

Project Cost Performance Analysis Using the Earned Value Method on the Laga Collector's Highway Improvement Project – Bauguia, Timor-Leste

Laurenco Luis ^{1*}, Hanie Teki Tjendani ², Esti Wulandari ³

^{1,2,3}Magister Teknik Sipil, Fakultas Teknik Universitas 17 Agustus 1945 Surabaya

Correspondent author: lorensluis@yahoo.com

Abstract: In order to support Laga-Bauguia trade activities, the Ministry of Public Works (PU) is building a road network to the southern region. In its development, there is the development of the Laga-Bauguia Access Road which will be implemented from February 2023 to February 2025. This highway is one of the most important highways because it will connect the north coast area and cross the hills to the Matabian Mountains area which is visited by many tourists, local and foreign. This research aims to analyze the performance of the Laga - Bauguia Highway improvement project in terms of costs and analyze the estimated costs for the remaining work, as well as the cost of completing the Laga - Bauguia Highway improvement project. Every construction project requires control measures in terms of costs, where in carrying out control it is necessary to know in advance the ongoing project performance. One way to determine the cost performance of the project is the Earned Value method. This method can reveal whether the progress in implementing project work is commensurate with the use of part of the budget. By analyzing the concept of Earned Value, the relationship between what has actually been achieved physically and the amount of budget that has been spent can be seen. During the review period in the 8th month, a CPI value of 5.50 was obtained, which means that the actual costs incurred were less than the budget costs. In the 13th month, the CPI value was obtained at 5.50, which means the actual costs incurred were smaller than the budgeted costs.

Keywords: cost performance, earned value method, highways

INTRODUCTION

Infrastructure in Timor Leste is developing very rapidly, this is done with the aim of supporting economic progress in Timor Leste. Infrastructure consists of various types, one of which is transportation infrastructure. There are 3 types of transportation, including air transportation, land transportation, and sea transportation (Rani, 2017). Complex and interrelated work items make construction work difficult to manage, so that achieving planned weekly progress targets is sometimes difficult to implement (Adzhar, 2022). This causes the realization graph on the S curve to be below the plan graph. If this cumulative deviation between plan progress and realization is not carried out early, it will risk the cost of the construction work (Yousantho, 2019). Therefore, there is a method for controlling costs in order to determine future cost overruns, this method is the earned value method (Wicaksono, 2021; Sedyanto & Hidayat, 2017; Asnur, 2020).

In 2023, the Timor Leste government, through the Ministry of Public Works, Directorate of Roads, Bridges, Flood Prevention and Control, is building a Collector Highway connecting Laga District and Bauguia District, which is located in the East Baucau Municipal area. This highway is one of the most important highways because it will connect the northern coastal areas and cross the hills to the Matabian Mountains area which is visited by many local and foreign tourists. This road improvement project has been implemented from February 9 2023 to February 8 2025.

This project was carried out by the contractor PT. NORINCO INTERNATIONAL COOPERATION Ltd with a contract value of US\$. 21,695,194.98. The Laga - Baugua Highway Construction Project is a government project with funding sources from the APBN for the 2022 - 2023 fiscal year. At the start of its implementation, this project has shown actual progress that is the same as the planned progress, namely in the 3rd month of construction, the project has reached 6.164%, while the planned progress for that month was also 6.164%. Until February 2024, the actual project progress has only reached 20.794%, while the planned progress is 29.110%.

The Earned Value method combines cost, schedule and work performance. Earned Value measures the amount of work that has been completed at one time and is assessed based on the amount of budget provided for the work. This method can reveal whether the progress in implementing project work is commensurate with the use of the budget. By analyzing the concept of Earned Value, the relationship between what has actually been physically achieved and the amount of budget that has been spent can be seen (Sukmono, et al, 2021; Maregoudru & Kumar, 2017). Based on cost performance, a project manager can identify the overall performance of the project and the work packages within it and then predict the cost performance of project completion (Mirnayani & Armansyah. 2016; Maromi, dan Indryani, 2015). The results of the project performance evaluation can be used as an early warning if there are performance inefficiencies in project completion so that management policies and changes in implementation methods can be implemented so that cost overruns can be prevented (Kartikasari, 2014). The research objectives to be achieved are analyzing the performance of the Laga - Baugua Highway improvement project in terms of costs and analyzing the estimated costs for the remaining work, as well as the cost of completing the Laga - Baugua Highway improvement project.

