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Application of *Earned Value Method* for Analysing Cost and Time Performance in the Construction of the Bank Mandiri Flat in Pare-Pare, South Sulawesi

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Abstract: The Bank Mandiri Pare-Pare Sulawesi flat construction project is scheduled to be completed within 43 weeks with a contract value of Rp. 17,117,245,280. With time and cost constraints, good and thorough control is needed. The purpose of this study is to determine the cost and time performance at the end of the project completion. The method used in this study is the Earned Value method, which combines cost, time, and physical work performance elements. Data obtained from the project include the project schedule, Cost Estimate (RAB), weekly project reports, and actual costs. An analysis of costs, schedules, variances, and performance indices was conducted, highlighting issues that arose during the study. The Project Schedule Performance Index (SPI) at the 39th week review was 1.076, indicating that the project was ahead of schedule. The Project Cost Performance Index (CPI) from week 30 to week 38 showed values below 1, indicating that project expenditures exceeded the budget due to suboptimal progress weighting, as purchased materials were still in transit to the project site and had not yet been counted as progress by the owner. while in week 39, the index began to rise above 1 because progress weighting has become optimal, as the ordered goods have arrived and are now being accounted for in progress.
Keywords: Earned Value, Cost and Time Performance

INTRODUCTION

Infrastructure development and construction projects in Indonesia are on the rise, particularly in the banking sector, one of which is Bank Mandiri, located in the city of Parepare, Sulawesi. With the growth of business and increased banking activity in Sulawesi, particularly in the city of Parepare, the need for adequate housing for employees in the area has begun to emerge. Additionally, Parepare, which is a port city in South Sulawesi, holds strategic importance for economic and banking activities. Bank Mandiri directly requires employees in this area to provide permanent housing support for staff, ensuring stable living conditions, reducing accommodation costs, and creating a better work environment.

The Parepare flat construction project is scheduled to be completed within 43 weeks with a contract value of Rp. 17,117,245,280. Given the time and cost constraints, effective and well-planned control is essential. For large-scale projects, the interdependence between tasks is highly complex, making control challenging. In project implementation, it is rare to find a project that proceeds exactly as planned. Typically,

delays occur in terms of time, cost, or progress. Therefore, a control method is needed to ensure the project proceeds according to plan. This study aims to determine project performance based on cost and time, estimate the final cost and time of the project, and identify the factors influencing delays or progress in the project.

RESEARCH METHODS

This is a quantitative research with descriptive analysis based on measurable data. This research uses the earned value method or earned value concept.

The research location is in Pare-Pare, South Sulawesi, with a project value of Rp. 17,117,245,280. The type of research used is quantitative with descriptive analysis. In this study, the earned value concept method is used to analyze performance and estimates of time and costs in the project in order to determine the extent of deviation in the Bank Mandiri Pare-Pare flat project. The secondary data required are:

1. RAB (Budget Plan)
2. Time Schedule
3. Weekly or Monthly Reports
4. Expenditure Reports

Based on the data obtained, the analysis was conducted systematically in accordance with the theoretical framework from previous studies. The research process began with a literature review followed by data collection.

RESULTS AND DISCUSSION

A. Project General Data

Project Name : Construction of Bank Mandiri Flats in Pare-Pare, Sulawesi
Project Location : JL. Habibie Pare-Pare
Project Owner : PT. Bank Mandiri, Tbk
Contractor : PT. Karutama Selaras
Contract Value : Rp. 17,117,245,280.,- (Exclude- VAT)
Implementation Period : June 25, 2024 to April 20, 2025 (43 weeks)
Building Area : 1850 m2
Number of Floors : 4 Floors

B. Project Schedule

Project schedule / time schedule The construction project for the Bank Mandiri Pare-Pare apartment complex will be carried out from June 25, 2024, to April 20, 2025. For this study, the review was conducted over one review period. As shown in Table 1, there is an increase in the Planned Value (PV) each week, indicating that the project's weekly budget expenditures are increasing. The first review period was conducted in January 2025 (Week 30 to Week 39).

