IJSSCS
International Journal of Social Science and Community Service
https://ijsscs.com/index.php/journal
Online ISSN 3047-5406

Performance Analysis on Road Implementation Project Based on Time and Cost

Agata Maria Orleans Alves[1], Hanie Teki Tjendani[2], Esti Wulandari[3]*

[1-3] Master of Civil Engineering Study Program, Universitas 17 Agustus 1945 Surabaya, Indonesia

E-mail: [1)] alvesagata2712@gmail.com , [2)] hanie@untag-sby.ac.id , [3)] wulandariesti@untag-sby.ac.id

ARTICLE INFO

Article History
Received : 17.01.2024
Revised : 30.01.2024
Accepted : 20.02.2024
Article Type: Research Article

*Coresponding author:
Agata Maria Orleans Alves
alvesagata2712@gmail.com

ABSTRACT

Effective time management is essential for ensuring project implementation aligns with the planned schedule, and one way to achieve this is through the use of Earned Value Analysis (EVA). EVA is employed to estimate the extent to which a project is progressing according to its work plan. This research aims to analyze the timeline of a road construction project using the Earned Value Analysis Method to estimate the final project completion time on a monthly basis. The methodology employed in this study involves the application of the Earned Value Method over a project duration of 18 months. The importance of the Earned Value Analysis Method lies in its ability to assist both the project owner and implementer in more easily analyzing the project's performance, thereby providing significant benefits for both parties. The study found that the project completion time did not align with the initial project schedule. Specifically, the calculation of the cumulative project completion time was 9 months, whereas the planned duration was 18 months. This indicates a delay of 7 months beyond the planned schedule.

Keywords: Time, Rate of Return, Road Implementation Project

1. Introduction

Law of the Republic of Indonesia Number 38 of 2004 states that a road is a transportation infrastructure that includes all parts of the road including complementary buildings and equipment intended for traffic, which is above the surface of the ground, below the surface of the ground and / or water, and above the surface of the water, except railways, lorries and cable roads. Roads have an important role, especially regarding the realization of balanced inter-regional development, equitable distribution of development results and strengthening of national defense and security in the context of realizing national development.

Based on Government Regulation Number 34 of 2006 concerning Roads, it is explained that the implementation of a conceptual and comprehensive road needs to see roads as a unified road network system that binds and connects centers of activity. In this connection, the primary road network system and the secondary road network system are known. In each road network system, roads are grouped according to function, status, and road class. The grouping of roads by status gives the Government the authority to organize roads that have national services and local governments to organize roads in their areas in accordance with the principles of regional autonomy.

Project implementation is part of the implementation and procurement of a building or infrastructure work, where the definition of the project in question is: Has goals and objectives, Limited by time, cost and resources, Something unique and non-repeated events, Completion in accordance with performance requirements and specifications designed to meet customer needs, Measurable and quantifiable results and activities planned, implemented and controlled.

Projects are defined as a unique set of activities that are limited to a certain duration, starting and ending at a certain time with the aim of producing a specific product. Meanwhile, management is the utilization of knowledge, skills and resources to achieve a certain goal. In simple terms, project management can be defined as the utilization of science and resources to achieve project goals. In project implementation, management plays an important role as a flow and control to achieve these main objectives.

Poor management risks causing project failure. In particular, project failure is caused by several things such as failure of the contractor to complete the work (project), failure of project financing by the owner, force majeure (natural disasters, pandemics), fire and so on. From these examples, it can be analyzed that apart from disasters (force majeure), the main cause of project failure is the unsynchronization of plans with implementation. It can be concluded that a good and successful project is a project with good management and the failure of a project is the failure of project management itself.

Along with the development of the industrial world, and the rapid development of transportation facilities, especially roads, the level of difficulty to manage and run a highway project is getting higher. The higher the level of difficulty, the longer the duration of time required to complete the project. Therefore, time management is needed, which in addition to sharpening priorities, also seeks to increase the efficiency and effectiveness of project management in order to achieve maximum results from available resources. All of this is to achieve the goal of a highway project, namely success that meets the criteria of time (schedule), as well as cost (budget) and quality (quality).

Cost management is a system designed to provide management with information for identifying opportunities for improvement, strategic planning, and making operational decisions regarding the procurement and use of resources required by the organization. The cost management system consists of all the tools, techniques, and methods that together form a cost management system. An integrated cost management system shows interrelationships with other system elements, namely: design and development systems, purchasing and production systems, customer service systems, and distribution and marketing systems.

Time management is very important in a project implementation to prevent project delay due to various reasons that may occur during implementation. Management from planning to the final stage of construction. Project time management is the activities required to ensure the time or duration for project completion. The activities carried out can be divided into 2 (two) parts, namely planning and controlling project time. The goal of management in civil engineering is the achievement of several objectives known as secondary objectives and constraints. The constraints seen in civil projects are usually related to performance, implementation time, cost constraints, quality of work and safety.

Timor Leste is a new country in the process of development with inadequate facilities and infrastructure, especially in the city of Baucau and is currently in the process of development since declaring its independence in 2002. Since then the government has promoted physical and non-physical development programs, physical infrastructure development and non-physical human resources. The physical development program is the responsibility of the Ministry of Public Works (MOP/Ministerio das Obras Publicas), with infrastructure being rebuilt from scratch after being destroyed in the 1999 riots. Infrastructure development was phased in according to urgency. From 2002 to 2011 infrastructure development was built according to what was called "what the people need now", there was no clear long-term or short-term plan. It was only in 2011 that the government published a plan or program entitled National Development Plan 2011-2030, with the publication of this program the development program became more focused.

