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COST PERFORMANCE ANALYSIS USING EARNED VALUE METHOD ON PRESERVATION OF EXIT TOLL ROAD SECTION 5 PANDAAN MALANG

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Abstract

The development of road or toll road infrastructure in a country can be used as a benchmark to determine the level of economic progress of a country, both macro and micro. The location of toll exits has a significant effect in absorbing labor and creating new business activities. Projects are dynamic, so contractors must be responsive to changes in situations and conditions on the project, if they want to succeed in reaping optimum profits. Aspects of planning a highly competitive construction at this time are very demanding on accuracy, effectiveness, efficiency, and economy in analyzing a project. In the world of construction projects, there are many things that can be done, one of which is cost control. In controlling costs, efforts can be made so that the realization of costs that occur is in accordance with the needs of implementation and is not excessive, such as cost suppression efforts, namely making savings without reducing quantity or quality. The Earned Value Method is used to determine project performance in terms of costs at one time, determine project performance in terms of schedule/time at one time, estimate costs to complete the project after the evaluation time and estimate the time to complete the project after the evaluation. In this research the author carried out a cost analysis using the Earned Value Method on the preservation of the Section 5 Pandaan Malang Toll Exit Road.

Keywords: *Earned Value Method, Time Performance Analysis, Cost Performance Analysis, Project Control, Actual Cost Estimation*

1. INTRODUCTION

Projects are dynamic, so contractors must be responsive to changes in the situation and conditions on the project, if they want to succeed in reaping optimum profits. This requires the contractor to establish a careful planning policy in anticipation of these circumstances, so that the project can still be implemented without experiencing delays. Through careful planning, a suitable project schedule can be prepared, according to site conditions. Project planning includes the sequence and timing of all project activities. With proper project planning, coordination between contractors will be more focused and problems that can harm project implementation can be avoided and overcome. The aspects of planning a highly competitive construction at this time are very demanding on accuracy, effectiveness, efficiency, and economy in analyzing a project. In the world of construction projects, there are many things that can be done, one of which is cost control (Fithra and Saleh 2011). In controlling costs, efforts can be made so that the realization of costs that occur is in accordance with the needs of implementation and is not excessive, such as cost reduction efforts, namely making savings without reducing quantity or

quality. Therefore, in planning a construction must have a technique that has considerable potential success in controlling costs.

The process of controlling a project includes all activities included in the project life cycle, so that in completing a project, you must look at the implementation by paying attention to the project control system so that the control can consider resources including time, cost and performance of the project work so that it can be controlled. The purpose of control is to ensure project completion in accordance with specifications, on time and able to utilize the resources that have been allocated.

Thus project control is a resource control consisting of time control, cost control and quality control or in other words, the three elements are commonly called project control elements, these three elements of project control are important parameters for project implementation which are often associated as project goals or project objectives. The purpose of project time/schedule control is that it must be carried out to the maximum within the time period and end date specified before the implementation of the work, and cost control is project control that must be completed at a cost that does not exceed the project budget, while quality control is the result of activities or work must meet the required specifications or criteria. To increase effectiveness in monitoring and controlling project activities, it is necessary to use a method, one of the methods that meets the problems above is using the Earned Value Method.

In the Preservation of Exit Toll Road Section 5 Pandaan Malang in the process of construction there are several obstacles in terms of cost and time. In this work there is a delay in progress so that it can cause cost overruns and if the work is not completed on time it will result in late fees, therefore the author will use the Earned Value Method in evaluating time performance and cost performance, for which 3 (three) indicators are used, namely, ACWP (Actual Cost of Work Performed), BCWP (Budgeted Cost of Work Performed), and BCWS (Bugeted Cost of Work Scheduled). ACWP is the actual cost of the work that has been carried out. This cost is obtained from project accounting or financial data at the reporting date (e.g. end of month), which is a record of all actual cost expenditures from work packages or accounting codes including overhead calculations and others. So, ACWP is the actual amount of expenditure or funds used to carry out work at a certain period of time. BCWP shows the value of the results from the point of view of the value of the work that has been completed against the budget provided to carry out the work. When the ACWP figure is compared to the BCWP, it will show a comparison between the costs that have been incurred for the work that has been carried out against the costs that should have been incurred for this purpose. BCWS is the budget for a work package, but it is organized and linked to the implementation schedule. So here there is a combination of cost, schedule, and scope of work, where each work element has been given an allocation of costs and schedules that can be a benchmark in the implementation of workers. so that the implementation of development can be in accordance with the time target and cost target that has been stated in the contract. By using the above indicators, various factors can be calculated that show the progress and performance of project implementation such as: integrated cost and schedule variances; monitoring variance changes against standard figures; productivity and performance indices; project completion cost forecasts. Earned Value Method (EVM) is one of the tools that can be used in project management that integrates cost, time and performance of project

implementation so as to determine the relationship between cost and time performance and the estimated cost and time required for project completion by controlling costs and time so that delays in the final implementation time can be prevented. In addition, additional costs due to delays can be optimized(Soeharto 1997).