METHODOLOGY

The subject of this research is to analyze the costs of the construction of the Laga–Baugua Collector Highway improvement project. The research subject will carry out calculations and analysis of project performance based on the earned value concept. Data collection for the subject of this research is secondary data collection obtained from the project. Data collection was carried out from March 2024 to April 2024. The object of this research was the Laga-Baugua Collector Highway improvement project.

The type of data collected must be oriented to the goals to be achieved or tested. However, what must be considered is the accuracy of the analysis technique. Where in this research the earned value management method is used. Research time in this sub-chapter explains the time the research was carried out including the research time span, description of each activity, data collection time, and data processing time. This research was conducted from March to April 2024.

The first step in analyzing project cost performance in this study is data collection. Data for this research were collected from project records, project financial reports, and direct observations in the field. Required data includes project budget, cost realization, project schedule, and other project performance-related information. Data collection was carried out systematically and structured. The data required includes RAB data, actual cost data incurred (Actual Cost), physical work progress data (Weekly Report) and planned time schedule data (Time Schedule). This research study uses quantitative research. The following is a flow diagram of the methodology used in carrying out this research:

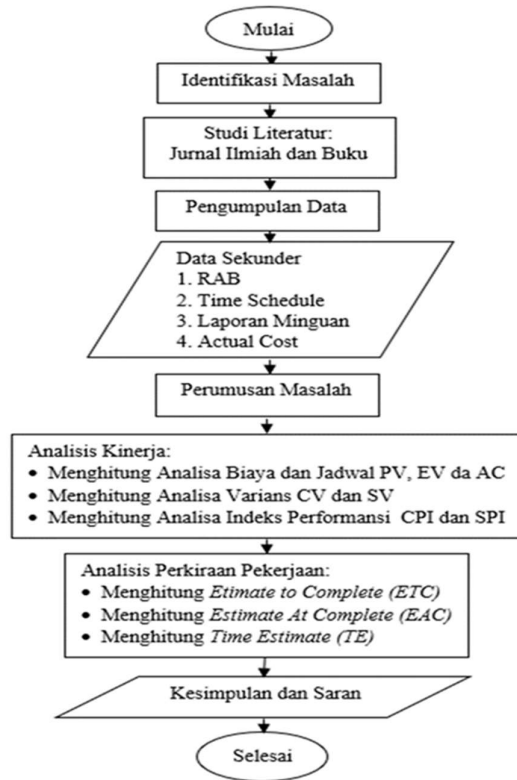


Figure 1. Flow diagram

RESULTS AND DISCUSSION

Calculation of Actual Cost (AC)

The Actual Cost (AC) calculation is obtained by adding up the direct costs and indirect costs up to the month under review. Table 1 shows a recapitulation of the actual cost (AC) calculation results for the 1st month to the 13th month.

Table 1. Monthly Actual Cost Recapitulation (AC) 1st - 13th

Month	Direct cost (\$)	Indirect costs (\$)	Cumulative AC
1	22.793,53	4.352,82	27.146,35
2	130.541,80	24.929,22	155.471,02
3	200.713,31	38.329,69	239.042,99
4	217.580,52	41.550,77	259.131,29
5	284.853,99	54.397,81	339.251,80
6	346.429,09	66.156,64	412.585,73
7	388.857,61	69.657,55	458.515,16
8	429.885,97	82.094,18	511.980,14

9	476.677,83	91.029,89	567.707,72
10	520.343,72	99.368,65	619.712,37
11	557.920,48	106.544,59	664.465,06
12	624.347,33	119.229,95	743.577,28
13	677.098,07	129.303,62	806.401,69

Calculation of Cost Variance (CV)

Calculation of Cost Variance (CV) for the 13th month is as follows:

$$\begin{aligned} \text{CV} &= \text{Earned Value (EV)} - \text{Actual Cost (AC)} \\ &= \text{US\$} 4.436.801,44 - \text{US\$} 806.401,69 \\ &= \text{US\$} 3.630.399,76 \end{aligned}$$

A positive Cost Variance (CV) value indicates the costs incurred are lower than the planned budget. The calculation for the next month can be done in the same way as the calculation above.

