INTERNATIONAL JOURNAL ON ADVANCED TECHNOLOGY, ENGINEERING, AND INFORMATION SYSTEM (IJATEIS)

COST AND TIME ANALYSIS USING EARNED VALUE METHOD BUILDING CONSTRUCTION OF DISTANCE LEARNING PROGRAM UNITS OF SURABAYA OPEN UNIVERSITY PHASE II

Mochamad Ranoe Asmoro[1*], Budi Witjaksana[2], Hanie Teki TJendani [3]
[1-3]Universitas 17 Agustus 1945 Surabaya
E-mail: [1)] ranoe_asmoro@yahoo.com, [2)] budiwitjaksana@untag-sby.ac.id,
[3)] hanie@untag-sby.ac.id

Abstract

Project delays often serve as a catalyst for conflicts and disagreements between project owners and contractors, leading to significant financial implications. Such delays result in costly consequences for both parties involved. Contractors face the imposition of penalty fines as stipulated in the contractual agreement, alongside incurring overhead costs during the prolonged project duration. Conversely, owners experience a direct impact on their revenue streams due to delays in the operationalization of the facility. In the context of the construction of the Surabaya Open University Distance Learning Program Unit building phase II, the examination of cost and time performance becomes imperative. Employing the earned value method offers a comprehensive approach to project performance evaluation, involving a meticulous comparison of actual expenses and timelines with the initially anticipated costs. This analytical approach aids in understanding the project's progress and identifying areas where adjustments may be necessary to mitigate potential delays. The Earned Value Method (EVM) analysis of the Surabaya Open University Distance Learning Program Unit building phase II reveals a projected total cost of IDR 73,908,443,223.09 by the time the project reaches completion. This estimation provides stakeholders with valuable insights into the financial commitment required for the successful conclusion of the project. Additionally, the anticipated timeline for completion is estimated at 53 weeks, serving as a crucial parameter for project planning and management.

Keywords: *Earned Value Method, Open University, Time, Costs*

1. INTRODUCTION

The construction of State buildings must be in accordance with functions that meet the requirements, safety, health, comfort, convenience, efficient use of resources, harmonious and in harmony with the environment and organized in an orderly, effective and efficient manner, in accordance with the provisions in the Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 22/PRT/M/2018 concerning Guidelines for State Building Construction.

The building to be built is a building construction work with an office complex and lecture halls that cover all task services and functions according to the plan. Both depend on careful planning of implementation methods, use of tools and scheduling. Management has five elements or commonly referred to as (5M), namely, men, money, materials, machines, and methods (Emerson et al, 2014).

In work planning, operational problems often arise that hinder the completion activities of a project such as lack of resources, improper resource allocation, delays in

project implementation and other problems outside the schedule in the work plan (Nicholas, 1990).

In the study Causes of Delays and Overruns of Construction Projects Developing Countries, the causes of delays in construction projects in developing countries during project planning and at the construction stage. The study was conducted where the construction project workers generally appeared and it can be concluded that careful planning throughout the early stages of construction projects is very important to minimize project delays and cost overruns in construction projects in developing countries (Chalibi and Camp, 1984).

There are three factors that affect the success and failure of a project, namely time, cost and quality (Rahmanto & Janizar, 2022). The benchmark for project success is usually seen from a short completion time with minimal costs without leaving the quality of the work. Systematic project management is needed to ensure that the project implementation time is in accorda nce with the contract or even faster so that the costs incurred can provide benefits and also avoid fines due to delays in project completion.

In construction project planning, optimized time and cost are very important to know. With optimal time and cost (Mareta, n.d.), the project contractor can get maximum profit. To be able to get this, what must be done in time and cost optimization is to create a project work network (network), find critical activities and calculate the duration of the project and know the amount of resources (resources). It requires us to use the right method in optimizing existing resources and available facilities such as engineering application computer program tools so that the project can be completed on time, at the right quality, and at the right cost.

In addition to careful construction planning, project management is also something that cannot be ignored. According to Santoso "project management is the activity of planning, organizing, directing and controlling the company's organizational resources to achieve certain goals within a certain time with certain resources".

