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COST ANALYSIS ON THE CONSTRUCTION OF SPORTS FACILITIES IN KEDEWAN SUB-DISTRICT, BOJONEGORO DISTRICT WITH EVM (EARNED VALUE METHOD)

Sanda Praja Riduwan[1*], Budi Witjaksana[2], Hanie Teki TJendani[3]
[1-3]Master of Civil Engineering Study Program, Faculty of Engineering, Universitas 17 Agustus 1945 Surabaya
E-mail: [1)] Sandariduwan@gmail.com, [2)] budiwitjaksana@untag-sby.ac.id , [3)] hanie@untag-sby.ac.id

Abstract

The implementation of construction work has the main targets in construction management, such as construction costs, quality of construction work and construction implementation time. Construction activities can be declared successful in their management if they produce work products with the quality criteria that have been determined, on time, and according to the agreed costs. Using EVM (Earned Value Method) in project management can be used to determine cost performance and implementation time during the project and the indicators used for analysis include: BCWP (Budget Cost of Work Performance), BCWS (Budget Cost of Work Schedule), ACWP (Actual Cost of Work Performance), SV (Schedule Variance), CV (Cost Variance), SPI (Schedule Performance Index), CPI (Cost Performance Index), EAS (Estimated At Schedule) and ETS (Estimated Temporary Schedule). By using this method in the Sports Facilities Construction Project, Kecamatan Kedewan, Kabupaten Bojonegoro, the ACWP (Actual Cost of Work Performed), BCWP (Budgeted Cost of Work Performed), and BCWS (Budgeted Cost of Scheduled) values were obtained. The CV value obtained <0 in weeks 1 to 7 indicates that the costs incurred were greater than the plan, but in weeks 8 to 15 the CV value >0 means that in that week the costs incurred were less than the plan. Meanwhile, meaning the project is experiencing a delay from plan. The estimated of the completion budget requirement obtained from the ETC (Estimate to Compile) value is Rp. 3,345,105,521.28, while the estimated final total project cost obtained from the EAC (Estimate at Complete) value is Rp. 5,680,868,593.22.

Keywords: *Earned Value Method, Cost And Time Performance, Project Management*

1. INTRODUCTION

The implementation of construction work has the main objectives in construction management, namely construction costs, quality or quality of construction work and construction implementation time. In construction activities can be declared successful in its management if it produces work products with quality or quality criteria in accordance with what has been determined, on time, and at the agreed cost.

In the development of construction with a large cost value, it will affect the complexity of the work and the materials used, it is necessary to improve the project management system in terms of techniques or methods of proper scheduling planning, controlling and managing project costs and efficient work methods so as to help manage the implementation of construction projects effectively.

The activities of a project can experience problems from various lines, such as the use of wasteful materials, unskilled labor and untimely project completion time, causing wasteful costs that are not according to plan. Cost and time control is part of the overall construction project management planning. In addition to the assessment of the quality aspect, the performance of a project can also be assessed from the aspects of cost and time. The costs that have been incurred and the time used to complete a job must be measured continuously for deviations from the plan. The existence of significant cost and time deviations provides an indication of poor project management. In addition, completion time is very important in project implementation. With time, it can be determined when a job ends. So that the project can be known to be efficient or wasteful in some jobs.

In the project implementation process, it is always related to the cost, time and quality of the construction. The initial stage in a construction project is the planning stage. Planning project activities is a very important issue because planning activities is the basis for the project to run and so that the implemented project can be completed with the optimal time. In the process of implementing a construction project, it will always be influenced by previous activities, starting from the planned ideas and planning. In the construction of a construction project, project cost control is important in the process of managing project costs (Agatha and Dani 2018). In the activities of a project, there will be many problems such as wasteful use of materials, unskilled labor and untimely project completion time, causing wasteful costs that are not in accordance with planning. Planning, cost and time control are part of overall construction project management. In addition to the assessment of the quality aspect, the performance of a project can also be assessed from the aspects of cost and time. The costs that have been incurred and the time used to complete a job must be measured continuously for deviations from the plan. The existence of significant cost and time deviations provides an indication of poor project management. In addition, time is very important in project implementation. With time, it can be determined when a job ends. In fact, it can also be known whether a job is wasteful or efficient if it cannot be managed properly. At the project planning stage, it is necessary to estimate the duration of the project implementation time. The reality in the field shows that the completion time of a project varies, as a result the estimated completion time of a project cannot be ensured to be kept. The level of accuracy of the estimated project completion time is determined by the level of accuracy of the estimated duration of each activity in the project. In addition to the accuracy of time estimates, confirmation of the relationship between project activities is also needed for project planning. To estimate time and cost in a project, optimization is required. In the implementation of a project, it is very rare to find a project that runs exactly as planned. Generally there is a delay from the planned, both the time and progress of the work, but there are also projects that experience acceleration from the original planned schedule(Sandriawan, Yuwono, and Prasetyo 2021).

A very important thing in the planning or implementation of a construction is the management of the project itself. A project requires planning (planning consultant), implementation (contractor), and construction management (supervisory consultant). Consultant services are usually required for large projects with high costs (Suryanto 2021). Currently there are many consultant offices for construction projects, in the field of planning or supervision. Consultants have a very important role in coordinating the

work of project participants at the planning and supervision stages. Although it cannot be separated from the support of the project owner (owner) as the funder and the contractor as the executor in the field, the consultant greatly assists the project owner in improving the performance of the implementation of the construction project, so that the total cost obtained is optimum and the project implementation is timely Consultants offer services in the form of expertise and skills in planning and supervising the course of construction projects. The criteria and standards for measuring consultant qualifications are not easy to determine. This is also supported by Ling (2003), who argues that some criteria in consultant selection are intangible. The process of selecting consultants on privately-owned construction projects does not yet have standardized guidelines, it is highly dependent on the policies of the relevant companies. This is different from the consultant selection process on government projects. Service providers on government projects require more competitive procedures than on private projects (Cheung et al., 2002).