A review of similar previous research is used as a comparison in adding insight or input in reviewing research Cost Analysis Using Earned Value Method on Preservation of Section 5 Pandaan Malang Exit Toll Road. The studies include:

Bridge projects play an important role in the road network system and must be kept in good working order. As the bridge ages, factors such as material durability, environmental conditions, and natural disasters can cause degradation that affects the serviceability of the bridge. This research aims to analyze the cost and time with the result value method in the case study of sembayat bridge preservation in Gresik. The research method uses several stages such as the literature study stage, primary data collection (direct interviews with project supervisors), secondary data (time schedule, weekly reports, and cost budget plans), and data processing. The result of the total planned cost is Rp. 4,489,082,250 while the total cost incurred for 17 weeks is Rp. 1,923,940,648.44. When compared to the calculated value of the accountant from the company, which is Rp. 1,913,667,654.92, the value spent is Rp. 10,272,993.52 greater than the total planning cost.. (Alfadin and Witjaksana 2023).

"Project control is a structured effort to establish standards in accordance with the plan, design information systems, compare implementation with established standards, analyze potential deviations, and take corrective actions necessary to ensure the effective and efficient use of resources in line with the set targets. Each project has its own specific plan and schedule, determining the start and end time of the project, implementation methods, and resource allocation. Operational challenges often arise in project planning (Tanggara, Agustin, and Hariyani 2021), such as resource shortages, improper allocation, delays, and other issues that may hinder the achievement of project goals as planned. This research utilizes a descriptive quantitative approach, which is a research method that describes the specific conditions of the project through the analysis of available data. This article will discuss the cost variance (CV) and schedule variance (SV) in the development of Griya Jenggala at PT. Sarana Loka Almika, evaluate the cost performance index (CPI) and schedule performance index (SPI) in the development of Griya Jenggala to assess its effectiveness, estimate the cost at completion (EAC) and estimated duration at completion (EAS) required to complete the Griya Jenggala project, as well as provide an estimation of potential profits or losses that may arise in the Griya Jenggala development project", (Nastiti et al. 2023).

This research was conducted with the aim of analyzing the cost effectiveness of the Teuku Umar I Road Pavement and Drainage Improvement Project in Tuban Regency, East Java. The earned value method is used in project implementation by involving variables/indicators/indices consisting of BCWS, BCWP, ACWP, CV, SV, CPI and SPI. The results of the analysis obtained in the reporting period from week 1 to 13, the value of the cost variance indicator produces a positive value calculation in the sense that cost management can produce cost savings of Rp. 76,988,677 or equivalent to 5.3% of the total budget (cost underrun) (Sugiyanto and Kosbiamtoro 2022).

"The earned value method (EVM) is an internationally known technique for project management that emphasizes the control of project cost performance and duration, thus allowing trends to be identified during execution and warning the project manager of variances that may affect the project so that they can take the necessary corrective measures(Hansen 2015). In this research, the finished projects of a construction company in the city of Cuenca, Ecuador, were assessed. EVM was applied to projects from a database developed with information from each one to rebuild past events, existing problems, and critical points and evaluate the performance over time. The results of this analysis are meant to determine the project's success, calculating the cost variance at the end. EVM motivates project stakeholders to pay attention to costs and progress so that timely actions can be taken to optimize resources, resulting in the completion of a project within budget and on time. In conclusion, EVM plays an essential role in the integral management of the project in terms of scope, time, and cost. Moreover, there are now guidelines for applying this method as a control tool in future construction projects", (Proaño-Narváez et al., 2022).

This study aims to determine the cost and schedule variance (Cost Variance/CV and Schedule Variance/SV), to determine the performance index in terms of cost and time (Cost Performance Index/CPI and Schedule Performance Index/SPI) and to determine the estimated cost and time for project completion. Earned value is one of the methods used to control project implementation. The object of this research is the Mandeh 1 Tourism Access Road Development project, in South Pesisir Regency, West Sumatra Province. The method used is descriptive analysis method carried out by describing with the intention of finding elements, analysis and even comparison. Data is taken directly from the field so that it is in accordance with the realization in the field. The results showed that the ACWP value was Rp. 37,571,614,926, the BCWP value was Rp. 41,757,520,198, and the BCWS was Rp. 41,746,238,807. The CPI value of 1.11 > 1 indicates that the Actual Cost incurred is less than the value of the work done or profit. The SPI value of 1 indicates that the project performance is the same as the plan schedule or there is no delay in work. The final cost of completing the EAC project amounted to Rp. 37,679,192,826.18, -. The VAC value or budget difference between the plan and the implementation amounted to Rp. 4,196,794,539.95 (Harefa and Surbakti 2021).