Cost control is necessary to maintain conformity between planning and implementation. Control aims to ensure that project costs do not exceed the implementation budget plan. The greatest opportunity to reduce the final cost of the project is at the feasibility study and planning stages (Hidayat, 2017). What is needed to control cost control is an implementation plan that concerns the quality, volume and unit price of the work obtained. (Pratiwi, 2012)

Projects are efforts or activities that are organized to achieve important goals, objectives, and expectations using the budget and available resources, which must be completed within the planned time period. So time and cost are very influential on the success and failure of a project. Systematic project management is needed to ensure that the time for carrying out work is in accordance with the schedule or can be faster so that the costs incurred are smaller than the budget so as to benefit and avoid delays in project completion which impact on cost losses and result in fines. (Nurhayati, 2010).

Time control is intended so that the construction implementation time can take place as planned. In an implementation must be in accordance with the planned time because it determines the success of a project(Maulidi et al., n.d.). In general, changes in

implementation time will affect the budget if project construction is still ongoing. It is clear that the actual completion must be compared with the overall plan. (Didik, 2013)

The earned value method is a way to measure the amount of work actually done on a project (i.e., to measure progress) and to estimate project costs and completion dates (Rahman, 2010).

Meanwhile, according to Soeharto (1995), the concept of value for money is the concept of calculating the amount of costs according to the budget in accordance with the work that has been completed or carried out (budgeted cost of works performed). When viewed from the amount of work completed, it means that this concept measures the amount of work units completed, at a time when assessed based on the amount of budget provided for the work. With this calculation, the relationship between what has actually been achieved physically and the amount of budget that has been spent is known.

(Anwar & Hayati, 2013)"Earned Value Concept for Construction Project Management" by Soemardi B.W, et al., where Fleming and Koppelman (1994) explained that the earned value concept compared to traditional cost management(Yomelda & Utomo, 2015). Traditional cost management only presents two dimensions, namely a simple relationship between actual costs and planned costs. With traditional cost management, the performance status cannot be known. Actual costs are indeed lower, but in reality, the fact that actual costs are lower than the plan does not indicate that the performance has been carried out in accordance with the target plan.

In contrast, the earned value concept provides a third dimension in addition to actual cost and planned cost(Sakinah, 2021). This third dimension is the amount of physical work that has been completed or called earned value/percent complete(Maromi & Indryani, 2015). With this third dimension, a project manager will be able to better understand how much performance is generated from a number of costs that have been incurred.

The basic concept of value for money can be used to analyze performance and forecast target achievement. For this purpose, 3 indicators are used, namely ACWP (actual cost of work performed), BCWP (budgeted cost of work performed), and BCWS (budgeted cost of work scheduled). (Soeharto, 1995).

The success of a project cannot be separated from a series of activities that include the planning, implementation and supervision stages, so that the predetermined goals can be achieved. In an effort to complete a construction project, a good technique or management method is needed to improve efficiency, productivity and quality of work. In connection with this, it is necessary to carry out supervision and control measures in all sectors, especially time and cost control.

One of the project control methods is the Earned Value Concept method. According to Andrzej Czemplik (2014) the Earned Value Concept is a control method used to control project costs and schedules in an integrated and efficient manner. This method shows project performance information for a reporting period and shows the estimated time and cost to complete all projects based on performance indicators at the time of reporting.

The Earned Value concept is a development of the Variance Analysis concept. In Variance Analysis only some work results are shown at the reporting time compared to the budget or schedule. The weakness of the Variance Analysis method is that it only analyzes cost and schedule variations separately so that it cannot reveal performance

problems carried out on a project. (Saputra, 2019)Whereas with the Earned Value Concept method, the performance of the activities being carried out can be known and can increase the effectiveness in monitoring project activities. Over time, a refinement of the method was found, namely the Earned Schedule (ES) method. This method has better results in evaluating project time performance and predicting the final project time. The Earned Schedule (ES) method is an extension of the Earned Value Method (EVM)(Mahapatni et al., 2019). The Earned Schedule method uses time units to calculate project schedule control, not cost units like the EVM method(Nisrina & Hisjam, 2022).

Project delays are often the source of disputes and claims between owners and contractors, making delays very costly. The contractor will be subject to penalty fines in accordance with the contract and will also experience overhead costs while the project is still ongoing. From the owner's side, project delays will have the impact of reducing revenue due to delays in operating the facility.

A project tends to experience delays if planning and control are not carried out properly. Various things can happen in a construction project that can cause an increase in processing time, so that the completion of the project is delayed.