As a newly independent country, Timor-Leste faces many problems, one of which is infrastructure, including the development of roads. The problem encountered is that the roads used today, including city roads, are road implementation projects that were carried out in previous years. In the case study that the author took, Baucau city is still in the process of development in the field of construction. Limitations in logistics and resources make roads in Baucau city still relatively undeveloped. In a construction project that is being carried out, it is constrained by the delivery of construction logistics materials which causes delays in the project implementation schedule and inflates the previously planned cost budget. Problems can arise if there is a discrepancy between the planned schedule that has been made and its implementation.

To reduce these problems, the importance of a method or technique that can reveal all the data needed for the control process is emphasized. This means that there must be a unified relationship in analyzing the progress of work with the amount of cost and time that has been used for it so that estimates or projections of funding needs can be made until the end of project implementation based on certain assumptions. In this case the author tries to analyze the time and cost management required in a road implementation project in Baucau city using the Earned Value Analysis (EVA) method (Dharmawan et al., 2023). The earned value concept method is one of the methods/techniques that can reveal all the data needed for the time and cost control process (Nono et al., 2019). It is hoped that this will reduce project cost overruns, and will ultimately benefit the contractors/consultants responsible for project implementation.

Based on the current problem the author took, the Road Implementation Project in Uaiaca - Qulecai to Ossu Baucau city, Timor Leste. In the implementation of the project there are many changes or problems that arise that affect the schedule of the plan made with its implementation. These problems are such as in the General Item, namely Mobilization where in the existing sub-items such as Facility Enginering which in the planning is not included in the workmanship system (room / supervise consultant office) but and in the implementation needs to be done, then there is also a problem where changes in the drawings that in the planning there are no complementary buildings such as retaining walls, channels and others but in the implementation there are, and also affect the housing of local residents.

So it is necessary to do land acquisition and a little time between 2-4 months because and from these problems, it is necessary to have a variation order that needs to be resolved, but the owner considers it a technical problem given relief for project implementers (supervision consultants) while completing the vo process but the work continues in the implementation process. From the previous schedule, the work will begin in February 2023 but due to the many problems and obstacles, the implementation process must begin in the third month after the release period.

To reduce these problems, the importance of work management is emphasized to overcome any problems that exist in the road implementation project so that it can be completed on time according to the pre-planned time and cost (Cahyono et al., 2022). So the author took the title: "Time and Cost Management Analysis with Earned Value Method on Road Implementation Project in Uaiaca - Quelecai to Ossu, Baucau City, Timor Leste" (Sari et al., 2021; Wicaksono, 2021). A technical method that can reveal all the data needed for the control process. This means that there must be a unified relationship in analyzing the progress of work with the amount of cost and time that has been used for it so that estimates or projections of funding needs can be made until the end of project implementation based on certain assumptions. In this case the author tries to analyze the time and cost management required in a project in Baucau city using (Ayatullah et al., 2023).

The Value for Money method can reveal whether the progress of project work is worth the expenditure of its budget share (Pabalik et al., 2018). By analyzing the concept of Earned Value, it can be seen the relationship between what has actually been achieved physically against the amount of budget that has been spent (Anjani et al., 2023). Based on this cost and time performance, a project manager can identify the performance of the overall project as well as the work packages within it and then predict the cost and time performance of the project completion. It is expected that this will reduce project cost overruns, and will ultimately provide its own benefits for the contractor as the person responsible for project implementation (Alfathan, 2021).

The contract implementation period is effective from the date specified in the special conditions of the contract and the completion of the entire work is for 18 calendar months. With a maintenance period of 365 calendar days (1 year). At this time, the project work has stepped on the 8th month with a progress of 29.26%, and is still running according to the schedule set at the beginning of the work. The expected result obtained in this study is a solution on how to reduce the cost of expenditure for the construction of highway projects using the method chosen by the author. And affect the schedule that has been planned by both parties that have been approved since the contract was issued.

2. Methodology

2.1. Research Subject

Research subjects are individuals or objects that are used as sources of information needed in data collection in a study. The subject in this research is Time Management Analysis on Road Implementation Project using Earned Value Concept (Gerung et al., 2016). This research focuses on time management.

2.2. Object of Research

The object used in this research is the Road Implementation Project in Uaiaca - Quelecai to Ossu Baucau city, Timor Leste.

2.3. Research Location

The research location is in Uaiaca - Quelecai to Ossu, Baucau city, Timor Leste. The researcher took the research location because Baucau is one of the cities that is in the face of development, especially in the field of roads, so the researcher wants to find information about how the current project implementation process is running.

2.4. Time & Place of Research

This research time was carried out from the date of issuance of the research permit in approximately 2 (one) month, 1 month of data collection and 1 month of data processing which includes presentation in the form of a thesis and the guidance process takes place.

2.5. Data Collection Technique

Data collection techniques are the methods used to obtain data. The data is obtained from the supervisory consultants and field staff who supervise the implementation of the highway project. The data required include:

a. Construction Work Agreement Letter (Unit Price Contract)
b. Time Schedule
c. Project budget cost recapitulation
d. Project weekly/daily report

3. Results and Discussion

3.1. Actual Cost Of Work Performance (ACWP)

Actual Cost Of Work Performance (ACWP) is calculated from the sum of direct costs, indirect costs and taxes. Indirect costs for each month are obtained from the total indirect costs divided by the number of months.