The earned value concept method can be used to analyze performance and make estimates of goal achievement. In the research conducted on the Construction of Trauma Center Building and Intensive Care Phase IV of RSUD DR. SOEDONO Madiun, data collection as research material was obtained from the implementing contractor and also some from the supervisory consultant. Time performance in the first week to week 7 (seven) obtained negative numbers for (SV) and (CV) meaning that the work was completed late and cost more than the budget. While the SPI and CPI values are < 1, then the time performance is not good, meaning that the work is late from the planned schedule. The project performance is the same as the performance at the time of the review in week 7 with a progress of -6.57%, the estimated cost required to carry out the project until completion is Rp. 64,938,243,717.90, meaning a loss of Rp. 1,773,437,194.04 from the contract value (Maulidi, Huda, and Tjendani, n.d.).

Project delays result in deviations in time and cost performance. Delays occur due to the use of wasteful materials and unskilled labor. The Tgk. Muda Lamkuta

Lhokseumawe Road Improvement Project is experiencing delays in week 7 which, if not immediately anticipated, will result in deviations in time and cost performance. The purpose of this research is to analyze the deviation of time and cost performance of work completion due to delays in the 7th week that has been used in the Tgk. Muda Lamkuta Lhokseumawe Road Improvement project. The method used in the form of the earned value concept examines the tendency of schedule variance and cost variance in a period during the project. The results of calculations and analysis in terms of project cost performance indicators up to week 7 obtained a negative Cost Variance (CV) value of -Rp. 75,525,362.06 with a cost performance index (CPI) < 1 so that from the calculation of Estimated At Completion (EAC) it is estimated that the project completion cost has increased by 10% from the planned budget of Rp. 2,915,600,000.00 increased to Rp. 3,207,160,000.00. It can be concluded that if the work rhythm does not change and there is no effort to improve performance, it can be predicted that the project will experience Cost Overrun in terms of cost (Ridha, R., Syarwan 2020).

Seiring dengan meningkatnya pembangunan maka kebutuhan akan sumber daya juga menjadi meningkat. Pada As development increases, the need for resources also increases. Construction work generally requires cost resources, human resources in the form of labor, material resources, tools and methods. The availability of these resources is decreasing day by day, this certainly affects the implementation of a job. One of the effects is the delay in terms of providing costs and work schedules. Earned value analysis is a way or method used to measure the amount of work actually done on a project, namely, to measure progress and to estimate project costs and completion dates, the method relies on a key measure known as earned value(Tangtobing and Waty 2023). known as earned value (budgeted cost of work performed or budgeted of work performance). The calculation of the earned value calculation is a calculation based on the cost according to the budget according to the work that has been carried out. When viewed from the work that has been completed at a time when assessed based on the amount of budget provided for the work The results of the analysis with the Earned Value Analysis method on the project Continued Improvement of Awang Long Road - Darmawan Road Kota Bangun Ilir Village Kota Bangun Subdistrict can be concluded that the work has been realized on time, the performance of the project implementer or contractor is better than the planning and the cost of expenditure is less than the planned budget cost (Fauzy 2021).

The construction of the Trenggalek Regency Health Office Building is a large-scale construction project. In large-scale projects there are often performance problems. Therefore, it is necessary to control costs and schedules so that the project runs according to plan. This study uses the Earned Value Method with the aim of knowing the performance index, and can estimate the cost and time of completion of the work, so as to obtain corrections that must be made for the progress of the project(Susanti, Melisah, and Juliantina 2019). The results of the study in week 12 were 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) of Rp. 627,422,077.59 or Schedule Performance Index

(SPI) is 0.678 < 1. Estimate at Completion (EAC) of Rp. 3,483,730,479.63 has a profit of Rp. 405,885,332.51. Estimate All Schedule (EAS) for 29.707 weeks, slow 5.707 weeks (Zakariyya, Ridwan, and Suwarno 2020).

2. RESEARCH METHODS

The Earned Value Method is a concept of calculating the budget according to the work that has been completed (Budgeted Cost of Works Performed)(Soemardi et al. 2006). This concept measures the amount of work units that have been completed, at a certain time, when assessed based on the amount of budget available for the work. For this reason, the relationship between what has been achieved physically and the amount of budget that has been spent can be known(Fleming and Koppelman 1994).

Calculations and data processing were carried out with Microsoft Excel software, using secondary data from the Section 5 Pandaan Malang Exit Toll Road Preservation Project as mentioned in the research flow chart.

The data used in this study include secondary data which is a number of information or facts obtained indirectly, namely from literature studies, namely in the form of a number of information or facts by studying books, documents, journals, laws and regulations, reports and so on relating to the problem under study which will be obtained from various data sources by recording or quoting from data sources that have previously been processed by the relevant agencies.