So, with this background, this research tries to examine the planning of the construction of the Surabaya Open University Distance Learning Program Unit building phase II in terms of cost and time performance(Johari & Islami, 2021), so that it can be a consideration in the implementation of Building Construction in the future. The considerable financing aspect is a concern in this study so that several alternative constructions are carried out with the aim of achieving cost efficiency and implementation time. However, in the implementation there are obstacles, namely the delay of more than 10% in week 11 which resulted in a Show Cause Meeting. (Aditama, 2021)This is used as the basis for conducting this research which does not correct errors or correct calculations that have been made by planners because this research leads to the Earned Value Method (EVM) so that the construction costs obtained are efficient with a case study of the Construction of the Surabaya Open University Distance Learning Program Unit Building Phase II.

Based on the above background, the purpose of this study is to obtain cost performance on the construction of the Surabaya Open University Distance Learning Program Unit Building Phase II based on the Earned Value Method(Aulia et al., 2018). As well as obtaining time performance on the construction of the Surabaya Open University Distance Learning Program Unit Building Phase II based on the Earned Value Method(Lamato et al., 2022).

2. RESEARCH METHODS

The location of this research is at Jl. Dr. Ir. H. Soekarno Blok M No.21, Kali Rungkut. The research location can be seen in Figure 3.3. which is located in Rungkut Sub-district, Surabaya City, East Java. The data to be collected and used in this research consists of secondary data. Data obtained from the results of data collection carried out by other parties that have been published, including reference books and journals related to the topic of study with additional data from the Project in the form of; RAB, S Curve

and Weekly Report. The following is the sequence of variables used in this study including:

a) Cost Component Analysis

1. ACWP (Actual Cost Work Performed)
2. BCWP (Budgeted Cost of Work Performed)
3. BCWS (Budgeted Cost of Work Schedule)

b) Analysis of Variance

1. Schedule Variance (SV)
2. Cost Variance (CV)

c) Performance Index Analysis

1. Schedule Performance Index (SPI)
2. Cost Performance Index (CPI)

d) Estimated Cost and Time of Project Completion

1. Estimate to Complete (ETC)
2. Estimate at Completion (EAC)
3. Time Estimated (TE)

3. DATA ANALYSIS AND DISCUSSION

3.1. Cost Components

3.1.1. BCWS (Budgeted Cost of Work Schedule)

BCWS (Budgeted Cost of Work Schedule) is the cost planned based on the project implementation schedule that has been completed. The BCWS value per week can be obtained based on the weight of the weekly plan in the Time Schedule. The basic calculation for work in month 1 can be seen as below:

Total Project Budget = Rp. 64,319,272,652
Time Schedule Plan Weight = 0,57%
BCWS Weight = Time Schedule Plan Weight x Total Project Budget
= 0.57% x IDR 64,319,272,651
= IDR 368,888,272

The BCWS value from month 1 to month 7 uses a contract value of Rp. 64,319,272,652. To get the result of the budgeted work schedule cost, the project budget value is multiplied by the weight of the work plan and results in the work schedule cost.

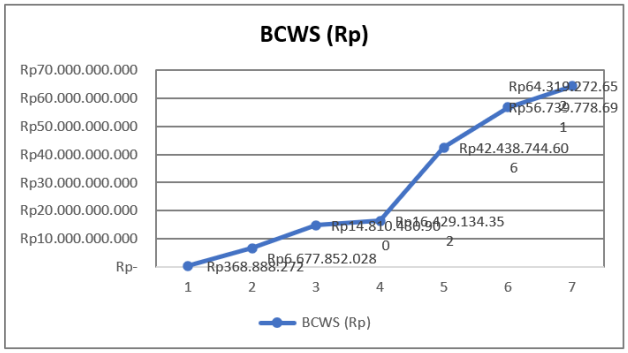

Figure 1. BCWS for each month

3.1.2. BCWP (Budgeted Cost of Work Performed)

BCWP (Budgeted Cost of Work Performed) is the value of the results of all work that has been completed. BCWP calculations can be calculated using weighted data on the realization of work on the Time Schedule. The basic calculation for work in month 1 can be seen as below:

Total Project Budget = Rp. 64,319,272,652
Time Schedule Plan Weight = 0,65%
BCWP Weight = *Time Schedule* Plan Weight x TotalProject Budget
= 0.65% x Rp. 64,319,272,651
= Rp414,998,771.60

The BCWP value from month 1 to month 4 uses a contract value of Rp. 64,319,272,652, it can be seen the use of realized costs against the budget issued every month of physical work.