13th month calculation :
Direct Costs : $ 25,461.00
Indirect Costs : $ 213,00
ACWP : Direct Cost + Indirect Cost
= $ 25,461.00+ $ 213,00
=$ 25,674.00

Table 1. Actual value of work performance (ACWP)

Month	Direct Costs	Indirect Costs	ACWP	ACWP Kom.
1	$47,344.22	$4,870.18	$52,214.40	$52,214.40
2	$47,344.22	$4,870.18	$52,214.40	$104,428.80
3	$47,344.22	$4,870.18	$52,214.40	$156,643.20
4	$47,344.22	$4,870.18	$52,214.40	$208,857.60
5	$47,344.22	$4,870.18	$52,214.40	$261,072.00
6	$25,461.00	$213.00	$25,674.00	$286,746.00
7	$25,461.00	$213.00	$25,674.00	$312,420.00

Month	Direct Costs	Indirect Costs	ACWP	ACWP Kom.
8	$25,461.00	$213.00	$25,674.00	$338,094.00
9	$25,461.00	$213.00	$25,674.00	$363,768.00
10	$25,461.00	$213.00	$25,674.00	$389,442.00
11	$25,461.00	$213.00	$25,674.00	$415,116.00
12	$25,461.00	$213.00	$25,674.00	$440,790.00
13	$25,461.00	$213.00	$25,674.00	$466,464.00

Source: Processed by Researchers, 2024

3.2. Budget Cost Of Work Schedule (BCWS) or PV

The budget owned by the project according to the inventory calculated on a percentage basis against the total cost according to field data for 13 Months. BCWS is calculated using the formula Result Value = (% Plan) x (budget). An example of BCWS calculation in the 13th month is as follows:

% Weight Plan Month 13 = 35,09%
Project Contract Value = $452,122.00
So
BCWS = (% Plan) x (Budget)
= 35,09% x $ 452,122.00
= $158,649.61

Table 2. BCWS/PV Value

Month	% Plan	Contract Value	BCWS/PV	BCWS/PV Kom(S)
1	0.04%	$452,122.00	$180.85	$180.85
2	0.58%	$452,122.00	$2,622.31	$2,803.16
3	1.18%	$452,122.00	$5,335.04	$8,138.20
4	2.22%	$452,122.00	$10,037.11	$18,175.30
5	3.97%	$452,122.00	$17,949.24	$36,124.55
6	5.81%	$452,122.00	$26,268.29	$62,392.84
7	8.26%	$452,122.00	$37,345.28	$99,738.11
8	11.65%	$452,122.00	$52,672.21	$152,410.33
9	14.80%	$452,122.00	$66,914.06	$219,324.38
10	18.36%	$452,122.00	$83,009.60	$302,333.98
11	21.92%	$452,122.00	$99,105.14	$401,439.12
12	27.80%	$452,122.00	$125,689.92	$527,129.04
13	35.09%	$452,122.00	$158,649.61	$685,778.65
14	44.73%	$452,122.00	$202,234.17	$888,012.82
15	63.84%	$452,122.00	$288,634.68	$1,176,647.51
16	79.11%	$452,122.00	$357,673.71	$1,534,321.22
17	94.26%	$452,122.00	$426,170.20	$1,960,491.42
18	99.96%	$452,122.00	$451,941.15	$2,412,432.57
19	100.00%	$452,122.00	$452,122.00	$2,864,554.57

Source: Processed by Researchers, 2024

Notes:
Column (4) = Column (2) x Column (3)
Column (5) = Cumulative of column (4)

3.3. Budget Cost Of Work Performance (BCWP) or EV

The earned value is the budgeted cost of the work completed by the implementer. BCWP using the formula:

Result Value = (% Completion) x (Budget)
An example of BCWP calculation in Month 13 is as follows:
% Weight of 13th month implementation = 29.26%

Contract Value of the project = $ 452,122.00
So
BCWP = (% Completion) x (Budget)
= 29,26%x $ 452,122.00
= $132,290.90

Tabel 3. Nilai BCWP / EV

Month	% Project	Contract Value	BCWP / EV	BCWP / EV Kom($)
1	2	3	4	5
1	0.04%	$452,122.00	$180.85	$180.85
2	0.74%	$452,122.00	$3,345.70	$3,526.55
3	2.71%	$452,122.00	$12,252.51	$15,779.06
4	4.79%	$452,122.00	$21,656.64	$37,435.70
5	6.30%	$452,122.00	$28,483.69	$65,919.39
6	8.36%	$452,122.00	$37,797.40	$103,716.79
7	11.34%	$452,122.00	$51,270.63	$154,987.42
8	14.18%	$452,122.00	$64,110.90	$219,098.32
9	18.71%	$452,122.00	$84,592.03	$303,690.35
10	22.21%	$452,122.00	$100,416.30	$404,106.64
11	26.13%	$452,122.00	$118,139.48	$522,246.122
12	28.11%	$452,122.00	$127,091.49	$649,337.616
13	29.26%	$452,122.00	$132,290.90	$781,628.514
14	30.85%	$452,124.00	$139,480.25	$1,060,588.713

Source: Processed by Researchers, 2024

Description :
Column (4) = Column (2) x Column (3)
Column (5) = Cumulative of column (4)

3.4. Schedule Varians (SV)

Schedule Variance is the difference between the value of the project performance results (BCWP/EV) and the planned budget EV (BCWP) - (BCWS) PV. with the formula:

