Earned Value Concept on Project: Delay Due Covid-19 Pandemic

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Keywords: Project Performance, Earned Value, Time Cost Trade Off.

Abstract: Earned value concept provides project performance cost and time estimates all project work. PIK Pulo Gadung Flats Project East Jakarta Project experienced a deviation -12.70% on the 441th day from 569 days due to the covid-19 pandemic. Resource delimitation, delimitation on the supply material, restrictions working time of government agency cause administrative management not optimal, workers who will to come Jakarta cause the arrival of workers not on time and others. The purpose research is to evaluation the performance PIK Pulo Gadung Flats Project Stage 2 Tower 3A East Jakarta Project with the earned value concept using Microsoft Project. The results estimated project time 666 days. The remaining duration to complete the remaining work is 225 days with a projected final cost of IDR 56,862,527,165.17. There are a deviation of (-IDR 6,166,888,821.53) compared to the initial cost of IDR 50,696,438,343.64. Alternative acceleration with time cost trade off method, work shifts, the project time becomes 656.7 days, cost of IDR 59,123,458,843.23. Addition of overtime hours, the project completion time 659.7 days, cost IDR 59,144,617,761.56. Recommended is work shift system because the completion time is 6 days faster than the addition overtime and cost required is more efficient IDR 1,862,634,002.74.

1 INTRODUCTION

Construction project of activity that takes a limited period of time, resources, to achieve results in the form of buildings or infrastructure (Messah, 2013). Deviation cost and time indicate poor project management. Earned value is one of the tools used in project management that integrates cost and time (Septian, 2019). The concept of earned value can analyze implementation performance and generate cost and time estimates for completion of all project work (Auzan, 2017).

The concept of earned value can be analyzed with Microsoft project applications. Accelerating the project completion time is an attempt to complete the project earlier than the completion time under normal circumstances. One method is to crash the program with the time cost trade off method. There are four factors that can be optimized to carry out acceleration in an activity, namely including increasing the amount of labor, scheduling overtime work, the use of heavy equipment and changes to construction methods in the field (Putri, 2018).

Silaosinan Bridge Construction project, Mentawai, the planned completion time is 39 weeks with a conctract value of 26, billion. In the 26th week there was a deviation in the weight of the work of 3,28%, with a deviation of costs of IDR 685.220.700,- and the estimated complation time being 42 weeks. By applying the concept of earned value, the project completion time is 39 weeks (according to the plan) and the cost deviation is IDR 113,771,442.60. Acceleration is carried out with overtime and additional work shifts (Atmaja, 2019).

PIK Pulo Gadung Flats Project Stage 2 Tower 3A East Jakarta Project consist of 16 floors, total planning cost IDR 50,696,438,344,64,- with duration 569 days. This project started on januari 13, 2020. Due to the rapidly spreading covid-19 pandemic in Jakarta, large-scale social restrictions (PSBB) had to be implemented, resulting in project implementation performance deviating by up to 12.70% in March 2021, the day 441th (63rd week of implementation)

This research aims to measure the performance PIK Pulo Gadung Flats Project Stage 2 Tower 3A East Jakarta Project with the concept of earned value using the Microsoft Project application. It can be known the duration and costs needed on the remaining work. The results of the earned value analysis are used as a reference to provide project acceleration solutions with the time cost trade off method with the addition of additional working

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hours (overtime) or the addition of shift work.modified.

2 METHOD

2.1 Object of Research

This research was conducted on PIK Pulogadung Flats Project Stage 2 Tower 3A East Jakarta Project.

Figure 1: PIK Pulogadung Flats Project Stage 2 Tower 3A East Jakarta Project (DKI Jakarta Public Housing and Residential Area Office).

2.2 Data

Data obtained from:
- Previous studies by researchers in the form of books, journals, final assignments, theses, blogspots.
- Project data in the form of cost budget plan, time schedule, weekly report obtained from project construction management consultants, PT.Yodya Karya.

2.3 Method

The methods used in this research, among others:
- The method used for project control is Earned Value Concept
- The method used to accelerate the project is Time Cost Trade Off by providing 2 kinds of alternatives, namely the addition of working hours (overtime) and the implementation of a work shift system.

2.4 Data Analysis

Stages of data analysis:
- Input data and compile schedules normal
- Input work breakdown structure
- Arrange the duration of each activity based on scheduling data of each work item.
- Determining predecessors.
- Input resource cost data.
- Earned value analysis:
  - Budgeted Cost of Work Schedule (BCWS)/ Planned Value (PV)

$$\text{BCWS} = \frac{Plan}{Overall} \times BAC \quad (1)$$

  - Budgeted Cost of Work Performance (BCWP)/ Earned Value (EV)

$$BCWP = \frac{Progress}{Overall} \times BAC \quad (2)$$

  - Actual Cost of Work Performance (ACWP)/ Actual Cost (AC)
  - Varians analysis: Cost Variance (CV) and Schedule Variance (SV)

$$\text{CV} = \text{BCWP} - \text{ACWP} \quad (3)$$

$$\text{SV} = \text{BCWP} - \text{BCWS} \quad (4)$$

  - Cost and schedule performance index: Cost Performance Index (CPI) and Schedule Performance Index (SPI)

$$\text{CPI} = \frac{BCWP}{BCWS} \quad (5)$$

$$SPI = \frac{BCWP}{ACWP} \quad (6)$$

- Project final cost estimate and schedule estimate
- Time cost trade off, solution of acceleration of project duration with the addition of shift work or overtime.