The secondary data in this study include scientific journals on previous research, related report data, related government regulations, the Budget Plan for the Road Preservation Project on the Exit Toll Road Section 5 Pandaan Malang obtained from BBPJN III East Java - Bali, Time Schedule for the Road Preservation Project on the Exit Toll Road Section 5 Pandaan Malang obtained from BBPJN III East Java - Bali, Weekly Progress up to Week 17 of the Road Preservation Project on the Exit Toll Road Section 5 Pandaan Malang obtained from BBPJN III Jatim - Bali, HSPK Malang Regency, SSH East Java Province, Guidelines for Preparing Construction Cost Estimates for Public Works and Public Housing.

2.1. Data Analysis Technique

2.1.1. Schedule and Cost Analysis

a. Planned Value/PV (Budgeted Cost of Work Schedule/ BCWS)
   PV = Progress Plan * BAC

Budgeted Cost of Work Scheduled (BCWS) is the cost allocated based on the work plan compiled against time. BCWS is calculated from the sum of the planned costs for the work within a certain period of time. BCWS at project completion is called Budget at Completion (BAC). It can be said that BCWS is the budget for a work package associated with the implementation schedule. So, it is a combination of cost, schedule, and scope of work. In traditional management, BCWS is known as the planning S-curve, which is an S-curve created before carrying out work.

b. Earned Value/EV (Budgeted Cost of Work Performed / BCWP)
   EV = Realisation progress * BAC

Budgeted Cost for Work Perforrned (BCWP) is the value received from the completion of the work during a certain period of time.BCWP is what is called eamed value. In traditional management, BCWP is known as the implementation S-curve, which is an S-curve created based on the work that has been completed during a certain period of time.

c. Actual Cost/AC (Actual Cost of Work Performed/ACWP)
AC = Direct Cost + Indirect Cost

- Direct Costs in this study are assumed to be based on secondary data obtained from Weekly Progress Data for Quantity estimation, while for Price estimation is taken from HSPK Malang City and HSPK of the nearest City/Regency, HSPK of East Java Province, SSH of East Java Province.
- Indirect Costs in this study are assumed to be 15% of Direct Costs, in accordance with the Guidelines for Preparing Construction Cost Estimates for Public Works and Public Housing in 2022.

2.1.2. Variance Analysis

CV = EV – AC

Cost variance is the difference between the value obtained after completing the work section and the actual value of project implementation. A positive value of the cost variance indicates that the work section was profitable during the period under review. If the CV value is negative, it indicates that the work section is loss-making.

2.1.3. Performance Index Analysis

CPI = EV / AC

Cost Performance Index is a comparison between the value received from the completion of the work and the actual costs incurred to complete the work. The CPI value is greater than l, indicating good cost performance, there are savings in the actual cost of implementation compared to the plan cost for that part of the work (Widiasanti, I. 2013).

Table 1. Element Assessment Earned Value

No	Indicator	Varian	Value	Performance	Value	Assessment
1	Cost	CV	+	CPI	>1	Profit
		CV	0	CPI	=1	Actual Cost = Planned Cost
		CV	-	CPI	<1	Loss

Source: Widiasanti & Lenggogeni, 2013

2.1.4. Cost Estimation at the End of Work

Cost or schedule forecasts are useful because they provide an early warning of what is likely to happen in the future, if trends at the time of reporting do not change. If the remaining work is assumed to be performing as it was at the time of reporting, then the cost forecast for the remaining work.

a. Estimate to Complete (ETC).
ETC = (BAC-EV)/CPI
b. Estimate at Complete (EAC).

EAC = AC+ETC

3. RESULTS AND DISCUSSION

3.1. Planned Value (BCWS)

Planned Value (BCWS) = % Progress Planned x Contract Value (BAC)
PV 1st Week = 0,059% x Rp. 46.447.201.153
PV 1st Week = Rp. 27.246.395

Table 2. Planned Value (BCWS)

Contract Value (BAC) = Rp. 46.447.201.153 PV (BCWS) = % Progress Planned x Contract Value (BAC)			
Week	**Progress Planned (%)**	**Cummulative Progress Planned (%)**	***PV (BCWS)***
1	0,059%	0,059%	Rp. 27.246.395
2	0,049%	0,107%	Rp. 49.792.790
3	0,049%	0,156%	Rp. 72.339.186
4	0,089%	0,245%	Rp. 113.737.301
5	0,160%	0,405%	Rp. 187.970.416
6	0,143%	0,548%	Rp. 254.397.671
7	0,143%	0,691%	Rp. 320.824.927
8	0,433%	1,124%	Rp. 522.047.042
9	0,432%	1,556%	Rp. 722.644.158
10	0,413%	1,969%	Rp. 914.689.645
11	3,481%	5,450%	Rp. 2.531.449.130
12	3,484%	8,934%	Rp. 4.149.769.365
13	3,304%	12,238%	Rp. 5.684.429.388
14	3,304%	15,543%	Rp. 7.219.089.410
15	3,304%	18,847%	Rp. 8.753.749.433
16	3,304%	22,151%	Rp. 10.288.409.455
17	3,304%	25,455%	Rp. 11.823.069.478

Source: Analysis Results, 2023

The Planned Value is obtained from the percentage of the plan weight multiplied by the contract value (BAC). The contract value (BAC) is Rp. 46,447,201,153. In Week 17 the Cumulative Plan Weight is 25.455%. From this weight, it can be calculated that the Planned Value (PV) or Budget Cost Work Schedule value is Rp. 11,823,069,478.