Schedule Varians (SV) = PV (BCWS) - EV (BCWP)

provided that if SV :
Negative (-) = Behind Schedule
Nol () = On Time
Positive (+) = ahead of schedule

Example of 13th month SV calculation:
13th month BCWS value = $158,649.61
BCWP value 13th month = $132,290.90
Schedule Varians (SV) = PV (BCWS) - EV (BCWP)
= $158,649.61 - $132,290.90
= -$26,358.71

Table 4. SV Value for Each Month

Month	PV/BCWS Kom.($)	EV/BCWP Kom.($)	SV($)
1	2	3	4
1	$ 180.85	$ 180.85	$ -
2	$ 2,622.31	$ 3,345.70	$ (723.40)
3	$ 5,335.04	$ 12,252.51	$ (6,917.47)
4	$ 10,037.11	$ 21,656.64	$ (11,619.54)
5	$ 17,949.24	$ 28,483.69	$ (10,534.44)
6	$ 26,268.29	$ 37,797.40	$ (11,529.11)
7	$ 37,345.28	$ 51,270.63	$ (13,925.36)
8	$ 52,672.21	$ 64,110.90	$ (11,438.69)

Month	PV/BCWS Kom.($)	EV/BCWP Kom.($)	SV($)
1	2	3	4
9	$ 66,914.06	$ 84,592.03	$ (17,677.97)
10	$ 83,009.60	$ 100,416.30	$ (17,406.70)
11	$ 99,105.14	$ 118,139.48	$ (19,034.34)
12	$ 125,689.92	$ 127,091.49	$ (1,401.58)
13	$ 158,649.61	$ 132,290.90	$ 26,358.71
14	$ 202,234.17	$ 139,479.95	$ 62,754.23
15	$ 288,634.68	$ 139,480.25	$ 149,154.43

Sumber : Olahan Data 2024

3.5. Schedule Performance Indeks (SPI)

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

Schedule performance index SPI $= \frac{EV(BCWP)}{PV(BCWS)}$

Example of 13th month SPI calculation

13th month EV(BCWP) value = $48,717,801.76
13th month PV(BCWS) value = $58,424,731.31

So :

SPI $= \frac{EV(BCWP)}{PV(BCWS)}$

SPI $= \frac{\$132,290.90}{\$158,649.61}$

SPI = 0,83

SPI value in the 13th month = 0.83 Based on the criteria that have been submitted, then in Month 13 the performance of project implementation is not good from planning, in the sense that the expenditure is greater than the budget or the schedule is less fast than the plan. The amount of SPI in each month based on the cumulative calculation of each month can be seen in table 5.

Table 5. Schedule Performance Index (SPI) Value

Month	BCWP / EV Kom($)	BCWS / PV Kumulatif ($)	SPI($)
1	2	3	4
1	$ 180.85	$ 180.85	1.00
2	$ 3,345.70	$ 2,622.31	1.28
3	$ 12,252.51	$ 5,335.04	2.30
4	$ 21,656.64	$ 10,037.11	2.16
5	$ 28,483.69	$ 17,949.24	1.59
6	$ 37,797.40	$ 26,268.29	1.44
7	$ 51,270.63	$ 37,345.28	1.37
8	$ 64,110.90	$ 52,672.21	1.22
9	$ 84,592.03	$ 66,914.06	1.26
10	$ 100,416.30	$ 83,009.60	1.21
11	$ 118,139.48	$ 99,105.14	1.19
12	$ 127,091.49	$ 125,689.92	1.01
13	$ 132,290.90	$ 158,649.61	0.83
14	$ 139,479.95	$ 202,234.17	0.69
15	$ 139,480.25	$ 288,634.68	0.48

Source: Processed Data 2024

Notes :
Column (4) = Column (2) / Column (3)

3.6. Estimate Temporar Schedule (ETS)

The estimated time for the remaining work is assumed to be the same as at the time of the evaluation. According to the project contract, the implementation of the Uaiaca - Quelecai to Ossu road in Baucau city, Timor Leste is 18 months.

The ETS calculation uses the following formula:

ETS = (Remaining Time)/SPI

An example of ETS calculation in the 13th month is:

13th month SPI value = 0,83
Project implementation plan time = 18 month
Finish Time = 13 month
Remaining time required = 18 month – 13 month = 5 month

So :

ETS = (Remaining Time)/SPI = (5)/0,83 = 6,00
Work time difference = Implementation plan time – (ETS + finish time)
= 18 month – (5 month + 6 month)
= 7 month

The conclusion that can be drawn from the performance results in month 13 is: if the project performance remains as it was during the implementation of month 13, the project will last for 5 months after month 13 or the project is delayed by 7 months The project manager (implementing consultant) can also find out the efficiency of resource use every month and also the efficiency of resource use every month in aggregate.