3 RESULT

3.1 Normal Schedule

Normal schedule can be seen in Figure 2.

	Ta Mc	Task Name	Duration	Start	Finish
1		**TOWER A3 - RUSUN PIK PULO GADUNG II**	**569 days**	**Mon 13/01/20**	**Tue 31/08/21**
2		**PEKERJAAN PERSIAPAN**	**126 days**	**Mon 13/01/20**	**Sun 17/05/20**
3		Perlengkapan K3	14 days	Mon 13/01/20	Sun 26/01/20
4		Pematangan Lahan	35 days	Mon 13/01/20	Sun 16/02/20
5		Bouwplank	42 days	Mon 17/02/20	Sun 29/03/20
6		Pagar Sementara Proyek	28 days	Mon 17/02/20	Sun 15/03/20

Figure 2: Normal schedule.

3.2 Tracking

After tracking the total duration increased to 666 days with a duration that has been carried out for 441 days, then the total duration of the remaining work is 225

days, there is a delay in the completion time of work for 97 days

3.3 Earned Value

Calculations of earned value with Microsoft project obtained:

- Budgeted Cost of Work Schedule (BCWS)/Planned Value (PV): IDR 49,855,815,324.20. The analysis can be seen in Figure 3.

	Ta Mc	Task Name	Duration	Start	Finish	BCWS
1		**TOWER A3 - RUSUN PIK PULO GADUNG II**	**666 days**	**Mon 13/01/20**	**Mon 06/12/21**	**Rp49.855.815.324,20**
2		**PEKERJAAN PERSIAPAN**	**203 days**	**Mon 13/01/20**	**Sun 16/08/20**	**Rp6.160.789.999,88**
3		Perlengkapan K3	14 days	Mon 17/02/20	Sun 01/03/20	Rp2.626.680.538,46
4	✓	Pematangan Lahan	35 days	Mon 24/02/20	Sun 29/03/20	Rp159.637.371,42
5		Bouwplank	42 days	Mon 13/01/20	Sun 10/05/20	Rp436.713.090,00
6	✓	Pagar Sementara Proyek	28 days	Mon 24/02/20	Sun 26/04/20	Rp757.339.000,00
7		Gudang Material	56 days	Mon 15/06/20	Sun 09/08/20	Rp975.260.000,00
8		Direksi Keet	56 days	Mon 09/03/20	Sun 16/08/20	Rp1.205.160.000,00
9	✓	**PEKERJAAN PONDASI**	**42 days**	**Mon 31/08/20**	**Sun 11/10/20**	**Rp5.628.060.631,60**

Figure 3: Budgeted cost of work schedule.

- Budgeted Cost of Work Performance (BCWP)/ Earned Value (EV): IDR 29,573,165,217.05. The analysis can be seen in Figure 4.

	Ta Mc	Task Name	Duration	Start	Finish	BCWP
1		**TOWER A3 - RUSUN PIK PULO GADUNG II**	**666 days**	**Mon 13/01/20**	**Mon 06/12/21**	**Rp29.573.165.217,05**
2		**PEKERJAAN PERSIAPAN**	**203 days**	**Mon 13/01/20**	**Sun 16/08/20**	**Rp6.160.789.999,88**
3		Perlengkapan K3	14 days	Mon 17/02/20	Sun 01/03/20	Rp2.626.680.538,46
4	✓	Pematangan Lahan	35 days	Mon 24/02/20	Sun 29/03/20	Rp159.637.371,42
5		Bouwplank	42 days	Mon 13/01/20	Sun 10/05/20	Rp436.713.090,00
6	✓	Pagar Sementara Proyek	28 days	Mon 24/02/20	Sun 26/04/20	Rp757.339.000,00
7		Gudang Material	56 days	Mon 15/06/20	Sun 09/08/20	Rp975.260.000,00
8		Direksi Keet	56 days	Mon 09/03/20	Sun 16/08/20	Rp1.205.160.000,00
9	✓	**PEKERJAAN PONDASI**	**42 days**	**Mon 31/08/20**	**Sun 11/10/20**	**Rp5.627.915.050,55**

Figure 4: Budgeted cost of work schedule.

- Actual Cost of Work Performance (ACWP)/Actual Cost (AC): IDR 33,170,040,819.23. The analysis can be seen in Figure 5.