In the implementation of construction projects, the time of completion of work can be influenced in terms of the methods used, the distribution of human resources, and the accuracy of the estimated scheduling of material stocks in the implementation. In solving these problems, a project control method is needed, one of which can use the Earned Value Analysis (EVA) method (Dumadi, Sunarjono, and Sahid 2014). Earned Value Analysis is one of the tools used in project management that integrates cost and time (Asmaroni and Setiawan 2020). The earned value concept presents three dimensions, namely the physical completion of the project (the percent complete) which reflects the planned absorption of costs (budgeted cost), the actual costs that have been incurred or what is called actual cost and what is obtained from the costs that have been incurred or what is called earned value (Witjaksana and Reresi 2012). From these three dimensions, with the concept of earned value, it can be linked between cost and time performance derived from the calcuEarlation of the variance of cost and time (Fleming and Koppelman 1994).

In the implementation of a construction project, planning and control are the most important functions in realizing project success. The problem that arises is how to achieve an optimum solution with limited resources. How to apply a method to the project to control cost and time, as well as control the implementation of construction projects against deviations, and evaluate the projected completion against deviations in the project. To increase the effectiveness in monitoring and controlling projects, it is necessary to use methods that integrate schedule and cost so as to reveal the performance of activities. One method that fulfills this purpose is the Earned Value Concept, which consists of three indicators, namely BCWS, BCWP, and ACWP. While the variance of existing data is emphasized to investigate deviations in cost or implementation schedules that have been planned or determined. If the performance figures are reviewed further, the performance index number is less than one (<1), and (>1) which means that the greater the deviation from the basic planning or budget, or the performance of the work is very good, it is necessary to assess whether planning may be unrealistic. The Result Value concept can be applied to this case study in the control objectives where based on the analysis, the control carried out has many deviations from the scheduling side at the time of the reports (Lumentah, Arsjad, and Malingkas 2020). Based on the calculated ETC and

EAC values, if the performance is not updated, there will be a shift (Tarore & Malingkas, 2012).

Often rework or variation orders are inevitable. This can occur with several possibilities, such as: contractor negligence, changes from the owner or architect, constraints in the field, etc. Analysis of the control of a project using the Earned Value method which integrates aspects of implementation methods, cost and time is needed as an indicator of project performance based on cost and time to take precautions so that project implementation goes according to plan (Nudja 2017). The basis of control in construction projects is that each work carried out must be thoroughly inspected and checked by the supervisory consultant in the field, whether it is in accordance with the specifications or not, with good control of the implementation of existing activities, schedule delays that result in project cost overruns can be avoided, anticipating changes in uncertain field conditions and overcoming the constraints of limited time in controlling all elements of project work, an effective control concept is needed, namely by comparing planning with project parameters that can be measured at any time.

The implementation of a project is very rare to find a project that runs exactly as planned. Generally, there are planned delays, both in time and work progress, but there are also projects that have accelerated from the original planned schedule. Kusjadmikahadi, (Leonda, 2008) that, the delay in construction projects means the increase in the implementation time of project completion that has been planned and stated in the contract documents. Completion of work not on time is a shortage of productivity levels and of course all of this will result in waste in financing, both in the form of direct financing spent on government projects, as well as in the form of investment overruns and losses on private projects. The active role of management is one of the main keys to successful project management. Such problems can cause delays in project work, so that the project cannot take place according to a predetermined plan. Project delays are often a source of disputes and demands between owners and contractors, so it will be very expensive in terms of both the contractor and the owner. The contractor will be subject to penalty fines in accordance with the contract, in addition the contractor will also experience additional overhead costs while the project is still ongoing. From the owner's side, project delays will have the impact of reducing income due to delays in operating the facility. This happens because in the field there are often and even always differences in perceptions between contractors as implementers and consultants as supervisors and planners, especially if planners are not involved in the project implementation period. As a result of these differences, two things arise, namely increasing project costs and delays in project completion from the planned schedule. To avoid losses in the project we can forecast (forecasting) the cost of completing the project with the Earned Value Concept (Earned Value Analysis) (Diasz 2023).

In the construction of sports facilities in Kedewan District, Bojonegoro Regency in the process of construction there are several obstacles in cost and time (Riza and Witjaksana 2022). 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 fines, therefore the author will use the Earned Value Analysis 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 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 in 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 the 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 3 indicators above, various factors can be calculated that show the progress and performance of project implementation such as: integrated cost (CV) and schedule (SV) variances; monitoring variance changes against standard figures; productivity and performance indices; project completion cost forecasts. So in this case the Earned Value Analysis (EVA) method is one of the tools that can be used in project management that integrates cost, time and project implementation performance so that it knows the extent of 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 these delays can be optimized (Daulasi, Mangare, and Walangitan 2016).

From the background of the problem above, the purpose of this research is to analyze the value of the cost variance (CV) of the Construction of Sports Facilities for Kedewan District, Bojonegoro Regency. As well as determining the amount of cost forecasts ETC (estimate to complate) and EAC (estimate at complete) until the project Development of Sports Facilities Kedewan District Bojonegoro Regency is completed.