Table 6. Estimate Temporary Schedule (ETS) value for each month

Month	BCWP / EV Cum. ($)	BCWS / PV Cumulative ($)	SPI	Planned Time	Completion Time	Remaining Time	ETS (Months)
1	2	3	4	5	6	7	8
1	$ 180.85	$ 180.85	1.00	0.04%	0.04%	0.00%	0.00%
2	$ 3,345.70	$ 2,622.31	1.28	0.58%	0.74%	-0.16%	-0.13%
3	$ 12,252.51	$ 5,335.04	2.30	1.18%	2.71%	-1.53%	-0.67%
4	$ 21,656.64	$ 10,037.11	2.16	2.22%	4.79%	-2.57%	-1.19%
5	$ 28,483.69	$ 17,949.24	1.59	3.97%	6.30%	-2.33%	-1.47%
6	$ 37,797.40	$ 26,268.29	1.44	5.81%	8.36%	-2.55%	-1.77%
7	$ 51,270.63	$ 37,345.28	1.37	8.26%	11.34%	-3.08%	-2.24%
8	$ 64,110.90	$ 52,672.21	1.22	11.65%	14.18%	-2.53%	-2.08%
9	$ 84,592.03	$ 66,914.06	1.26	14.80%	18.71%	-3.91%	-3.09%
10	$ 100,416.30	$ 83,009.60	1.21	18.36%	22.21%	-3.85%	-3.18%
11	$ 118,139.48	$ 99,105.14	1.19	21.92%	26.13%	-4.21%	-3.53%
12	$ 127,091.49	$ 125,689.92	1.01	27.80%	28.11%	-0.31%	-0.31%
13	$ 132,290.90	$ 158,649.61	0.83	35.09%	29.26%	5.83%	6.99%
14	$ 139,479.95	$ 202,234.17	0.69	44.73%	30.85%	13.88%	20.12%
15	$ 139,480.25	$ 288,634.68	0.48	63.84%			
16	$ -	$ 357,673.71	0.00	79.11%			
17	$ -	$ 426,170.20	0.00	94.26%			
18	$ -	$ 451,941.15	0.00	99.96%			
19	$ -	$ 452,122.00	0.00	100.00%			

Source: Processed Data 2024

Explanation:

Column (4) = Column (2) / Column (3)
Column (6) = Column (5) - Column (6)
Column (8) = Column (7) / Column (4)

3.7. Estimate All Schedule (EAS)

The estimated total project completion time is calculated based on the time that has been completed summed up with the ETS results. Using the following formula:

EAS = Finish time + ETS

Suppose to calculate the total estimated completion time of the 13th month project is :

Finish time 13th month = 29,26
13th month ETS score = 6,00
Then : EAS = 29,26+ 6,00
= 6,29 (6 month)

In the 13th month, the estimated total time required to complete the project is 6 months starting from the first month of implementation, with the project performance index decreasing.

Table 7. Estimate All Schedule (EAS) value for each month

Month	SPI	Planned Time	Remaining Time	Completion Time	ETS (Months)	EAS (Months)	Time Difference
		1	2	3	4	5	6
1	1.00	0.04%	0.00%	0.04%	0.00%	0.04%	0.00%
2	1.28	0.58%	-0.16%	0.74%	-0.13%	0.61%	-0.03%
3	2.30	1.18%	-1.53%	2.71%	-0.67%	2.04%	-0.86%
4	2.16	2.22%	-2.57%	4.79%	-1.19%	3.60%	-1.38%
5	1.59	3.97%	-2.33%	6.30%	-1.47%	4.83%	-0.86%
6	1.44	5.81%	-2.55%	8.36%	-1.77%	6.59%	-0.78%
7	1.37	8.26%	-3.08%	11.34%	-2.24%	9.10%	-0.84%
8	1.22	11.65%	-2.53%	14.18%	-2.08%	12.10%	-0.45%
9	1.26	14.80%	-3.91%	18.71%	-3.09%	15.62%	-0.82%
10	1.21	18.36%	-3.85%	22.21%	-3.18%	19.03%	-0.67%
11	1.19	21.92%	-4.21%	26.13%	-3.53%	22.60%	-0.68%
12	1.01	27.80%	-0.31%	28.11%	-0.31%	27.80%	0.00%
13	0.83	35.09%	5.83%	29.26%	6.99%	36.25%	-1.16%
14	0.69	44.73%	13.88%	30.85%	20.12%	50.97%	-6.24%
15	0.48	63.84%	0.00%	0.00%	0.00%	0.00%	63.84%
16	0.00	79.11%	0.00%	0.00%	0.00%	0.00%	79.11%
17	0.00	94.26%	0.00%	0.00%	0.00%	0.00%	94.26%
18	0.00	99.96%	0.00%	0.00%	0.00%	0.00%	99.96%
19	0.00	100.00%	0.00%	0.00%	0.00%	0.00%	100.00%

Source: Processed Data 2024

Explanation:

Column (5) = Column (3) + Column (4)
Column (6) = Column (5) - Column (1)
Column (8) = Column (6) - Column (3)

The results of the analysis of the Road Implementation project in Uaiaca - Quelecai to Ossu, Baucau city, Timor Leste using Microsoft Excel, obtained indicators of the concept of the value of the results in Table 3.