Calculation of Cost Performance Index (CPI)

Calculation of the Cost Performance Index (CPI) for the 13th month is as follows:

$$\begin{aligned} \text{CPI} &= \text{Earned Value (EV)} / \text{Actual Cost (AC)} \\ &= \text{US\$} 4.436.801,44 / \text{US\$} 806.401,69 \\ &= \text{US\$} 5,50 \end{aligned}$$

A CPI value greater than 1 indicates spending less than the budget. The calculation for the next month can be done in the same way as the calculation above. Table 2 shows a recapitulation of the results of calculating the Cost Performance Index (CPI) values in the 1st month to the 13th month.

Tabel 2. CPI values at month of 1st – 13th

Month	EV value	AC value	CPI value
1	149.358,52	27.146,35	5,50
2	855.397,57	155.471,02	5,50
3	1.315.208,43	239.042,99	5,50
4	1.425.733,73	259.131,29	5,50
5	1.866.554,73	339.251,80	5,50
6	2.270.036,10	412.585,73	5,50
7	2.548.056,31	458.515,16	5,56
8	2.816.901,64	511.980,14	5,50
9	3.123.513,34	567.707,72	5,50
10	3.409.641,58	619.712,37	5,50
11	3.655.869,77	664.465,06	5,50
12	4.091.143,16	743.577,28	5,50

13	4.436.801,44	806.401,69	5,50
----	--------------	------------	------

Calculation of Remaining Costs (Estimate to Complete)

Represents the estimated cost for the remaining work. Calculation of Estimate to Complete (ETC) for the 13th month with a Progress Value < 50% is as follows:

$$\begin{aligned}
 \text{ETC} &= \text{BAC} - \text{EV} \\
 &= \text{US\$} \ 21.336.931,06 - \text{US\$} \ 4.436.801,44 \\
 &= \text{US\$} \ 16.900.129,62
 \end{aligned}$$

Table 3 shows a recapitulation of the calculation results for the Estimate to Complete (ETC) value in the 1st month to the 13th month.

Table 3. ETC value in the 1st month to the 13th month

Month	BAC	EV Value	ETC Value
1	21.336.931,06	149.358,52	21.187.572,54
2	21.336.931,06	855.397,57	20.481.533,49
3	21.336.931,06	1.315.208,43	20.021.722,63
4	21.336.931,06	1.425.733,73	19.911.197,33
5	21.336.931,06	1.866.554,73	19.470.376,33
6	21.336.931,06	2.270.036,10	19.066.894,96
7	21.336.931,06	2.548.056,31	18.788.874,75
8	21.336.931,06	2.816.901,64	18.520.029,42
9	21.336.931,06	3.123.513,34	18.213.417,72
10	21.336.931,06	3.409.641,58	17.927.289,48
11	21.336.931,06	3.655.869,77	17.681.061,29
12	21.336.931,06	4.091.143,16	17.245.787,90
13	21.336.931,06	4.436.801,44	16.900.129,62

Calculation of Total Final Project Costs (Estimate at Complete)

It is the estimated total cost at the end of the project. Calculation of Estimate at Complete (EAC) for the 13th month is as follows:

$$\begin{aligned}
 \text{EAC} &= \text{ETC} + \text{AC} \\
 &= \text{US\$} \ 16.900.129,62 + \text{US\$} \ 806.401,69 \\
 &= \text{US\$} \ 17.706.531,30
 \end{aligned}$$