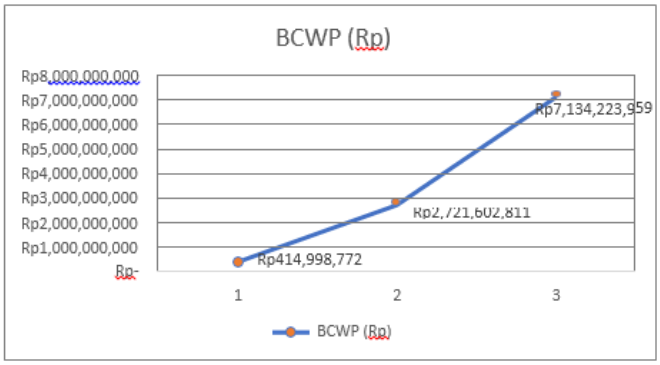

Figure 2. BCWP for each month

3.1.3. ACWP (Actual Cost of Work Performanced)

ACWP (Actual Cost of Work Performanced) is the actual cost incurred for work that has been completed data on the weight of the work plan on the Time Schedule. The basic calculation for work in month 1 can be seen as below:

Actual Cost = Total Project - (10% x total project cost)
= Rp. 64,319,272,651 - (10% x Rp. 64,319,272,651)
= IDR57,887,345,386

Time Schedule Plan Weight = 0,65%
ACWP Weight = *Time Schedule* Realization Weight x Actual Cost
= 0.65% x IDR57,887,345,386
= IDR 37,349,889,444

Table 1. Recapitulation of ACWP Analysis Results

Rekapitulasi Analisa ACWP											
Minggu	**Biaya Langsung**		**Rencana**		**Biaya Tidak Langsung**		**Bobot (%)**	**ACWP**	
1	Rp	-	Rp	-	Rp	-	-	Rp	-
2	Rp	27,238,384	Rp	21,510,307	Rp	1,075,515	0.03	Rp	28,313,899
3	Rp	230,999,485	Rp	191,680,064	Rp	9,584,003	0.30	Rp	240,583,488
4	Rp	414,998,772	Rp	368,888,272	Rp	18,444,414	0.57	Rp	433,443,185
5	Rp	518,705,864	Rp	1,533,744,744	Rp	76,687,237	2.38	Rp	595,393,101
6	Rp	777,543,579	Rp	2,466,525,148	Rp	123,326,257	3.83	Rp	900,869,837
7	Rp	1,270,581,380	Rp	3,542,227,953	Rp	177,111,398	5.51	Rp	1,447,692,778
8	Rp	1,469,827,394	Rp	4,895,672,202	Rp	244,783,610	7.61	Rp	1,714,611,004
9	Rp	2,721,602,811	Rp	6,677,852,028	Rp	333,892,601	10.38	Rp	3,055,495,413
10	Rp	3,459,990,953	Rp	8,867,126,080	Rp	443,356,304	13.79	Rp	3,903,347,257
11	Rp	4,250,925,049	Rp	12,097,553,551	Rp	604,877,678	18.81	Rp	4,855,802,726
12	Rp	5,195,247,034	Rp	14,823,854,315	Rp	741,192,716	23.05	Rp	5,936,439,750
13	Rp	7,134,223,959	Rp	14,810,430,900	Rp	740,521,545	23.03	Rp	7,874,745,504
14	Rp	8,946,376,486	Rp	14,970,167,126	Rp	748,508,356	23.27	Rp	9,694,884,842
15	Rp	12,443,197,872	Rp	15,236,394,170	Rp	761,819,709	23.69	Rp	13,205,017,581
16	Rp	14,538,179,963	Rp	15,757,768,908	Rp	787,888,445	24.50	Rp	15,326,068,408

Source: Researcher Analysis Data, 2023

From Table 1. it can be seen that the value of ACWP results until week 16 costs that have been done with a total cost of Rp.15,326,068,408 with an amount of weight of 24.50%. Actual costs in the field are usually incurred for work use, project tools, and so on. ACWP costs are incurred for projects from week 1 to week 16 with a total cost of Rp.15,326,068,408.