3.8. Estimate All Completion (EAC)

Table 8. Indicators of the concept of cumulative outcome value

Month	BCWS / PV Kom($)	BCWP / EV Kom($)	SV($)	SPI($)	ETS(Bulan)	EAS (Month)
1	2	3	4	5	6	7
1	$ 180.85	$ 180.85	$ 1.00	1.00	0.00%	0.04%
2	$ 2,622.31	$ 3,526.55	$ 723.40	1.28	-0.13%	0.61%
3	$ 5,335.04	$ 15,779.06	$ 6,917.47	2.30	-0.67%	2.04%
4	$ 10,037.11	$ 37,435.70	$ 11,619.54	2.16	-1.19%	3.60%
5	$ 17,949.24	$ 65,919.39	$ 10,534.44	1.59	-1.47%	4.83%
6	$ 26,268.29	$ 103,716.79	$ 11,529.11	1.44	-1.77%	6.59%
7	$ 37,345.28	$ 154,987.42	$ 13,925.36	1.37	-2.24%	9.10%
8	$ 52,672.21	$ 219,098.32	$ 11,438.69	1.22	-2.08%	12.10%
9	$ 66,914.06	$ 303,690.35	$ 17,677.97	1.26	-3.09%	15.62%
10	$ 83,009.60	$ 404,106.64	$ 17,406.70	1.21	-3.18%	19.03%
11	$ 99,105.14	$ 522,246.12	$ 19,034.34	1.19	-3.53%	22.60%
12	$ 125,689.92	$ 649,337.62	$ 1,401.58	1.01	-0.31%	27.80%
13	$ 158,649.61	$ 781,628.51	$ (26,358.71)	0.83	6.99%	36.25%
14	$ 202,234.17	$ 921,108.46	$ (62,754.23)	0.69	20.12%	50.97%
15	$ 288,634.68	$ 1,060,588.71	$ (149,154.43)	0.48	0.00%	0.00%
16	$ 357,673.71	$ -	$ -	0.00	0.00%	0.00%
17	$ 426,170.20	$ -	$ -	0.00	0.00%	0.00%
18	$ 451,941.15	$ -	$ -	0.00	0.00%	0.00%
19	$ 452,122.00	$ -	$ -	0.00	0.00%	0.00%

Source: Processed Data 2024

Notes:

Column (5) = Column (3) / Column (2)
Column (7) = Column (6) - Column (3)

Table 9. All Completion Calculation (EAC)

Month	BAC	BCWP Kom.	ACWP Kom.	CPI	EAC
1	2	3	4	5	6
1	$ 452,122.00	$ 180.85	$ 52,214.40	0.00	$ 1,565.96
2	$ 452,122.00	$ 3,345.70	$ 52,214.40	0.06	$ 28,970.28
3	$ 452,122.00	$ 12,252.51	$ 52,214.40	0.23	$ 106,093.87
4	$ 452,122.00	$ 21,656.64	$ 52,214.40	0.41	$ 187,523.85
5	$ 452,122.00	$ 28,483.69	$ 52,214.40	0.55	$ 246,638.88
6	$ 452,122.00	$ 37,797.40	$ 25,674.00	1.47	$ 665,616.41
7	$ 452,122.00	$ 51,270.63	$ 25,674.00	2.00	$ 902,881.59
8	$ 452,122.00	$ 64,110.90	$ 25,674.00	2.50	$ 1,129,000.08
9	$ 452,122.00	$ 84,592.03	$ 25,674.00	3.29	$ 1,489,675.00
10	$ 452,122.00	$ 100,416.30	$ 25,674.00	3.91	$ 1,768,342.16
11	$ 452,122.00	$ 118,139.48	$ 25,674.00	4.60	$ 2,080,449.38
12	$ 452,122.00	$ 127,091.49	$ 25,674.00	4.95	$ 2,238,095.37
13	$ 452,122.00	$ 132,290.90	$ 25,674.00	5.15	$ 2,329,657.44
14	$ 452,122.00	$ 139,479.95	$ 25,674.00	5.43	$ 2,456,257.38
15	$ 452,122.00	$ 139,480.25	$ -	$ -	$ -
16	$ 452,122.00	$ -	$ -	$ -	$ -
17	$ 452,122.00	$ -	$ -	$ -	$ -
18	$ 452,122.00	$ -	$ -	$ -	$ -
19	$ 452,122.00	$ -	$ -	$ -	$ -

Source: Processed Data 2024

Example of 13th Month Calculation

= (BCWP Kom.)/(ACWP Kom.)
= 3,616.98/2,622.31
= 1,38

EAC = Total project cost x CPI

= $452,122.00 x 1.38
= $623,616.55

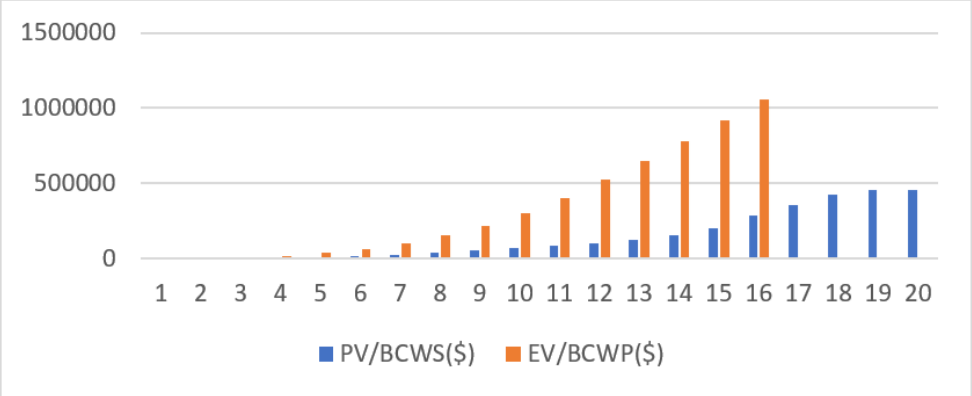
Comparison of Calculation Results on the Road Implementation Project in Uaiaca-Quelecai to Ossu Baucau city, Timor Leste with the benchmarks used are as follows:

a. Outcome Value Concept (Earned Value)

The results of the calculation of the Road Implementation Project in Uaiaca - Quelecai to Ossu Baucau city, Timor Leste obtained data used to determine the state of the project during project evaluation. The calculation of the Road Implementation Project in Uaiaca - Quelecai to Ossu, Baucau City, Timor Leste shows the time variance that occurs in the project, so that the result value concept method can monitor work, and show time deviations in the project that can be seen on the presentation curve so that it becomes an accurate proof tool (Permana, 2022). The results of the calculation of the indicators of the value of results concept can provide an early warning to the implementer to take corrective actions to be taken to prevent deviations until the project ends (Nufah et al., 2019; Winarto, 2021).

b. Variance Rate

The variance figure consists of cost variance and schedule variance, in this analysis using PV and EV indicators to determine schedule variance.