	Ta Mc	Task Name	Duration	Start	Finish	ACWP
1		**TOWER A3 - RUSUN PIK PULO GADUNG II**	**666 days**	**Mon 13/01/20**	**Mon 06/12/21**	**Rp33.170.040.819,23**
2		**PEKERJAAN PERSIAPAN**	**203 days**	**Mon 13/01/20**	**Sun 16/08/20**	**Rp6.160.789.999,88**
3		Perlengkapan K3	14 days	Mon 17/02/20	Sun 01/03/20	Rp2.626.680.538,46
4	✓	Pematangan Lahan	35 days	Mon 24/02/20	Sun 29/03/20	Rp159.637.371,42
5		Bouwplank	42 days	Mon 13/01/20	Sun 10/05/20	Rp436.713.090,00
6	✓	Pagar Sementara Proyek	28 days	Mon 24/02/20	Sun 26/04/20	Rp757.339.000,00
7		Gudang Material	56 days	Mon 15/06/20	Sun 09/08/20	Rp975.260.000,00
8		Direksi Keet	56 days	Mon 09/03/20	Sun 16/08/20	Rp1.205.160.000,00
9	✓	**PEKERJAAN PONDASI**	**42 days**	**Mon 31/08/20**	**Sun 11/10/20**	**Rp4.893.283.772,00**

Figure 5: Actual cost of work performance.

- Variance analysis: CV value obtained (-IDR 3,596,875,602.18). This means that until the 63rd week there is a considerable cost deviation. From the variance schedule (SV), it was obtained that the project was late with cost overruns of (IDR 20,282,650,107,14). The full analysis can be found in Figure 6.

	Ta Mc	Task Name	Duration	Start	Finish	CV	SV
1		**TOWER A3 - RUSUN PIK PULO GADUNG II**	**666 days**	**Mon 13/01/20**	**Mon 06/12/21**	**-Rp3.596.875.602,18**	**-Rp20.282.650.107,14**
2		**PEKERJAAN PERSIAPAN**	**203 days**	**Mon 13/01/20**	**Sun 16/08/20**	**Rp0,00**	**Rp0,00**
3		Perlengkapan K3	14 days	Mon 17/02/20	Sun 01/03/20	Rp0,00	Rp0,00
4	✓	Pematangan Lahan	35 days	Mon 24/02/20	Sun 29/03/20	Rp0,00	Rp0,00
5		Bouwplank	42 days	Mon 13/01/20	Sun 10/05/20	Rp0,00	Rp0,00
6	✓	Pagar Sementara Proyek	28 days	Mon 24/02/20	Sun 26/04/20	Rp0,00	Rp0,00
7		Gudang Material	56 days	Mon 15/06/20	Sun 09/08/20	Rp0,00	Rp0,00
8		Direksi Keet	56 days	Mon 09/03/20	Sun 16/08/20	Rp0,00	Rp0,00
9	✓	**PEKERJAAN PONDASI**	**42 days**	**Mon 31/08/20**	**Sun 11/10/20**	**Rp734.631.278,55**	**-Rp145.581,05**

Figure 6: Cost variance and schedule varians.

- Cost and schedule performance index: results of the analysis obtained the value of cost performance index (CPI) 0.89, meaning that there has been a cost deviation. And the Schedule Performance Index (SPI) value was obtained 0.59 (late project).

3.4 Estimated Final Project Cost

The final projected cost of completion can be seen in Estimate All Cost (EAC) on Microsoft Project. From the results of the calculation of the EAC value of IDR 56,862,527,165,17. There was a difference of (-IDR 6,166.088,821.53), a fairly large cost overrun.

3.5 Time Cost Trade Off

In this stage the activities that will be accelerated are activities on t he critical task after tracking, namely the work of beams and slabs on the 6th – 16th floor. There are 2 alternative solutions used to determine the project completion time, including the addition of working hours (overtime) and the work shift system:

- working hours (overtime), the duration is reduced to 659.7 days at a cost of IDR 60,986,092,845.97.
- work shifts, the duration is reduced to 656.7 days at a cost of IDR 59,123,458,843.23.

The recapitulation of crashing results can be seen in Table 1.

Table 1: Recapitulation of result *crashing*.

Stage	*Tracking duration*	*Crashing duration*	*Cost* (IDR)
Normal	569		50.696.438.343,64
After *tracking*	666		59.144.617.761,56
Crashing the addition of working hours (overtime)	666	659,7	60.986.092.845,97
Crashing work shift system	666	656,7	59.123.458.843,23

Based on the results obtained above, the recommended acceleration alternative for this project is the implementation of a work shift system because the completion time is 6 days faster than the addition of working hours (overtime) and the cost required to complete the project is more efficient by IDR 1,862,634,002.74.

4 CONCLUSIONS

We PIK Pulo Gadung Flats Project Stage 2 Tower 3A East Jakarta Project on day 441 experienced a deviation of 12.70% (total duration of 569 days). The application of the result value with Microsoft project obtained an estimated project completion time of 666 days, a difference of 97 days compared to the original plan. The remaining duration to complete the remaining work amounted to 225 days with a projected final cost of IDR 56,862,527,165.17. There was an irregularity of (-IDR 6,166,088,821.53) compared to the initial cost of IDR 50,696,438,343.64. The best alternative solution is to accelerate the duration of the project by increasing the work shift of the project completion time to 656.7 days at a cost of IDR 59,123,458,843.23. While with the addition of overtime hours, the project completion time became 659.7 days at a cost of IDR 59,144,617,761.56.

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