2. RESEARCH METHODS

Data collection is obtained from the executing contractor, PT Unedo Phazippo Utama as well as several from the Supervisory consultant. The types of data collected are secondary data types and literature studies, including:

a. Time schedule plan and time schedule realization of the Kedewan District Sports Building construction project :

a) S curve (Master schedule)
b) Project actual S curve

b. Contract Cost Budget Plan

Is the budgeted cost to complete all work items. RAB is listed in the work contract between the owner (project owner) and the implementing contractor which consists of unit price analysis, list of wages and material prices.

c. Monthly, weekly and daily project reports from the implementing contractor

Is a progress report on the achievement of project achievements that have been achieved in one weekly period for weekly reports and for monthly reports on project achievements that have been achieved in one monthly period. In this project, cut off progress is carried out every Sunday so that the weekly progress period starts from Monday to Sunday. This weekly and bualan report contains the volume and weight of work progress in the period of weeks for weekly and months for monthly reports.

d. Project cost realization report

The realization report is usually called the actual cost (Actual Cost) is information on the use of funds or costs that have been incurred for work that has been completed. Actual costs consist of:

a) Direct Costs
- Material Costs (BPG)
- Labor Costs / Wages (BAU)
- Tool Cost (BLA)

b) Indirect Cost

Indirect cost data obtained from the project finance department includes:
- Office Overhead Costs
- Field Overhead Costs

Data analysis in this study, as follows:

1. Analysis of Project Progress or Delay Factors To analyze the factors causing project progress or delay, it is done by :
   a. Interview with the implementing contractor (Site Engineer Manager, supervisor and logistics) and direct observation of the daily performance of the project.
   b. Checking material delivery whether it is in accordance with the material arrival schedule.
   c. Checking the weekly report to find out the percentage of work that has been done for one week.
   d. Checking the daily report to find out the pattern of labor usage, tool usage, material usage, weather conditions and the use of field working hours.
2. Earned Value Analysis Method :
   a. Calculate the value of ACWP (Actual Cost of Work Performance), BCWS (Budgeted Cost Work Schedule), BCWP (Budgeted Cost for Work Performed).ACWP value.
   b. Calculation based on cost aspects

Calculating the value of CV (Cost Variance), CPI (Cost Performance Index), ETC (Estimate to Complete), EAC (Estimate at Complete).

3. RESULTS AND DISCUSSION

3.1. Calculation of BCWS, BCWP and ACWP

The use of Earned Value Method in this project produces Planned Value (PV) or Budgeted Cost Work Schedule (BCWS), Earned Value (EV) or Budgeted Cost Work Performed (BCWP), Actual Cost (AC) or Actual Cost of Work Performed (ACWP), then

compared continuously in each phase of the project until completion. Cost and value utilization information obtained quickly throughout the project life cycle is very helpful for a fast and integrated project control and supervision system.

The method used in controlling costs and time in the field is to use a Time Schedule. This method is often used in construction projects and the percentage of the project plan and the percentage of realization are depicted in the S-curve graph Based on the S-curve graph of project planning and realization, the percentage of work until week 15, because in week 15 there is an increase in the percentage of work volume. The actual physical percentage (realization) of the project tends to be smaller or later than the plan. Earned value analysis was conducted in week 15(Ervianto 2009).

3.2. Calculations Planned Value (PV) or Budgeted Cost Work Schedule (BCWS)

In this project, the value of the 1st change contract has not been ppn Rp. 5,683,390,775.00 and to calculate PV or BCWS it is obtained from progress data and project budget with the following formula;

PV or BCWS = (% progress plan) x (Budget) Calculation

PV or BCWS in week 1

PV or BCWS = (% plan) x (Total project budget)

PV or BCWS = (0.21%) x (Rp. 5,683,390,775.00)

PV or BCWS = Rp 11,973,271.24

For the calculation of the next week, it can be done in the same way as the calculation above, seen in table 4.2 below:

Tabel 1. Tabel Planned Value (PV) or Budgeted Cost Work Schedule (BCWS)

No	Week Period	Weekly Plan Progress (%)	Progress Plan Cumulative (%)	PV or BCWS (Weekly)	PV or BCWS (Cumulative)
a	b	c	d	e = c x Contract Value	g = d x Contract Value
1	Ke-1	0.21	0.21	Rp. 11.973.271,24	Rp. 11.973.271,24
2	Ke-2	1.42	1.63	Rp. 80.899.126,39	Rp. 92.872.397,64
3	Ke-3	2.61	4.24	Rp. 148.160.329,14	Rp. 241.032.726,78
4	Ke-4	2.02	6.26	Rp. 114.818.080,18	Rp. 355.850.806,96
5	Ke-5	2.34	8.60	Rp. 133.126.688,63	Rp. 488.977.495,59
6	Ke-6	4.29	12.89	Rp. 243.640.655,67	Rp. 732.618.151,27
7	Ke-7	1.29	14.18	Rp. 73.136.249,40	Rp. 805.754.400,67
8	Ke-8	4.81	18.98	Rp. 273.223.930,05	Rp. 1.078.978.330,73
9	Ke-9	4.00	22.98	Rp. 227.328.728,24	Rp 1.306.307.058,98
10	Ke-10	2.14	25.12	Rp. 121.572.635,61	Rp 1.427.879.694,60
11	Ke-11	5.60	30.72	Rp. 318.059.520,49	Rp. 1.745.939.215,09
12	Ke-12	5.98	36.70	Rp. 339.882.256,96	Rp. 2.085.821.472,06
13	Ke-13	5.67	42.37	Rp. 322.158.121,73	Rp. 2.407.979.593,80
14	Ke-14	4.09	46.46	Rp. 232.520.330,01	Rp. 2.640.499.923,81
15	Ke-15	5.20	51.66	Rp. 295.809.825,25	Rp. 2.936.309.749,06

Source: Secondary Data (Project Weekly Report) Construction of Kedewan District Sports Facilities Building Year 2023.