3.1.4. Variance Calculation

1) Time Variant (SV)

The Time Variant (SV) value can be calculated with the basic calculation of the Time Variant (SV) value in month 1.

SV = BCWP - BCWS
= Rp296,313,875 - 335,584,388
= - Rp39,270,514

The results of the SV calculation are minus, which means there is a delay in the time of work implementation. For further calculations the SV value is like table 4.

Table 2. Calculation of Time Variance (SV) Value for Each Month

MONTH	BCWP		BCWS		SV		DESC
1	Rp	296,313,875	Rp	335,584,389	-Rp	39,270,514	DELAY
2	Rp	631,898,264	Rp	628,328,217	Rp	3,570,047	ACCORDING

3	Rp	1,142,414,940	Rp	1,213,815,874	-Rp	71,400,934	DELAY
4	Rp	1,820,723,811	Rp	1,831,433,951	-Rp	10,710,140	DELAY
5	Rp	3,034,539,685	Rp	3,070,240,152	-Rp	35,700,467	DELAY
6	Rp	5,247,968,632	Rp	5,340,789,845	-Rp	92,821,214	DELAY
7	Rp	9,631,985,964	Rp	9,735,517,318	-Rp	103,531,354	DELAY
8	Rp	16,482,905,559	Rp	16,597,147,053	-Rp	114,241,494	DELAY

Implementation of project work from month 1 to month 8. The implementation of the project in the 1st month was delayed, then in the 2nd month accordingly, but in the 3rd month there was a delay until the 8th month. The SV value from month 1 can be seen that when obtained the number (SV) is delayed. Only in the 2nd month the work is in accordance.

Table 3. Calculation of Time Variance (SV) Value for Each Week

WEEK	BCWP		BCWS		SV		DESC
1	Rp	-	Rp	-	Rp	-	ACCORDING
2	Rp	27,238,384	Rp	21,510,307	Rp	5,728,077	ACCORDING
3	Rp	230,999,485	Rp	191,680,064	Rp	39,319,421	ACCORDING
4	Rp	414,998,772	Rp	368,888,272	Rp	46,110,500	ACCORDING
5	Rp	518,705,864	Rp	1,533,744,744	-Rp	1,015,038,880	DELAY
6	Rp	777,543,579	Rp	2,466,525,148	-Rp	1,688,981,569	DELAY
7	Rp	1,270,581,380	Rp	3,542,227,953	-Rp	2,271,646,572	DELAY
8	Rp	1,469,827,394	Rp	4,895,672,202	-Rp	3,425,844,808	DELAY
9	Rp	2,721,602,811	Rp	6,677,852,028	-Rp	3,956,249,217	DELAY
10	Rp	3,459,990,953	Rp	8,867,126,080	-Rp	5,407,135,127	DELAY
11	Rp	4,250,925,049	Rp	12,097,553,551	-Rp	7,846,628,502	DELAY
12	Rp	5,195,247,034	Rp	14,823,854,315	-Rp	9,628,607,281	DELAY
13	Rp	7,134,223,959	Rp	14,810,430,900	-Rp	7,676,206,941	DELAY
14	Rp	8,946,376,486	Rp	14,970,167,126	-Rp	6,023,790,640	DELAY
15	Rp	12,443,197,872	Rp	15,236,394,170	-Rp	2,793,196,298	DELAY
16	Rp	14,538,179,963	Rp	15,757,768,908	-Rp	1,219,588,945	DELAY

From table 3, it can be seen that week 5 starts to delay until week 16. The following is a graph for the SV value.

2) Cost Variance (CV)

The Cost Variance (CV) value can be calculated with the basic calculation of the Cost Variance (CV) value in month 1.

CV = BCWP - ACWP
= Rp414,998,772 - Rp410,395,650
= IDR4,603,121

Table 4. Calculation of Cost Variance (CV) Value for Each Month

MONTH	BCWP		ACWP		CV	
1	Rp	414,998,771.60	Rp	410,395,650.24	Rp	4,603,121.36
2	Rp	2,721,602,811.39	Rp	2,691,415,088.20	Rp	30,187,723.19
3	Rp	7,134,223,958.91	Rp	7,055,091,920.57	Rp	79,132,038.34

Table 4, shows the cost variance (CV) value from month 1 to month 3 where the project is running for 3 months.