3.2. Earned Value (BCWP)

Earned Value (BCWP) = % Progress Realisation x Contract Value (BAC)
EV 1st Week = 0,046% x Rp. 46.447.201.153

EV 1st Week = Rp. 21.365.713

Table 3. Earned Value (BCWP)

Contract Value (BAC) = Rp. 46.447.201.153 EV (BCWP) = %Progress Realisation x Nilai Kontrak (BAC)			
Week	**Progress Realisation (%)**	**Cummulative Progress Realisation (%)**	**EV (BCWP)**
1	0,046%	0,046%	Rp. 21.365.713
2	0,000%	0,046%	Rp. 21.365.713
3	0,016%	0,062%	Rp. 28.797.265
4	0,044%	0,106%	Rp. 49.234.033
5	0,011%	0,117%	Rp. 54.343.225
6	0,218%	0,335%	Rp. 155.598.124
7	1,130%	1,465%	Rp. 680.451.497
8	1,495%	2,960%	Rp. 1.374.837.154
9	1,167%	4,127%	Rp. 1.916.875.992
10	1,315%	5,442%	Rp. 2.527.656.687
11	2,531%	7,973%	Rp. 3.703.235.348
12	3,331%	11,304%	Rp. 5.250.391.618
13	3,594%	14,898%	Rp. 6.919.704.028
14	3,244%	18,142%	Rp. 8.426.451.233
15	3,367%	21,509%	Rp. 9.990.328.496
16	3,145%	24,654%	Rp. 11.451.092.972
17	4,358%	29,012%	Rp. 13.475.261.999

Source: Analysis Results, 2023

Earned Value is obtained from the percentage of realization weight multiplied by the contract value (BAC). The contract value (BAC) is Rp. 46,447,201,153. In Week 17 the Cumulative Realization Weight was 29.012%. From this weight, it can be calculated that the Earned Value (EV) or Budget Cost Work Performance value is Rp. 13,475,261,999.

3.3. Actual Cost (ACWP)

AC = Direct Cost + Indirect Cost

AC 1st Week = Direct Cost 1st Week + Indirect Cost 1st Week

Direct Costs in this study are assumed to be based on secondary data obtained from Weekly Progress Data for Quantity estimation, while for Price estimation is taken from HSPK Malang City, HSPK nearby Cities/Regencies, and SSH East Java Province.

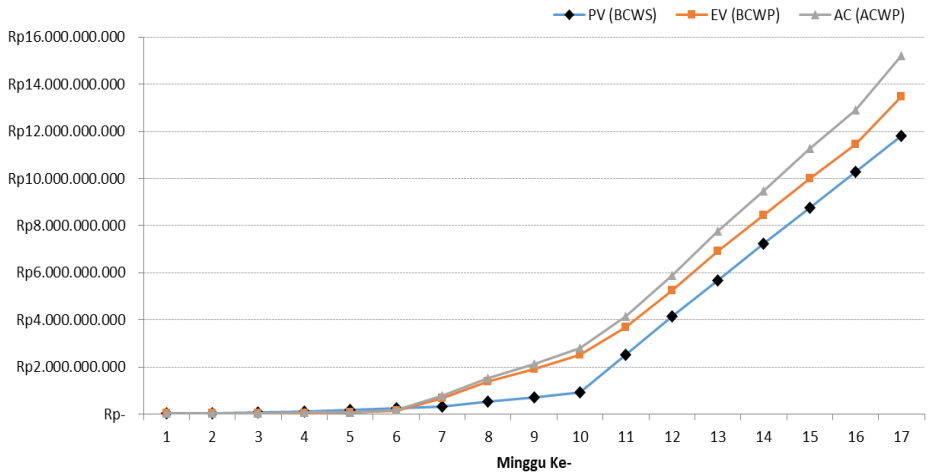
Indirect Costs in this study are assumed to be 15% of Direct Costs, in accordance with the Guidelines for Preparing Construction Cost Estimates for Public Works and Public Housing in 2022.