From the calculation obtained in week 15,
PV or BCWS = (% plan) x (Total project budget)
PV or BCWS = (51.66%) x (Rp. 5,683,390,775.00)
PV or BCWS = IDR 295,809,825.25

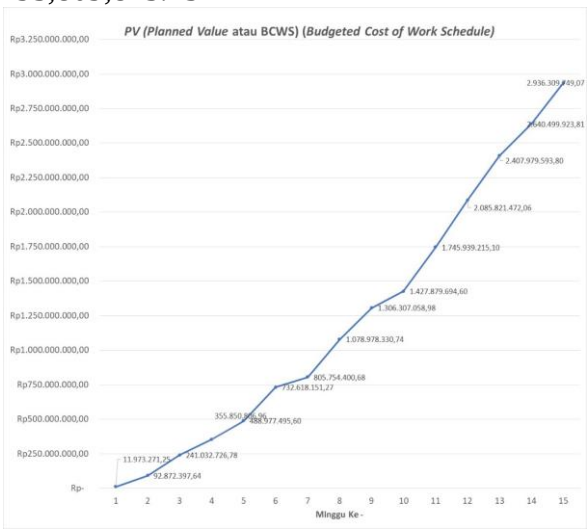

Figure 1. Grafik Planned Value (PV) or Budgeted Cost of Work Schedule BCWS
Source: PT Unedo Phazippo Utama secondary data (Weekly Report and Project Schedule) 2023

Description: graphs and tables Planned Value (PV) / Budgeted Cost of Work Schedule (BCWS) can be seen spending costs every week according to the contract.

3.3. Calculations Earned Value (EV) or Budgeted Cost Work Performed (BCWP)

In this project Earned Value (EV) or Budgeted Cost of Work Schedule BCWP is the budgeted cost for work that has been completed, obtained by multiplying the percentage of progress that has been carried out with the budget;

EV or BCWP = (% actual progress) x (Budget) Calculation
EV or BCWP in week 1
EV or BCWP = (% actual) x (Total project budget)
EV or BCWP = (0.17%) x (Rp. 5,683,390,775.00)
EV or BCWP = Rp 9,575,506.91

For the calculation of the next week, it can be done in the same way as the calculation above, seen in table 4.4 below:

Tabel 2 Tabel Earned Value (EV) or Budgeted Cost Work Performed (BCWP)

No	Week Period	Weekly Actual Progress (%)	Cumulative Actual Progress (%)	EV or BCWP (Weekly)	EV or BCWP (Cumulative)
a	b	c	d	e = c x Contract Value	g = d x Contract Value

1	Ke-1	0.17	0.17	Rp. 9.552.659,99	Rp. 9.552.659,99
2	Ke-2	0.37	0.54	Rp. 21.078.777,89	Rp. 30.631.437,89
3	Ke-3	0.98	1.52	Rp. 55.531.116,24	Rp. 86.162.554,14
4	Ke-4	0.63	2.14	Rp. 35.674.709,82	Rp. 121.837.263,97
5	Ke-5	0.93	3.08	Rp. 52.996.911,14	Rp. 174.834.175,12
6	Ke-6	1.57	4.64	Rp. 89.157.443,07	Rp. 263.991.618,19
7	Ke-7	5.41	10.06	Rp. 307.744.636,73	Rp. 571.736.254,92
8	Ke-8	6.76	16.82	Rp. 383.946.398,10	Rp. 955.682.653,03
9	Ke-9	4.49	21.30	Rp. 255.047.072,77	Rp 1.210.729.725,80
10	Ke-10	2.52	23.83	Rp. 143.366.357,68	Rp 1.354.096.083,48
11	Ke-11	6.03	29.86	Rp. 342.735.672,30	Rp 1.696.831.755,78
12	Ke-12	3.49	33.35	Rp. 198.346.988,05	Rp. 1.895.178.743,84
13	Ke-13	4.82	38.17	Rp. 273.889.274,70	Rp. 2.169.068.018,55
14	Ke-14	1.97	40.13	Rp. 111.868.493,08	Rp. 2.280.936.511,64
15	Ke-15	0.98	41.12	Rp. 55.863.588,17	Rp. 2.336.800.099,81

Source: secondary data (Weekly Project Report) Construction of Kedewan District Sports Facilities Building Year 2023.

From the calculation of the table above, EV or BCWP is obtained in week 15, with the formula EV or BCWP = (% actual) x (Total project budget)
EV or BCWP = (0.41.12%) x (Rp. 5,683,390,775.00)
EV or BCWP = Rp 55,863,588.17

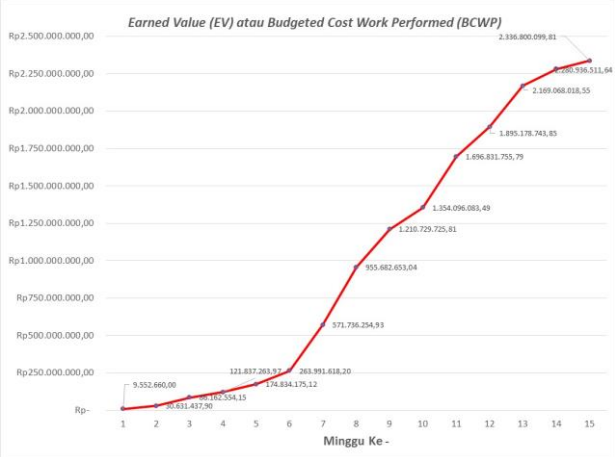

Figure 2. Graph of Earned Value (EV) or Budgeted Cost of Work Performed (BCWP)

Description: graph and table Earned Value (EV) / Budgeted Cost of Work Performanced (BCWP) when compared with graph and table Planned Value (PV) / Budgeted Cost of Work Schedule (BCWS) can be seen there is a delay from week 1 to 15 seen from the cost expenditure week 1 to 15 far from the plan.