The cost variance value (CV) is the value obtained after completing the work section with the actual value of project implementation, the CV value is used to determine whether the project is within budget or over budget. The cost variance value shows positive, meaning that the costs incurred are greater or wasteful.
The following table shows the cost variance values from week 1 to week 16.

Table 5. Calculation of Cost Variance (CV) Value for Each Week

WEEK	BCWP	ACWP	CV
1	Rp -	Rp -	Rp -
2	Rp 27,238,384.11	Rp 28,313,899.44	-Rp 1,075,515.34
3	Rp 230,999,484.91	Rp 240,583,488.09	-Rp 9,584,003.18
4	Rp 414,998,771.60	Rp 433,443,185.20	-Rp 18,444,413.60
5	Rp 518,705,863.94	Rp 595,393,101.13	-Rp 76,687,237.19
6	Rp 777,543,579.40	Rp 900,869,836.83	-Rp 123,326,257.42
7	Rp 1,270,581,380.40	Rp 1,447,692,778.04	-Rp 177,111,397.64
8	Rp 1,469,827,393.85	Rp 1,714,611,003.93	-Rp 244,783,610.08
9	Rp 2,721,602,811.39	Rp 3,055,495,412.79	-Rp 333,892,601.41
10	Rp 3,459,990,953.04	Rp 3,903,347,257.06	-Rp 443,356,304.02
11	Rp 4,250,925,048.84	Rp 4,855,802,726.40	-Rp 604,877,677.56
12	Rp 5,195,247,034.29	Rp 5,936,439,750.05	-Rp 741,192,715.76
13	Rp 7,134,223,958.91	Rp 7,874,745,503.90	-Rp 740,521,544.99
14	Rp 8,946,376,486.14	Rp 9,694,884,842.45	-Rp 748,508,356.31
15	Rp 12,443,197,872.37	Rp 13,205,017,580.88	-Rp 761,819,708.51
16	Rp 14,538,179,963.02	Rp 15,326,068,408.43	-Rp 787,888,445.41

Source: Researcher Analysis Data, 2023

3.1.5. Performance Index Calculation

1) Schedule Performance Index (SPI)

SPI is a performance efficiency factor in completing work that can be shown by the comparison between the value of work that has been physically completed (EV) and the planned cost expenditure incurred based on the work plan (PV).

Table 6. *Schedule Performance Index (SPI)* Calculation for Each Month

MONTH	BCWP	BCWS	SPI
1	Rp 414,998,772	Rp 368,888,272	1.12
2	Rp 2,721,602,811	Rp 6,677,852,028	0.41
3	Rp 7,134,223,959	Rp 14,810,430,900	0.48
AVERAGE			0.67

Source: Researcher Analysis Data, 2023

Table 7. Calculation of Schedule Performance Index (SPI) for Each Week

MINGGU		BCWP		BCWS		SPI
1	Rp	-	Rp	-		0.00
2	Rp	27,238,384	Rp	21,510,307		1.27
3	Rp	230,999,485	Rp	191,680,064		1.21
4	Rp	414,998,772	Rp	368,888,272		1.12
5	Rp	518,705,864	Rp	1,533,744,744		0.34
6	Rp	777,543,579	Rp	2,466,525,148		0.32
7	Rp	1,270,581,380	Rp	3,542,227,953		0.36
8	Rp	1,469,827,394	Rp	4,895,672,202		0.30
9	Rp	2,721,602,811	Rp	6,677,852,028		0.41
10	Rp	3,459,990,953	Rp	8,867,126,080		0.39
11	Rp	4,250,925,049	Rp	12,097,553,551		0.35
12	Rp	5,195,247,034	Rp	14,823,854,315		0.35
13	Rp	7,134,223,959	Rp	14,810,430,900		0.48
14	Rp	8,946,376,486	Rp	14,970,167,126		0.60
15	Rp	12,443,197,872	Rp	15,236,394,170		0.82
16	Rp	14,538,179,963	Rp	15,757,768,908		0.92
RATA RATA						0.58

Source: Researcher Analysis Data, 2023

From the table above, it can be seen that the work in week 1 to week 4 of the project work is ahead of schedule. However, in the 5th week to the 16th week the work on the project began to experience delays.
The following is a description of the SPI value, where ;
SPI = 1 = project on time
SPI > 1 = faster project
SPI < 1 = project is late

3.1.6 Cost Performance Index (CPI)

CPI is a factor of cost efficiency that has been incurred can be shown by comparing the value of work that has been physically completed (EV) with the costs that have been incurred in the same period (AC)(Priyo & Indraga, 2015).