C. *Planned Value* (PV) Calculation

PV can be calculated by multiplying the cumulative percentage of weekly planned progress by the BAC value.

The cumulative percentage of planned work progress is obtained from the S-curve graph, which contains a description of the work, the percentage of the work weight, and the percentage of planned progress.

The Budget At Completion (BAC) value is the total contract value after deducting value-added tax (VAT). The Budget At Completion (BAC) value is obtained from the summary of the budget cost plan (RAB). The calculation of Planned Value (PV) for week 39 is as follows:

PV = Cumulative planned weight x BAC
= 88.5833 % x Rp. 17,117,245,280,-
= Rp.15,163,020,738,-

For the calculation of the following week, it can be done in the same way as the calculation above. Table 1 below shows the results of *the Planned Value* (PV) calculation in the 30th week to the 39th week.

Table 1. *Planned Value* (PV) from week 30 to week 39

Week to -	% Cumulative Progress Plan	PV Value
30	45.768%	7,834,220,820
31	47.4529%	8,122,629,285
32	51.2944%	8,780,188,263
33	55.6053%	9,518,095,590
34	60.0517%	10,279,196,784
35	64.147%	10.980.199.330
36	69.4753%	11,892,257,510
37	74.9452%	12,828,553,710
38	81.4922%	13,949,219,758
39	88.5833%	15,163,020,738

From table 1, it can be seen that there is an increase in the *Planned Value* (PV) every week, meaning that the planned cost expenditure for each week of the project has increased.

D. Earned Value (EV) Calculation

Earned Value (EV) can be calculated by multiplying the cumulative percentage of progress realization by the total planned budget costs for a job (BAC).

percentage of realization progress is the cumulative project achievements that have been achieved in one week. The cumulative percentage of realization progress is obtained from the weekly progress report.

Budget At Completion (BAC) value is the total value of the contract after deducting value added tax (VAT). *Budget At* Completion (BAC) value is obtained from the recapitulation of the Cost Budget Plan (RAB).

EV calculation for week 39 is as follows:

EV = cumulative realized weight x BAC
= 95.315% x Rp. 17,117,245,280,-
= Rp. 16,315,302,339

For the calculation of the following week, it can be done in the same way as the calculation above. Table 2 shows the results of the calculation of *Earned Value* (EV) in the 30th week to the 39th week.

For the calculation of the following week, it can be done in the same way as the calculation above. Table 2 shows the results of the calculation of *Earned Value* (EV) in the 30th week to the 39th week.

Table 2. *Earned* Value (EV) from week 30 to week 39

Week To	% Cumulative Realization Progress	EV Value
30	48.0892%	8,231,546,317
31	50.7791%	8,691,983,097
32	53.1126%	9,091,414,016
33	55.639%	9,523,864,101
34	60.1227%	10,291,350,027
35	66.0464%	11,305,324,286
36	72.0156%	12,327,086,891
37	76.3723%	13,072,833,916
38	83.9622%	14,372,015,716
39	95.315%	16,315,302,338

From table 2, it can be seen that there is an increase in the *Earned Value* (EV) every week, meaning that the planned cost expenditure for each week of the project has increased.

E. *Actual Cost* (AC) Calculation

Actual Cost (AC) is the actual cost incurred to complete the work during a certain period. *Actual Cost* (AC) consists of:

1. Direct Cost
   a. Material Cost
      Material costs are obtained by multiplying the unit price of the material by the volume.
   b. Wage Cost
      Wage costs are obtained by multiplying the unit price of wages by the volume of work done.
   c. Tool Cost
      The cost of equipment is obtained from the equipment section by adding up the cost of purchased equipment and the cost of renting equipment.

Direct costs are obtained by adding up the costs of materials, wages and tools up to the review week.

Table 3 shows a recapitulation of the results of direct cost calculations for weeks 30 to 39.