3.4. Actual Cost Calculation (AC) or Actual Cost of Work Performed (ACWP)

In this project Actual Cost (AC) or also called Actual Cost of Work Performed (ACWP) is the real cost use :

Actual Cost Sunday consists of costs:

A. Direct Costs:
   - Material Cost
   - Labor Cost

B. Indirect Costs
   - Office overhead: Staff salaries, Office equipment
   - Field Overhead: Fence, Directors Kit, Security, Transportation/Fuel

In this study for indirect costs using the author's assumptions on the basis of previous research. The indirect costs made have been detailed so that they are close to what is being done.

Details of indirect costs are attached.

AC or ACWP = direct cost + indirect cost

Table 3. Table of Indirect Costs of Construction Work of Kedewan Sports Hall

No	Week Period	Direct Costs
1	Ke-1	Rp. 8.907.224,20
2	Ke-2	Rp. 60.182.939,29
3	Ke-3	Rp. 110.220.276,67
4	Ke-4	Rp. 85.416.120,75
5	Ke-5	Rp. 99.036.365,12
6	Ke-6	Rp. 181.250.545,50
7	Ke-7	Rp. 54.407.935,58
8	Ke-8	Rp. 203.258.303,62
9	Ke-9	Rp. 169.115.683,45
10	Ke-10	Rp. 90.441.008,14
11	Ke-11	Rp. 236.612.651,66
12	Ke-12	Rp. 252.847.146,17
13	Ke-13	Rp. 239.661.706,46
14	Ke-14	Rp. 172.977.849,43
15	Ke-15	Rp. 220.060.531,53

Source: author's assumption in 2023

Indirect costs are made according to the plan expenditure every week according to the author's assumptions with detailed every week so that it is close to the estimated conditions of the plan Indirect cost

Table 4. Table of Direct Costs for Construction of Kedewan Sports Hall

No	Week Period	Indirect Costs
1	Ke-1	Rp. 10.570.070,00
2	Ke-2	Rp. 15.437.857,14
3	Ke-3	Rp. 2.737.857,14
4	Ke-4	Rp. 25.787.857,14

5	Ke-5	Rp. 4.092.357,14
6	Ke-6	Rp 77.37.857,14
7	Ke-7	Rp. 4.092.357,14
8	Ke-8	Rp. 28.287.857,14
9	Ke-9	Rp. 4.092.357,14
10	Ke-10	Rp. 4.092.357,14
11	Ke-11	Rp. 4.092.357,14
12	Ke-12	Rp. 29.642.357,14
13	Ke-13	Rp. 2.737.857,14
14	Ke-14	Rp. 4.937.857,14
15	Ke-15	Rp. 3.027.571,42

Source: Weekly Report of Kedewan Sub-district Sports Building Construction Project

Direct costs are made according to the weekly expenditure plan made by the implementing contractor referring to the weekly percentage data on the work schedule. The ACWP value for week 15 is IDR 223,088,102.96, then accumulated in the previous week, so that the ACWP value up to week 15 is IDR 2,335,763,071.93. The ACWP calculation recapitulation is as follows

For the calculation of the next week can be done in the same way as the calculation above, seen in table 5 below:

Tabel 5. Tabel Actual Cost of Work Performed (ACWP)

No	Week Period	Direct Costs	Indirect Costs	ACWP	ACWP (Cumulative)
a	b	c	d	e = c + d	g = d x Contract Value
1	Ke-1	Rp. 8.907.224,20	Rp. 10.570.070,00	Rp. 19.477.294,20	Rp. 19.477.294,20
2	Ke-2	Rp. 60.182.939,29	Rp. 15.437.857,14	Rp. 75.620.796,43	Rp. 95.098.090,63
3	Ke-3	Rp. 110.220.276,67	Rp. 2.737.857,14	Rp. 112.958.133,81	Rp. 208.056.224,45
4	Ke-4	Rp. 85.416.120,75	Rp. 25.787.857,14	Rp. 111.203.977,89	Rp. 319.260.202,35
5	Ke-5	Rp. 99.036.365,12	Rp. 4.092.357,14	Rp. 103.128.722,27	Rp. 422.388.924,62
6	Ke-6	Rp. 181.250.545,50	Rp 77.37.857,14	Rp. 188.988.402,64	Rp. 611.377.327,27
7	Ke-7	Rp. 54.407.935,58	Rp. 4.092.357,14	Rp. 58.500.292,73	Rp. 669.877.620,00
8	Ke-8	Rp. 203.258.303,62	Rp. 28.287.857,14	Rp. 231.546.160,76	Rp. 901.423.780,77
9	Ke-9	Rp. 169.115.683,45	Rp. 4.092.357,14	Rp. 173.208.040,60	Rp. 916.301.238,37
10	Ke-10	Rp. 90.441.008,14	Rp. 4.092.357,14	Rp. 94.533.365,28	Rp. 1.169.165.186,65
11	Ke-11	Rp. 236.612.651,66	Rp. 4.092.357,14	Rp. 240.705.008,80	Rp. 1.409.870.195,46
12	Ke-12	Rp. 252.847.146,17	Rp. 29.642.357,14	Rp. 282.489.503,32	Rp. 1.692.359.698,78
13	Ke-13	Rp. 239.661.706,46	Rp. 2.737.857,14	Rp. 242.399.563,60	Rp. 1.934.759.262,38
14	Ke-14	Rp. 172.977.849,43	Rp. 4.937.857,14	Rp. 177.915.706,58	Rp. 2.112.674.968,96
15	Ke-15	Rp. 220.060.531,53	Rp. 3.027.571,42	Rp. 223.088.102,96	Rp. 2.335.763.071,93