Table 4. Actual Cost Of Work Performance (ACWP)

(ACWP)AC = Direct Cost + Indirect Cost		
Week	**AC (ACWP)**	**AC (ACWP) Kumulatif**
1	Rp. 23.907.619	Rp. 23.907.619
2	Rp.-	Rp. 23.907.619
3	Rp. 8.625.000	Rp. 32.532.619
4	Rp. 23.194.120	Rp. 55.726.739
5	Rp. 6.148.475	Rp. 61.875.214
6	Rp. 114.658.449	Rp. 176.533.663
7	Rp. 594.044.170	Rp. 770.577.834
8	Rp. 763.030.562	Rp. 1.533.608.395
9	Rp. 589.284.199	Rp. 2.122.892.594
10	Rp. 677.225.691	Rp. 2.800.118.285
11	Rp. 1.333.179.993	Rp. 4.133.298.278
12	Rp. 1.749.381.236	Rp. 5.882.679.514
13	Rp. 1.892.383.410	Rp. 7.775.062.924
14	Rp. 1.708.958.085	Rp. 9.484.021.009
15	Rp. 1.775.375.473	Rp. 11.259.396.482
16	Rp. 1.658.101.982	Rp. 12.917.498.463
17	Rp. 2.301.989.176	Rp. 15.219.487.639

Source: Analysis Results, 2023

In Week 17, it can be seen that the Actual Cost (AC) value is Rp. 2,301,989,176. While the Cumulative Actual Cost value is Rp. 15,219,487,639. This cumulative AC value will be used as data in the next analysis.



Source: Analysis Results, 2023

Figure 1. PV(BCWS), EV (BCWP), AC (ACWP) Graphics

Figure 1, shows that the EV (BCWP) value after week 6 has increased against the PV (BCWS) value. The graph also shows that the AC (ACWP) value is greater than the EV (BCWP) value.

Figure 1, shows that this data has Cost Variance, where the value is then used to determine the Cost Performance Index (CPI).

3.4. Cost Variance (CV)

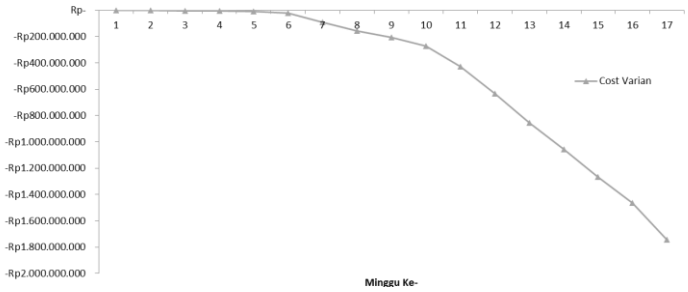
CV = EV – AC
AC 1st Week = EV 1st Week – AC 1st Week
AC 1st Week = Rp21.365.713- Rp23.907.619
AC 1st Week = -Rp2.541.907

Table 5. Cost Variance (CV)

CV = EV - AC				
Week	**EV**	**AC**	**CV**	**Description**
1	Rp. 21.365.713	Rp. 23.907.619	-Rp. 2.541.907	Cost Overrun
2	Rp. 21.365.713	Rp. 23.907.619	-Rp. 2.541.907	Cost Overrun
3	Rp. 28.797.265	Rp32.532.619	-Rp3.735.354	Cost Overrun
4	Rp. 49.234.033	Rp. 55.726.739	-Rp. 6.492.706	Cost Overrun
5	Rp. 54.343.225	Rp. 61.875.214	-Rp. 7.531.989	Cost Overrun
6	Rp. 155.598.124	Rp. 176.533.663	Rp.20.935.540	Cost Overrun
7	Rp. 680.451.497	Rp. 770.577.834	Rp.90.126.337	Cost Overrun
8	Rp. 1.374.837.154	Rp.1.533.608.395	-Rp.158.771.21	Cost Overrun
9	Rp. 1.916.875.992	Rp.2.122.892.594	-Rp.206.016.603	Cost Overrun
10	Rp. 2.527.656.687	Rp.2.800.118.285	-Rp.272.461.598	Cost Overrun
11	Rp. 3.703.235.348	Rp.4.133.298.278	-Rp.430.062.930	Cost Overrun
12	Rp. 5.250.391.618	Rp.5.882.679.514	-Rp.632.287.896	Cost Overrun
13	Rp. 6.919.704.028	Rp.7.775.062.924	-Rp.855.358.896	Cost Overrun
14	Rp. 8.426.451.233	Rp.9.484.021.009	-Rp.1.057.569.76	Cost Overrun
15	Rp. 9.990.328.496	Rp.11.259.396.42	-Rp.1.269.067.986	Cost Overrun
16	Rp.11.451.092.972	Rp.12.917.498.43	-Rp. 1.466.405.491	Cost Overrun
17	Rp.13.475.261.999	Rp.15.219.487.69	-Rp. 1.744.225.641	Cost Overrun

Source: Analysis Results, 2023

From Table 5, it can be seen that from Week 1 to Week 17 the Cost Variant is negative. Where the CV value is negative (-), it means that this project is experiencing Cost Overrun. Cost Overrun can cause significant losses for the contractor.