Table 3. Recapitulation of Direct Costs from Week 30 to Week 39

Week To	Direct Costs
30	10,643,752,779

31	11,025,874,252
32	11,493,366,241
33	11.987.261.180
34	12,541,352,243
35	12,892,578,783
36	13,425,618,239
37	13,618,208,517
38	13,963,337,489
39	14,142,016,583

2. Indirect Cost

Indirect cost data was obtained from the project finance department. Table 4 shows a summary of the results of indirect cost calculations up to week 39.

Table 4. Recapitulation of Indirect Costs Weeks 30 - 39.

Week To	Indirect Costs
30	325,541,988
31	346,865,876
32	369.108.015
33	392,319,729
34	416,615,920
35	441,617,538
36	441,617,538
37	494.128.080
38	521,286,750
39	548,832,091

The calculation of *Actual Cost* (AC) is obtained by adding direct costs and indirect costs up to the review week. Table 5 shows a recapitulation of the results of the calculation of *Actual Cost* (AC) for weeks 30 to 39.

Table 5. Recapitulation of *Actual Cost* (AC) Week 30 – 39

Week To	*Actual Cost* (AC)
30	10,969,294,767
31	11,372,740,128
32	11,862,474,256
33	12,379,580,909
34	12,957,968,163
35	13,334,196,321
36	13,867,235,777

37	14,112,336,596
38	14,484,624,239
39	14,690,848,675

From table 5, it can be seen that there is an increase in *the Actual Cost* (AC) value every week, meaning that the project's weekly cost expenditure increases .

F. *Cost Variance* (CV) Calculation

The calculation of *Cost Variance* (CV) for week 39 is as follows:

CV = Earned Value (EV) – *Actual Cost* (AC)
= Rp. 16,315,302,338 – Rp. 14,690,848,675
= Rp. 1,624,453,664

The positive value *of Cost Variance* (CV) began to appear in week 39, indicating that the costs incurred were lower than the planned budget. While the negative value was found in week 30 to week 38, the weighting of progress in the field was not optimal because the goods had been purchased but were still in the delivery stage to the location so that the assessment from the owner or supervisory consultant was still limited to the weight according to the PO, the goods had not been installed. For the calculation of the following week, it can be done in the same way as the calculation above. Table 6 shows a recapitulation of the results of *the Cost Variance* (CV) calculation from week 30 to week 39.

Table 6. Recapitulation of Cost Variance (CV) Calculations from Week 30 to Week 39

Week To	*Cost Variance (CV)*
30	- 2,737,748,450
31	- 2,680,757,030
32	- 2,771,060,240
33	- 2,855,716,808
34	- 2,666,618,135
35	- 2,028,872,034
36	- 1,540,148,885
37	- 1,039,502,679
38	- 112,608,522
39	1,624,453,664

G. *Schedule Variance* (SV) Calculation

The calculation of *Schedule Variance* (SV) for week 39 is as follows:

SV = *Earned Value* (EV) - *Planned Value* (PV)
= Rp. 16,315,302,338- Rp. 15,163,020,738
= Rp. 1,152,281,601

Negative values indicate that the project implementation time is slower than the initial planning. The calculation for the following weeks can be done in the same way as the calculation above. Table 7 shows a recapitulation of the results of the Schedule Variance (SV) calculation for weeks 30 to 39.

Table 7. Recapitulation of *Schedule Variance* (SV) Calculations for weeks 30 to 39

Week To	Schedule Variance (SV)
30	397,325,497
31	569,353,813
32	311,225,754
33	5,768,512
34	12,153,244
35	325.124.957
36	434,829,382
37	244.280.207
38	422,795,958
39	1,152,281,601

H. Schedule Performance Index (SPI) Calculation

The calculation of *the Schedule Performance Index* (SPI) for the 63rd week is as follows:

SPI = *Earned Value* (EV) / *Planned Value* (PV)
= Rp. 16,315,302,338 / Rp. 15,163,020,738
= 1.076

SPI value more than 1 indicates that the implementation time is faster than the planned schedule. For the calculation of the next week can be done in the same way as the calculation above.