Source: Author's Processed Results Year 2023

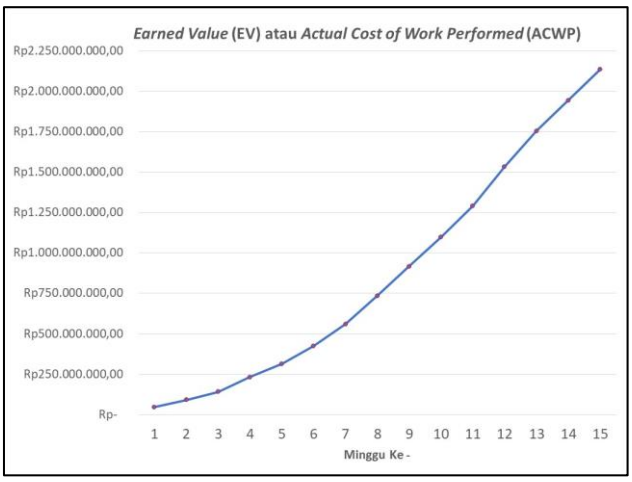

Figure 3. Graph of Actual Cost (AC) or Actual Cost of Work Performed (ACWP)
Description: graph and table Actual Cost (AC) / Actual Cost od Work ACWP can be seen actual tactical spending.

From the three indicators that have been calculated, namely Budgeted Cost of Work Schedule (BCWS), Budgeted Cost Work Performed (BCWP), and Actual Cost of Work Performed (ACWP), it provides an overview of the achievement of cost and time cumulatively in each week, as follows:

Table 6 Recapitulation Table for Cumulative Calculation of Planned Value (PV) or BCWS, Earned Value (EV) or BCWP, and Actual Cost (AC) or ACWP

No	Week Period	PV or BCWS	EV or BCWP	AC or ACWP
a	b	d	e	g
1	Ke-1	Rp. 11.973.271,24	Rp. 9.552.659,99	Rp. 19.477.294,20
2	Ke-2	Rp. 92.872.397,64	Rp. 30.631.437,89	Rp. 95.098.090,63
3	Ke-3	Rp. 241.032.726,78	Rp. 86.162.554,14	Rp. 208.056.224,45
4	Ke-4	Rp. 355.850.806,96	Rp. 121.837.263,97	Rp. 319.260.202,35
5	Ke-5	Rp. 488.977.495,59	Rp. 174.834.175,12	Rp. 422.388.924,62
6	Ke-6	Rp. 732.618.151,27	Rp. 263.991.618,19	Rp. 611.377.327,27
7	Ke-7	Rp. 805.754.400,67	Rp. 571.736.254,92	Rp. 669.877.620,00
8	Ke-8	Rp. 1.078.978.330,73	Rp. 955.682.653,03	Rp. 901.423.780,77
9	Ke-9	Rp 1.306.307.058,98	Rp 1.210.729.725,80	Rp. 916.301.238,37
10	Ke-10	Rp 1.427.879.694,60	Rp 1.354.096.083,48	Rp. 1.169.165.186,65
11	Ke-11	Rp. 1.745.939.215,09	Rp 1.696.831.755,78	Rp. 1.409.870.195,46
12	Ke-12	Rp. 2.085.821.472,06	Rp. 1.895.178.743,84	Rp. 1.692.359.698,78
13	Ke-13	Rp. 2.407.979.593,80	Rp. 2.169.068.018,55	Rp. 1.934.759.262,38
14	Ke-14	Rp. 2.640.499.923,81	Rp. 2.280.936.511,64	Rp. 2.112.674.968,96
15	Ke-15	Rp. 2.936.309.749,06	Rp. 2.336.800.099,81	Rp. 2.335.763.071,94

Source: Secondary Data (RAB Contract, Schedule, Actual Cost) Construction of Kedewan District Sports Facilities Building in 2023.

From the table above in week 15, it can be seen that the PV value is Rp.2,936,309,749.06, the EV value is Rp. 2,336,800,099.81 and the AC value is Rp. 2,335,763,071.94.

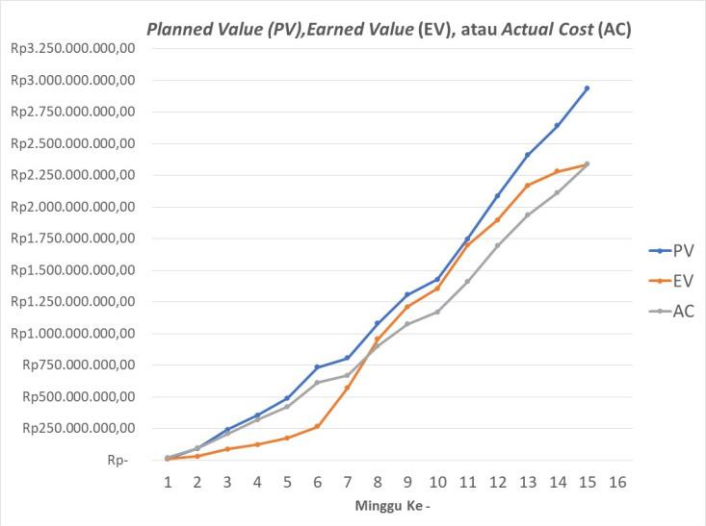

Figure 4. Relationship Graph of Planned Value (PV) or BCWS, Earned Value (EV) or BCWP, and Actual Cost (AC) or ACWP

Description: The graph shows the comparison of BCWS (PV) and BCWP (EV) values. Week 1 to week 15 shows that the BCWP (EV) value is smaller than BCWS (PV). This shows that the work has not been done according to the plan schedule.

