclusions were obtained:

1. The cost performance indicator on this project shows a profit, but there is still a negative deviation in the activity implementation schedule.
2. From the calculation/estimation of cost and time, an Estimate At Completion (EAC) value of Rp. 16,624,276,448.77 was obtained for the completion of the project until the end of the contract from the total contract value of Rp. 18,898,770,576.77 and for the results of the Time Estimate (TE) calculation, the total project completion time requirement was 221 days from the total contract time provided for 210 days, so there was a delay of around 11 days.
3. The implementing contractor is advised to pay more attention to project control efforts from the beginning of the implementation of project activities by paying attention to the variance of performance indicators in the field as used in the Earned Value method (Romadhonnia, Aulady, and Nuciferani 2018).

From these conclusions, it can be concluded that the Pasuruan Regency BPBD building complex construction project experienced a negative deviation in the activity implementation schedule and it is necessary to make better project control efforts so that the project can be completed according to the plan that has been prepared.

4.2 SUGGESTIONS

1. The implementing contractor should pay more attention to project control efforts from the beginning of the implementation of project activities, among them by paying attention to the variance of performance indicators in the field as used in the Earned Value method(Nurtsani, Septiadi, and Suharyanto 2017).
2. All organizers of the BPBD building complex construction project to immediately take accelerated steps to catch up with delays and avoid potential delays in project completion time.

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