I. Cost Performance Index (CPI) Calculation

An example of calculating *the Cost Performance Index* (CPI) for week 39 is as follows:

CPI = *Earned Value* (EV) / *Actual Cost* (AC)
= Rp. 16,315,302,338 / Rp. 14,690,848,675
= Rp. 1.11

The CPI value in the 30th week to the 38th week shows results below <1 so that expenditure is greater than the budget because progress in the field has not been calculated with goods that are still in transit to the location , while in the 39th week it is greater than 1 indicating expenditure is less than the budget. The calculation for the following week can be done in the same way as the calculation above. Table 8 shows a recapitulation of the calculation results of *the Cost Performance Index* (CPI) and *Schedule Performance Index* (SPI) values in the 30th week to the 39th week.

Table 8. CPI and SPI Values Week 30 – 39

Week To	CPI Value	SPI Value
30	0.750	1,051
31	0.764	1,070

32	0.766	1,035
33	0.769	1,001
34	0.794	1,001
35	0.848	1,030
36	0.889	1,037
37	0.926	1,019
38	0.992	1,030
39	1,111	1,076

J. Project Cost and Completion Time Estimates (Week 30 to Week 39)

There are 3 Variants that will be analyzed to estimate the final cost of the project, namely *Estimate To Complete* (ETC), *Estimate At Completion* (EAC) and *Time Estimate* (TE).

- *Estimate To Complete (ETC)*

It is an estimate of the cost for the remaining work. Calculation of *Estimate To Complete* (ETC) for the 39th week with Progress Value > 50% as follows:

ETC = (BAC – EV)/ CPI
= (Rp. 15,163,020,738 – 16,315,302,338) / 1,111
= Rp. 722,096,480

- *Estimate at Complete (EAC)*

It is an estimate of the total cost at the end of the project. The calculation of *the Estimate At Complete* (EAC) for week 39 is as follows:

EAC = ETC + AC
= Rp. 722,096,480 + Rp. 14,690,848,674
= Rp. 15,412,945,155

- *Time Estimate (TE)*

It is the estimated time for project completion. An example of calculating *the Time Estimate* (TE) for the 67th week is as follows:

TE = ATE + ((OD-(ATE x SPI)) / SPI)
= 39 + ((43 – (39 x 1.076)) / 1.076)
= 43 Weeks

Table 9 shows a recapitulation of the calculation results of *Estimate To Complete* (ETC), *Estimate At Completion* (EAC) and *Time Estimate* (TE) in the 30th to 39th weeks.

Table 9. *Estimate To Complete* (ETC), *Estimate At Completion* (EAC) and *Time Estimate (TE)* values from week 60 to week 67

Week To	ETC	EAC	TE
30	11,841,013,508	22,810,308,276	43
31	11,023,757,896	22,396,498,024	43
32	10.472.102.202	22,334,576,459	43
33	9,870,245,488	22,249,826,397	43
34	8,594,570,500	21,552,538,663	43

35	6,854,937,865	20.189.134.186	43
36	5,388,641,807	19,255,877,584	43
37	4,366,007,772	18,478,344,368	43
38	2,766,739,159	17,251,363,398	43
39	722,096,481	15,412,945,155	43

From table 9 it can be seen that the estimated project completion time (TE) is 43 weeks. The time is in accordance with the expected plan duration.

K. Project Progress or Delay Factor Analysis (Week 30 to Week 39)

From the results of the project performance calculation, it shows that the project experienced an increase in spending from the plan. This is caused by several factors as follows:

a. The delay in progress weighting is due to the indented goods still being in the delivery stage to the project location so that the owner cannot yet assess the weight for the progress of realization in the field.
b. This work coincides with the Eid holiday so deliveries to the location are slow.

CONCLUSION

From the analysis results, the following conclusions were drawn:
The project schedule performance index (SPI) in the 39th week review was 1.076, indicating that the project was ahead of schedule. The Project Cost Performance Index (CPI) from week 30 to week 38 showed values below 1, indicating that project expenditures exceeded the budget due to suboptimal weighting of items. However, starting from week 39, the CPI began to rise above 1 because the weighting of progress had become optimal, as the ordered items had arrived and progress had begun

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