The project is experiencing delays in work, this is indicated by the BCWP (EV) value which is smaller than the BCWS (PV) value. For actual costs or ACWP in the first week to week 15, the cost expenditure is less than the plan with the ACWP graph marked lower than BCWP (EV).

3.5. Calculation Based on Cost Aspect

The use of the EV method in this project Earned Value Analysis is seen from the cost aspect, Cost Variance (CV), Cost Performance Index (CPI), Estimate at Complete (EAC) are used. Details of the calculation of these parameters are as follows:

3.6. Calculation of Cost Variance (CV) or Calculation of Costs

Cost variance is the difference between the value of the project performance results (BCWP) Budgeted Cost Work Performed and the planned budget (BCWS) Budgeted Cost of Work Schedule.

Review of the calculation of the CV cost variance at week 15, obtained from the reduction of Earned Value and Actual Cost at week 15.

CV = EV or BCWP - AC or ACWP

CV = Rp 2,336,800,099.81- Rp 2,335,763,071.94 = Rp 1,037,027.87

A negative value or CV value greater than 0 (CV> 0) indicates that the costs incurred are less than the planned budget.

This CV value can indicate that the project is delayed or running faster than planned and the costs incurred are greater than or smaller than the planned budget, for the calculation of the next week can be done in the same way as the calculation above, seen in the following table

Table 7. Cumulative Cost Variance (CV) Value Table for Each Week

No	Week Period	BCWP	ACWP	CV
a	b	d	e	g
1	Ke-1	Rp. 9.552.659,99	Rp. 19.477.294,20	- Rp. 9.924.634,20
2	Ke-2	Rp. 30.631.437,89	Rp. 95.098.090,63	- Rp. 644.66.652,73
3	Ke-3	Rp. 86.162.554,14	Rp. 208.056.224,45	- Rp. 121.893.670,31
4	Ke-4	Rp. 121.837.263,97	Rp. 319.260.202,35	- Rp. 197.422.938,38
5	Ke-5	Rp. 174.834.175,12	Rp. 422.388.924,62	- Rp. 247.554.749,50
6	Ke-6	Rp. 263.991.618,19	Rp. 611.377.327,27	- Rp. 347.385.709,07
7	Ke-7	Rp. 571.736.254,92	Rp. 669.877.620,00	- Rp. 98.141.365,07
8	Ke-8	Rp. 955.682.653,03	Rp. 901.423.780,77	Rp. 54.258.872,26
9	Ke-9	Rp 1.210.729.725,80	Rp. 916.301.238,37	Rp. 136.097.904,43
10	Ke-10	Rp 1.354.096.083,48	Rp. 1.169.165.186,65	Rp. 184.930.896,83
11	Ke-11	Rp 1.696.831.755,78	Rp. 1.409.870.195,46	Rp. 286.961.560,32
12	Ke-12	Rp. 1.895.178.743,84	Rp. 1.692.359.698,78	Rp. 202.819.045,06
13	Ke-13	Rp. 2.169.068.018,55	Rp. 1.934.759.262,38	Rp. 234.308.756,16
14	Ke-14	Rp. 2.280.936.511,64	Rp. 2.112.674.968,96	Rp. 168.261.542,67
15	Ke-15	Rp. 2.336.800.099,81	Rp. 2.335.763.071,94	Rp. 1.037.027,87

Source: Author's Processed Results Year 2023

3.7. Calculation of Cost Performance Index (CPI)

Cost variance is the difference between the value of the project performance results (BCWP) Budgeted Cost Work Performed and the planned budget (BCWS) Budgeted Cost of Work Schedule.

The calculation of the CPI value in week 15, is as follows:

CPI = BCWP / ACWP

CPI = Rp. 2,336,800,099.81 / Rp 2,335,763,071.94

CPI = 1.0004

Obtained CPI value> 0, namely 1.0004

The CPI value greater than 1 indicates that the cost performance is still good because the costs incurred (AC) are smaller than the value obtained (EV).

3.8. Estimate To Complete (ETC) Calculation

Is an estimation tool and is used with earned value calculations to develop performance reports

ETC = (BAC - BCWP) / CPI

ETC = (Rp. 5,683,390,775.00 - Rp. 2,336,800,099.81) / 1,004

ETC = Rp. 3,345,105,521.28

3.9. Estimate At Complete (EAC) Calculation

Merupakan prakiraan biaya total pada akhir proyek yang diperoleh dari biaya aktual (AC) ditambah dengan ETC

EAC = ACWP + ETC

EAC = Rp. 2.335.763.071,94+ Rp. 3.345.105.521,28

EAC = Rp. 5.680.868.593,22

3.10. Schedule Performance Index (SPI) calculation

Project managers often want to know the use of resources, which can be expressed as a productivity index or performance index. schedule performance index (SPI). The schedule productivity index is the value of the efficiency of resource utilization at the time of the evaluation.

SPI = BCWP / BCWS

Table 10. Cumulative Schedule Performance Index (SPI) Value Table for Each Week

No	Week Period	BCWS	BCWP	SPI
a	b	c	d	e = c / d
1	Ke-1	Rp. 11.973.271,24	Rp. 9.552.659,99	0.80
2	Ke-2	Rp. 92.872.397,64	Rp. 30.631.437,89	0.33
3	Ke-3	Rp. 241.032.726,78	Rp. 86.162.554,14	0.36
4	Ke-4	Rp. 355.850.806,96	Rp. 121.837.263,97	0.34
5	Ke-5	Rp. 488.977.495,59	Rp. 174.834.175,12	0.36
6	Ke-6	Rp. 732.618.151,27	Rp. 263.991.618,19	0.36
7	Ke-7	Rp. 805.754.400,67	Rp. 571.736.254,92	0.71
8	Ke-8	Rp. 1.078.978.330,73	Rp. 955.682.653,03	0.89
9	Ke-9	Rp 1.306.307.058,98	Rp 1.210.729.725,80	0.93
10	Ke-10	Rp 1.427.879.694,60	Rp 1.354.096.083,48	0.95
11	Ke-11	Rp. 1.745.939.215,09	Rp 1.696.831.755,78	0.97
12	Ke-12	Rp. 2.085.821.472,06	Rp. 1.895.178.743,84	0.91
13	Ke-13	Rp. 2.407.979.593,80	Rp. 2.169.068.018,55	0.90
14	Ke-14	Rp. 2.640.499.923,81	Rp. 2.280.936.511,64	0.86
15	Ke-15	Rp. 2.936.309.749,06	Rp. 2.336.800.099,81	0.80