Source: Processed Data 2024

Figure 1. Comparison of PV and EV results

Description:

Vertical Axis : Value of PV and EV results ($)
Horizontall Axis : Duration of work (Months)

Figure 1. shows the comparison of PV and EV values. Months 4,5,6,7,8,9,10,11,12,13,14,15,16 show that the EV value is greater than PV. There is no EV & PV value that is the same in each month. This shows the difference in each month that the work is carried out in accordance with the planning weight for months 1 to 12 and even work that has not been done has been done first. However, in the 13th month and 14th month, the work is not in accordance with the plan, which means that it shows that the work items that should have been done according to the time schedule have been done on time, but in the remaining months the work has regressed, so it can be seen that the EV value is below PV, which is what causes delays in the work schedule.

c. Schedule Variant

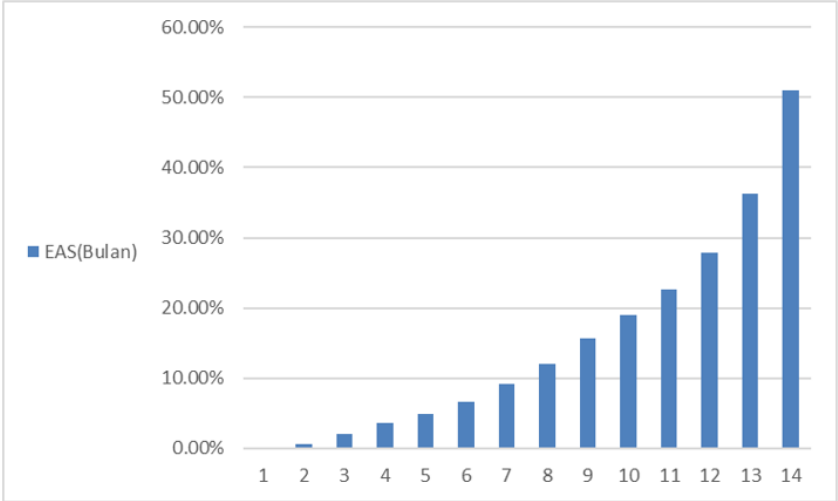
The results of the calculation of the schedule variance (SV) of the Road Implementation Project in Uaiaca - Quelecai to Ossu, Baucau city, Timor Leste are not always positive and the productivity index is not always worth 1 in each month, as seen in the 13th month:

Schedule Variance (SV) = -$26,358.71

Schedule Productivity Index (SPI) = 0,83

The SV value of month 13 is negative, and the SPI value of month 13 is delayed or the implementation time is longer than expected.

d. End-of-Time Projection Number



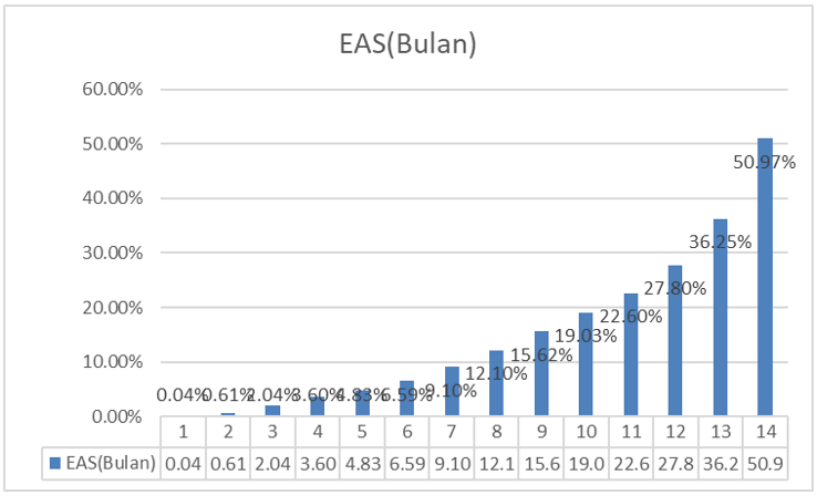
Source: Processed Data 2024

Figure 2. Histogram of Cumulative EAS by Month

Description:

Vertical Axis: Cumulative All Schedule Estimate Value ($)Axis
Horizontall Axis : Duration of work execution (Month)

The graph above is the result of the cumulative Estimate All Schedule (EAS) value generated using the Earned Value Analysis method.



Source: Processed Data 2024

Figure 3. EAS Histogram by Month

The graph above is the result of the Estimate All Schedule (EAS) value for each cumulative month generated using the Earned Value Analysis method.

Description:

Vertical Axis: All Complicated Estimate value per month ($)
Horizontal Axis: Duration of work execution (Month)

Estimated completion time of the 13th month EAS project on a cumulative basis.