Table 8. Calculation of Cost Performance Index (CPI) for Each Month

MONTH	BCWP		ACWP		CPI
1	Rp	414,998,772	Rp	410,395,650	1.01
2	Rp	2,721,602,811	Rp	2,691,415,088	1.01
3	Rp	7,134,223,959	Rp	7,055,091,921	1.01
AVERAGE					**1.01**

Table 9. Calculation of *Cost Performance Index (CPI)* Every Week

WEEK	BCWP	ACWP	CPI
1	Rp -	Rp -	0.00
2	Rp 27,238,384	Rp 28,313,899	0.96
3	Rp 230,999,485	Rp 240,583,488	0.96
4	Rp 414,998,772	Rp 433,443,185	0.96
5	Rp 518,705,864	Rp 595,393,101	0.87
6	Rp 777,543,579	Rp 900,869,837	0.86
7	Rp 1,270,581,380	Rp 1,447,692,778	0.88
8	Rp 1,469,827,394	Rp 1,714,611,004	0.86
9	Rp 2,721,602,811	Rp 3,055,495,413	0.89
10	Rp 3,459,990,953	Rp 3,903,347,257	0.89
11	Rp 4,250,925,049	Rp 4,855,802,726	0.88
12	Rp 5,195,247,034	Rp 5,936,439,750	0.88
13	Rp 7,134,223,959	Rp 7,874,745,504	0.91
14	Rp 8,946,376,486	Rp 9,694,884,842	0.92
15	Rp 12,443,197,872	Rp 13,205,017,581	0.94
16	Rp 14,538,179,963	Rp 15,326,068,408	0.95
AVERAGE			**0.85**

From the table above, it can be seen from week 2 to week 16 with a value below 1, which means that there is waste in the costs incurred during project implementation. The following is a description of the CPI value, where;
CPI = 1 = cost as planned
CPI > 1 = more cost-effective
CPI < 1 = more wasteful cost

3.1.7. Estiame to Complete (ETC)

ETC is the estimated cost for the remaining work up to week 31.
ETC = (BAC - EV)/CPI
= (64.319.272.651,95 - 14.538.179.963,02) / 0,85
= 58.582.374.814,66
So the costs incurred from week 17 to week 31 amounted to Rp. 58,582,374,814.66

3.1.8. Estiame at Complete (EAC)

EAC is the estimated cost until the end of the project.
EAC = ETC + AC
= 15.326.068.408,43 + 58.582.374.814,66
= 73.908.443.223,09
So the costs incurred until the project was completed amounted to Rp. 73,908,443,223.09

3.1.9. Time Estimate (TE)

TE is the estimated time to complete the project until completion.
TE = ATE + ((OD-(ATE x SPI)) / SPI)
= 16+((31-(16*0,58))/0,58)
= 53 weeks

4. CONCLUSION

Based on the results of the analysis carried out on the Surabaya Open University Distance Learning Program Unit Building Phase II project, the following conclusions can be drawn.

a) Based on the results of the analysis Earned Value Method (EVM) , the estimated cost incurred until the project is completed is Rp. 73,908,443,223.09 of Rp. 64,319,272,652.
b) Based on the results of the Earned Value Method (EVM) analysis, the estimated time required until the project is completed is 53 weeks from the planned 31 weeks.

5. ADVICE

The suggestions that can be conveyed are as follows:

a) To the contractor implementing the project Construction of the Surabaya Open University Distance Learning Program Unit Building Phase II in order to minimize the problems that occur during the implementation process so as to reduce costs and speed up work.
b) Future research needs to add structural work.
c) The results of this study are expected to provide useful information for parties involved in the implementation of construction projects to find out what are the causal factors that become obstacles in project implementation.

REFERENCES

Aditama, R. (2021). *Analisis Biaya Dan Waktu Menggunakan Metode Evm (Earned Value Method) Pada Proyek Konstruksi (Studi Kasus Pada Proyek Pembangunan Gedung Laundry Rsud Sidaorjo)*. Universitas 17 Agustus 1945 Surabaya.