Source: Analysis Results, 2023

Figure 2. Cost Varian (CV) Graphics

Figure 2, which is a graph from Table 5 can be seen in Week 17 Cost Variant is negative. Where if the Cost Variant is negative (-), it means that this project is experiencing cost overruns.

3.5. Cost Performance Index (CPI)

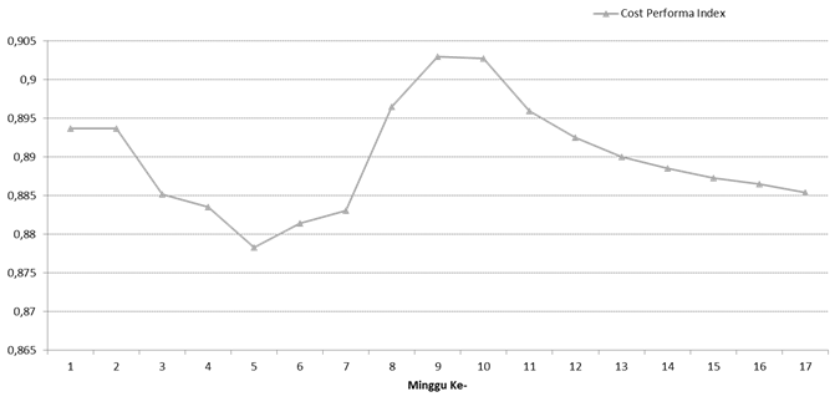
CPI = EV / AC
CPI 1st Week = EV 1st Week / AC 1st Week
CPI 1st Week = Rp21.365.713 / Rp23.907.619
CPI 1st Week = 0,893677971

Table 6. Cost Performance Index (CPI)

CPI = EV / AC				
Week	**EV**	**AC**	**CPI**	**Description**
1	Rp. 21.365.713	Rp. 23.907.619	0,893677971	Cost Overrun
2	Rp. 21.365.713	Rp. 23.907.619	0,893677971	Cost Overrun
3	Rp. 28.797.265	Rp. 32.532.619	0,885181258	Cost Overrun
4	Rp. 49.234.033	Rp. 55.726.739	0,883490296	Cost Overrun
5	Rp. 54.343.225	Rp. 61.875.214	0,87827131	Cost Overrun
6	Rp. 155.598.124	Rp. 176.533.663	0,881407664	Cost Overrun
7	Rp. 680.451.497	Rp. 770.577.834	0,883040579	Cost Overrun
8	Rp. 1.374.837.154	Rp. 1.533.608.395	0,89647211	Cost Overrun
9	Rp. 1.916.875.992	Rp. 2.122.892.594	0,902954769	Cost Overrun
10	Rp. 2.527.656.687	Rp. 2.800.118.285	0,902696397	Cost Overrun
11	Rp. 3.703.235.348	Rp. 4.133.298.278	0,895951634	Cost Overrun
12	Rp. 5.250.391.618	Rp. 5.882.679.514	0,892517025	Cost Overrun
13	Rp. 6.919.704.028	Rp. 7.775.062.924	0,889986884	Cost Overrun
14	Rp. 8.426.451.233	Rp. 9.484.021.009	0,888489305	Cost Overrun
15	Rp. 9.990.328.496	Rp. 11.259.396.482	0,887288099	Cost Overrun
16	Rp. 11.451.092.972	Rp. 12.917.498.463	0,886479143	Cost Overrun
17	Rp. 13.475.261.999	Rp. 15.219.487.639	0,885395246	Cost Overrun

Source: Analysis Results, 2023

From Table 6, it can be seen that from Week 1 to Week 17 Cost Performance Index (CPI) < 1. In Week 17 the Cost Performance Index (CPI) is 0.885395246, which means that until Week 17 the project is experiencing cost overruns because the CPI value < 1.



Source: Analysis Results, 2023

Figure 3. Cost Performance Index (CPI) Graphics

Figure 3. which is a graph from Table 6, can be seen in Week 17 Cost Performance Index < 1. which means the project is experiencing cost overruns.

3.6. Estimate To Cost (ETC)

$$\text{ETC} = \frac{BAC - EV}{CPI}$$

$$\text{ETC 1st Week} = \frac{BAC - EV\ 1st\ Week}{CPI\ 1\text{st Week}}$$

$$\text{ETC 1st Week} = \frac{Rp.46.447.201.153 - Rp21.365.713}{0{,}893677971}$$

$$\text{ETC 1st Week} = \text{Rp}51.949.177.381$$

Table 7. Estimate Temporary Cost (ETC)