Source: Author's Processed Results Year 2023

The calculation of the SPI value in week 15 is as follows:

SPI = BCWP / BCWS

= Rp 2,336,800,099.81 / Rp 2,936,309,749.06

= 0,80

From the results of these calculations, the SPI value is 0.80.

An SPI value of less than 1 indicates that the project is delayed. The work performance is not as expected and has not been able to achieve the planned work target.

3.11. Calculation of Estimated Temporary Schedule (ETS)

Is the method used to calculate the estimated time remaining
ETS = Time Remaining / SPI

Table 11. Cumulative Estimate Temporary Schedule (ETS) Value Table for Each Week

No	Week Period	SPI	Plan Time	Cumulative Residual Time	Remaining Time	ETS
a	b	c	d	e	f= d-e	g=f/c
1	Ke-1	0.80	210	2	206	260.71
2	Ke-2	0.33	210	8	196	612.45
3	Ke-3	0.36	210	14	190	548.29
4	Ke-4	0.34	210	20	184	554.93
5	Ke-5	0.36	210	26	178	514.61
6	Ke-6	0.36	210	32	172	493.98
7	Ke-7	0.71	210	38	166	242.40
8	Ke-8	0.89	210	44	160	187.42
9	Ke-9	0.93	210	50	154	172.63
10	Ke-10	0.95	210	56	148	162.39
11	Ke-11	0.97	210	62	142	152.28
12	Ke-12	0.91	210	68	136	156.28
13	Ke-13	0.90	210	74	130	150.98
14	Ke-14	0.86	210	80	124	150.49
15	Ke-15	0.80	210	84	122	158.33

Source: Author's Processed Results Year 2023

The calculation of the SPI value in week 15 is as follows:
ETS = Remaining Time / SPI
= 122/0.80
= 158.33 rounded up 159 Days

3.12. Estimate At Schedule (EAS) Calculation

Is a method used to estimate the project completion time
EAS = Finish Time + ETS

Table 12. Cumulative Estimate All Schedule (EAS) Value Table for Each Week

No	Week Period	SPI	Plan Time	Cumulative Residual Time	Remaining Time	ETS	EAS	Time Difference
a	b	c	d	e	f= d-e	g=f/c	h=e+g	i=h-d
1	Ke-1	0.80	210	2	206	260.71	262.71	52.71
2	Ke-2	0.33	210	8	196	612.45	620.45	410.45
3	Ke-3	0.36	210	14	190	548.29	562.29	352.29

4	Ke-4	0.34	210	20	184	554.93	574.93	364.93
5	Ke-5	0.36	210	26	178	514.61	540.61	330.61
6	Ke-6	0.36	210	32	172	493.98	525.98	315.98
7	Ke-7	0.71	210	38	166	242.40	280.40	70.40
8	Ke-8	0.89	210	44	160	187.42	231.42	21.42
9	Ke-9	0.93	210	50	154	172.63	222.63	12.63
10	Ke-10	0.95	210	56	148	162.39	218.39	8.39
11	Ke-11	0.97	210	62	142	152.28	214.28	4.28
12	Ke-12	0.91	210	68	136	156.28	224.28	14.28
13	Ke-13	0.90	210	74	130	150.98	224.98	14.98
14	Ke-14	0.86	210	80	124	150.49	230.49	20.49
15	Ke-15	0.80	210	84	122	158.33	242.33	32.33

Source: Author's Processed Results Year 2023

The calculation of the EAS value in week 15, is as follows:
EAS = Finish Time - ETS
= 210 + 32.33
= 242.33 rounded up 243 Days

From the results of the ETS and EAS calculations, it can be concluded that the processing time is 33 days longer than the planned schedule of 210 days.

4. CONCLUSIONS and SUGGESTIONS

4.1 CONCLUSIONS

Based on the analysis that has been carried out, the following conclusions are obtained;

1. From the results of the calculation analysis, the CV and SV values are obtained. According to table 4.9, it is obtained from week 1 to 15, the CV value <0 in week 1 to week 7 illustrates that the costs incurred are greater than the plan, but in week 8 to 15 the CV>0 value, so in that week the costs incurred are greater than the plan.
2. Calculation of the ETC (estimate to complete) value obtained the estimated budget required for completion is Rp. 3,345,105,521.28, while the EAC (estimate at complete) value obtained the estimated final total cost of the project is Rp.5,680,868,593.22.

4.2 SUGGESTIONS

Suggestions from the research that has been done are as follows:

1. In the cost and time analysis, for the cost analysis, the CV results predict that the project cost is higher or lower than planned, it is necessary to pay attention to indirect costs which greatly affect the results of the Actual Cost (AC) calculation.
2. For project executors, management with the Earned Value Method should be carried out from the start of the project to overcome project delays, this can avoid mismatches in terms of cost and time(Rumere, Tjakra, and Ingkiriwang 2019).

3. With the analysis of the project using EVM, the implementing contractor can run the project optimally.

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