Anwar, S., & Hayati, N. I. (2013). Analisis Pemakaian Metode Earned Value Sebagai Alat Pengendalian Proyek. *Astonjadro*, *2*(2), 19–28.

Aulia, P. S., Yogaswara, B., & Suwarsono, L. W. (2018). Analisis Kinerja Pengelolaan Proyek Pembangunan Kantor Bkd Kab. Karanganyar Dengan Menggunakan Earned Value Method. *Eproceedings Of Engineering*, *5*(3).

Hidayat, A. (2017). *Analisa Kinerja Biaya Dan Waktu Pada Pelaksanaan Proyek Konstruksi Dengan Metode Earned Value (Studi Kasus Proyek Konstruksi Mall Dan Hotel X Di Pekanbaru)*. Universitas Mercu Buana.

Johari, G. J., & Islami, N. N. (2021). Analisis Biaya Dan Waktu Menggunakan Metode Earned Value Concept Pada Proyek Mbe Well Hook Up. *Jurnal Konstruksi*, *19*(1),

325–335.
Lamato, F. I., Utiarahman, A., & Tuloli, M. Y. (2022). Analisis Earned Value Terhadap Proyek Pembangunan Renovasi Gedung Kantor Bpjn. *Jurnal Vokasi Sains Dan Teknologi*, *1*(2).
Mahapatni, I. A. P. S., Wirahaji, I. B., & Wijaya, I. M. H. (2019). Pengendalian Proyek Dengan Earned Value Method (Evm) Pada Proyek Pemeliharaan Jalan Provinsi Denpasar-Simpang Pesanggaran. *Widya Teknik*, *13*(02), 37–46.
Mareta, M. (N.D.). *Analisis Kinerja Biaya Dan Waktu Pelaksanaan Pembangunan My Tower Hotel &Amp; Apartment Project Menggunakan Metode Nilai Hasil (Earned Value)*.
Maromi, M. I., & Indryani, R. (2015). Metode Earned Value Untuk Analisa Kinerja Biaya Dan Waktu Pelaksanaan Pada Proyek Pembangunan Condotel De Vasa Surabaya. *Jurnal Teknik Its*, *4*(1), D54–D59.
Maulidi, N., Huda, M., & Tjendani, H. T. (N.D.). *Analisis Biaya Dan Waktu Pada Pembangunan Gedung Trauma Center Dan Intensive Care Tahap Iv Rsud Dr. Soedono Madiun Dengan Metode Earned Value*.
Nisrina, S., & Hisjam, M. (2022). Earned Value Method Untuk Analisis Pengendalian Jadwal Dan Biaya Pada Sebuah Proyek Konstruksi Pump House. *Jurnal Teknik Industri: Jurnal Hasil Penelitian Dan Karya Ilmiah Dalam Bidang Teknik Industri*, *8*(1), 71–84.
Priyo, M., & Indraga, K. F. (2015). Analisis Kinerja Biaya Dan Jadwal Terpadu Dengan Konsep Earned Value Method (Studi Kasus: Proyek Pembangunan Gedung). *Semesta Teknika*, *18*(2), 106–121.
Rahmanto, T., & Janizar, S. (2022). Pengendalian Biaya Dan Waktu Dengan Metode Earned Value Proyek Familia Urban Bekasi. *Jurnal Teknik Sipil Cendekia (Jtsc)*, *3*(2), 331–342.
Sakinah, K. N. (2021). Analisis Kinerja Biaya Dan Waktu Menggunakan Metode Earned Value Dan Earned Schedule Pada Proyek Pembangunan Villa Pasir Angin Puncak-Bogor. *Akselerasi: Jurnal Ilmiah Teknik Sipil*, *3*(1).
Saputra. (2019). *Analisa Nilai Hasil Biaya Menggunakan Metode Earned Value Pada Pembangunan Kolam Renang Paluabara Park Palu Sulawesi Tengah* [Universitas Muhammadiyah Jember]. Http://Repository.Unmuhjember.Ac.Id/Id/Eprint/3334
Yomelda, Y., & Utomo, C. (2015). Analisa Earned Value Pada Proyek Pembangunan Vimala Hills Villa & Resort Bogor. *Jurnal Teknik Its (Sinta: 4, If: 1.1815)*, *4*(1), D76–D81.

Copyrights