BAC = Rp. 46.447.201.153 ETC = (BAC – EV) / CPI			
Week	**EV**	**CPI**	**ETC**
1	Rp. 21.365.713	0,893677971	Rp. 51.949.177.381
2	Rp. 21.365.713	0,893677971	Rp. 51.949.177.381
3	Rp. 28.797.265	0,885181258	Rp. 52.439.433.671
4	Rp. 49.234.033	0,883490296	Rp. 52.516.668.638
5	Rp. 54.343.225	0,87827131	Rp. 52.822.923.162
6	Rp. 155.598.124	0,881407664	Rp. 52.520.082.268
7	Rp. 680.451.497	0,883040579	Rp. 51.828.591.713
8	Rp. 1.374.837.154	0,89647211	Rp. 50.277.486.046
9	Rp. 1.916.875.992	0,902954769	Rp. 49.316.230.113

BAC = Rp. 46.447.201.153 ETC = (BAC – EV) / CPI			
Week	**EV**	**CPI**	**ETC**
10	Rp. 2.527.656.687	0,902696397	Rp. 48.653.727.450
11	Rp. 3.703.235.348	0,895951634	Rp. 47.707.894.223
12	Rp. 5.250.391.618	0,892517025	Rp. 46.158.009.746
13	Rp. 6.919.704.028	0,889986884	Rp. 44.413.572.626
14	Rp. 8.426.451.233	0,888489305	Rp. 42.792.580.296
15	Rp. 9.990.328.496	0,887288099	Rp. 41.087.976.625
16	Rp. 11.451.092.972	0,886479143	Rp. 39.477.644.163
17	Rp. 13.475.261.999	0,885395246	Rp. 37.239.796.930

Source: Analysis Results, 2023

From Table 7, it can be seen that in Week 17 the Estimate to Cost (ETC) value or the cost required until the project ends is IDR 37,239,796,930.

3.7. Planned Value (BCWS)

EAC = ETC + AC
EAC 1st Week = ETC 1st Week + AC 1st Week
EAC 1st Week = Rp51.949.177.381 + Rp23.907.619
EAC 1st Week = Rp51.973.085.000

Table 8. Estimate At Cost (EAC)

EAC = ETC + AC			
Week	**AC**	**ETC**	**EAC**
1	Rp. 23.907.619	Rp. 51.949.177.381	Rp. 51.973.085.000
2	Rp. 23.907.619	Rp. 51.949.177.381	Rp. 51.973.085.000
3	Rp. 32.532.619	Rp. 52.439.433.671	Rp. 52.471.966.290
4	Rp. 55.726.739	Rp. 52.516.668.638	Rp. 52.572.395.377
5	Rp. 61.875.214	Rp. 52.822.923.162	Rp. 52.884.798.376
6	Rp. 176.533.663	Rp. 52.520.082.268	Rp. 52.696.615.932
7	Rp. 770.577.834	Rp. 51.828.591.713	Rp. 52.599.169.547
8	Rp. 1.533.608.395	Rp. 50.277.486.046	Rp. 51.811.094.442
9	Rp. 2.122.892.594	Rp. 49.316.230.113	Rp. 51.439.122.707
10	Rp. 2.800.118.285	Rp. 48.653.727.450	Rp. 51.453.845.735
11	Rp. 4.133.298.278	Rp. 47.707.894.223	Rp. 51.841.192.501
12	Rp. 5.882.679.514	Rp. 46.158.009.746	Rp. 52.040.689.260
13	Rp. 7.775.062.924	Rp. 44.413.572.626	Rp. 52.188.635.550
14	Rp. 9.484.021.009	Rp. 42.792.580.296	Rp. 52.276.601.305
15	Rp. 11.259.396.482	Rp. 41.087.976.625	Rp. 52.347.373.107
16	Rp. 12.917.498.463	Rp. 39.477.644.163	Rp. 52.395.142.626

17	Rp. 15.219.487.639	Rp. 37.239.796.930	Rp. 52.459.284.569

Source: Analysis Results, 2023

From Table 8, it can be seen that in Week 17 the value of Estimate at Cost (EAC) or the final cost required during the project period is IDR 52,459,284,569.

4. CONCLUSION

The cost performance of the Section 5 Pandaan Malang Exit Toll Road Preservation Project is not in accordance with the budgeted costs, until week 17 the costs that have been incurred amounted to Rp15,219,487,639 with a cost variance (CV) of -Rp1,744,225,641. CPI 0.885395246 in week 17. The CPI value < 1, meaning that the project is experiencing cost overruns. The estimated final value of the Project or Estimate at Cost (EAC) is Rp52,459,284,569, while the project contract value is 46,447,201,153.

Suggestions for further research, for Actual Cost Analysis, primary data should be obtained in the form of a Project Budget Plan from the contractor, so that the analysis results can be more accurate. Further Cost Performance Analysis can be carried out using the Earned Value Method on the Preservation of Section 5 Pandaan Malang Exit Toll Road against the contract addendum value. Cost Performance Analysis can be carried out on the Preservation of Section 5 Pandaan Malang Exit Toll Road using other project control methods.

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