The 13th month EAS value uses the formula:

Remaining time = 5 month

Finish time = 29,26

SPI = 0,83

ETS	= (Remaining Time)/SPI = 5/0,83 = 6 month
EAS	= finish time + ETS = 29,26% + 6 = 6,29 bulan
Time difference	= implementation plan time - EAS = 35,09 – 6,29 month = 2,21 (2 month)

e. Handling of Delays Incurred

From the results of the data analysis above, it was found that there were delays in the 3rd to 5th months. Possible handling to reduce the negative appearance of the delay is by increasing the number of workers or workers' working hours so that the productivity of work implementation increases. This may affect the cost of project implementation but the consultant has calculated the additional material costs before the project is run so that it does not have a labor impact on project financing.

4. Conclusion

The project schedule performance index (SPI) at the 13th month review of 0.83 indicates that the project is delayed. The project cost performance index (CPI) of 1.38 indicates that the project realization cost is less than budgeted. Monitoring of time and cost project performance should be carried out every day as a monitoring process, then a weekly or monthly report can be made as a recapitulation of the monitoring results that have been carried out. This is useful in order to facilitate the implementation of the project for the next if there are problems that occur based on the daily project report, so that monitoring of project performance time and cost will be carried out more effectively.

It is recommended to accelerate the progress of the work so that there is no delay, on the consultant's side it is necessary to add labor, because the completion of the work that has been delayed by 7 months, the cost lost by the owner is $205,483.12 from the contract value of the contract value of $452,122.00. And the final cost of the study period (which should have been if there was no delay) amounted to $246,638.88, so that the rest of the contract value caused the supervisory consultant to experience a profit of 45%. For future research, conduct a comparative study between the Earned Value method and other project management methods for time and cost management analysis on highway implementation projects. This research can provide insight into the advantages and disadvantages of each method and its applicability in the context of construction projects.

5. References

Alfathan, M. F. (2021). Penerapan Analisis Konsep Nilai Hasil di Proyek Pembangunan Sarana Prasarana Radar Pasif STT Natuna dengan menggunakan Program Primavera P6.

Anjani, A., Nugroho, M. W., Sundari, T., & Ramadhani, R. (2023). Analısıs Proyek Pembangunan Jembatan Pelabuhan Patımban Menggunakan Metode Earned Value. Jurnal Sıpıl Saıns, 13(2).

Ayatullah, M. A., Syafrudin, S., & Sarmingsih, A. (2023). Analisis Manajemen Waktu Pada Proyek Pembangunan Jalan Parang Garuda East Kawasan Industri Kendal. Jurnal Profesi Insinyur Indonesia, 1(3), 88–92.

Cahyono, B., Witjaksana, B., & Tjendani, H. T. (2022). Analısıs Manajemen Rısıko Pelaksanaan Proyek Pembangunan Jalan Tol Manado-Bıtung Seksı 2 STA 14+ 067–39+ 700. Senakama: Prosiding Seminar Nasional Karya Ilmiah Mahasiswa, 1(1), 57–66.

Dharmawan, R. D., Safarizki, H. A., & Firdausi, A. A. (2023). Evaluasi Efektivitas Keputusan Addendum Proyek Terhadap Waktu Pekerjaan Proyek Berbasis Earned Value Method. J@ Ti Undip: Jurnal Teknik Industri, 18(1), 51–61.

Gerung, J. O., Dundu, A. K. T., & Mangare, J. B. (2016). Analisa Penerapan Manajemen Waktu Pada Pembangunan Jaringan Daerah Irigasi Sangkup Kiri. Jurnal Sipil Statik, 4(7).

Nono, Y., Pratasis, P. A. K., & Malingkas, G. Y. (2019). Analisis Metode Nilai Hasil Terhadap Waktu Dan Biaya Pada Proyek Office and Distribution Center, Aırmadıdı, Mınahasa Utara-Manado. Jurnal Sipil Statik, 7(11).

Nufah, Y. W., Yanti, G., & Lubis, F. (2019). Analisis Proyek Dengan Metode Earned Value Concept (Studi Kasus Pada Proyek Pembangunan Jalan Tol Ruas Pekanbaru–Dumai Seksi 2 Sta. 9+ 500–33+ 600). Prosiding Seminar Nasional Cendekiawan, 1–59.

Pabalik, C. P., Walangitan, D. R. O., & Pratasis, P. A. K. (2018). Analisis Nilai Hasil Terhadap Waktu Pada Proyek Konstruksi.(Studi Kasus: Pembangunan Gedung Laboratorium Fakultas Teknik Universitas Sam Ratulangi). Jurnal Sipil Statik, 6(11).

Permana, A. P. (2022). Penerapan Analısıs Konsep Nılaı Hasıl Pada Proyek Pembangunan Gedung Dınas Perhubungan Surakarta Menggunakan Aplıkası Prımavera P6.

Sari, H. M., Hendriyani, I., & Widyaningrum, A. E. (2021). Earned Value Analysis pada Proyek Pembangunan Gedung Arsip Kantor BPN: Earned Value Analysis of BPN Office Archives Building Projects. Jurnal Ilmiah Teknik Sipil Transukma, 3(2), 154–167.

Wicaksono, R. M. B. (2021). Analisis kinerja biaya dan waktu menggunakan metode earned value pada Proyek Pembangunan Infrastruktur Laboratorium Tradisional Food GMP Facility (Paket 3). Akselerasi: Jurnal Ilmiah Teknik Sipil, 3(1).

Winarto, T. J. (2021). Analisis durasi proyek x dengan metode earned schedule. Jurnal Dimensi Pratama Teknik Sipil, 10(1), 82–89.