Tabel 4. Value of EAC at month of 1-13

Month	ETC Value	AC Value	EAC Value
1	21.187.572,54	27.146,35	21.214.718,89
2	20.481.533,49	155.471,02	20.637.004,51
3	20.021.722,63	239.042,99	20.260.765,62
4	19.911.197,33	259.131,29	20.170.328,62
5	19.470.376,33	339.251,80	19.809.628,13
6	19.066.894,96	412.585,73	19.479.480,69
7	18.788.874,75	458.515,16	19.247.389,92
8	18.520.029,42	511.980,14	19.032.009,56
9	18.213.417,72	567.707,72	18.781.125,44
10	17.927.289,48	619.712,37	18.547.001,84
11	17.681.061,29	664.465,06	18.345.526,36
12	17.245.787,90	743.577,28	17.989.365,18
13	16.900.129,62	806.401,69	17.706.531,30

CONCLUSION

From the results of the analysis, it was concluded that at the beginning of project implementation, namely the first month to the 7th month, the Cost Variance (CV) value was positive, indicating that the work was in accordance with costs where expenditure was less than the budget. After the project continues in the 8th month to the 13th month, the Cost Variance (CV) value is positive, then the expenditure costs are less than the budget

The combination of a high CPI value (5.5) shows that the project has very good performance in terms of costs. Although cost efficiency is excellent, additional efforts need to be made to accelerate the project to meet the desired schedule. Cost performance is critical in project management to achieve overall success. If conditions like this continue until the project is completed, then the cost of completing the project is US\$. 17,706,531.30.

REFERENCES

- Adzhar, Wan M.A.W and Keng, Tan Ching. (2022). *Construction Cost Control for Road Project in the Context of Malaysian Contractors. Journal of Architecture, Planning & Construction Management Volume 12 Issue 2.*
- Hafnindar A. Rani, S.T., M.M. (2017). *Manajemen Proyek Konstruksi.* Yogyakarta. Deepublish.
- Kartikasari, Dwi. (2014). *Pengendalian Biaya dan Waktu dengan Metode Earned Value (Studi Kasus: Proyek Struktur dan Arsitektur Production Hall-02 Pandaan).* *Jurnal Teknik Sipil Untag Surabaya* Desember 2014, Vol.7 No.2, hal. 107-114.
- Lulu, Laurensius. (2003). *Buku Ajar Rencana Anggaran Biaya (RAB).* Kupang.
- Maromi, M.Izeul dan Indryani, Retno. (2015). *Metode Earned Value untuk Analisa Kinerja Biaya dan Waktu Pelaksanaan pada Proyek Pembangunan Condotel De Vasa Surabaya.* *Jurnal Teknik ITS*

Vol. 4, No.1, (2015) ISSN: 2337-3539 (2301-9271 Print).

Maregoudru and Kumar. (2017). *Cost Analysis of Road Construction Project by Earned Value Analysis using Primavera P6*. *Internasional Research Journal of Engineering and Technology* (IRJET).

Mirnayani and Armansyah. (2016). Penerapan *Earned Value Method* Sebagai Alat Ukur Kinerja Biaya dan Jadwal Pada Proyek Apartemen Easton Park Serpong. *Rekayasa Sipil*, vol. 5, no. 1, pp. 8–16, 2016.

Nono, Yousantho. (2019). Analisis Metode Nilai Hasil Terhadap Waktu dan Biaya Pada Proyek *Office and Distribution Center*, Airmadidi, Minahasa Utara-Manado. *Jurnal Sipil Statik* Vol.7 No.11 November 2019 (1453-1476) ISSN: 2337-6732.

Pranata, Andi Asnur. (2020). Analisis Kinerja Biaya dan Waktu dengan Menggunakan Metode *Earned Value*. *UG Jurnal* Vol.14 Edisi 09 September 2020.

Sediyanto, S., & 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. *Jurnal Ilmu Teknik Dan Komputer*, 1(1), 36–51.

Sukmono, Zainuri dan Apriani. (2021). Pengendalian Biaya dan Waktu dengan Metode *Earned Value* (Studi Kasus: Rancang dan Bangun Sistem Penyediaan Air Minum Kota Dumai 450 LPD Tahap 1A). *Jurnal Rekayasa Konstruksi Mekanika Sipil (JRKMS)* Volume 04 Nomor 01 Mei 2021.

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). *Jurnal Ilmiah Teknik Sipil Volume 3*, No.1.



© 2024 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/3.0/>).