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Analysis of Time Delays in The Implementation of The Construction of A Light Brick Factory in Lamongan Using The Earned Value Method

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Abstract. *Factory is an Industrial Building that processing raw material. This Light Weight Brick Factory Constructions will help the region to develop their economies further. In this case, the Lightweight Brick Factory Constructions have several problem that cause construction delays. This research was carried out because of delays in the lightweight brick factory construction project in Lamongan which was scheduled for completion in the 15th week with a contract value of IDR 1,835,474,186. in week 10 there was a delay of - 42.73%, week 11 there was a delay of - 42.66%, week 12 there was a delay of - 44.84%, week 13 there was a delay of - 48.08%, week 14 have a delay of -46.18%, and week 15 have a delay of -44.68% from the planned schedule. The results of the research analysis of the project Schedule Performance Index (SPI) at the 15th week of review were 0.55, indicating that the project was have a delays. These results show that the project was 11 weeks late out of the planned 16 weeks. The factor that made the project late in completion was the contractor or vendor because there were other problems that created a lack of cash flow*

Keywords: *Factory, Construction, SPI, Earned Value.*

1. INTRODUCTION

The existence of the factory is to grow the economy and create new jobs in the area, which will later have a mixed used center concept consisting of meeting room facilities, leadership rooms, staff rooms and other places. The development and use aspects are very important overall.

The large scope of work carried out (Mockler 1972) and the complexity of the problems found in the field, such as the construction of factories which require relatively large costs and a relatively long time, make the scheduling position very important in assisting project managers and other employers when setting time parameters for project activities. and the costs required at any time are a means of being able to coordinate effectively in project control. If so, it is important to pay attention to using the earned value method.

According to (Mockler 1972), Control involves a structured approach to establish benchmarks aligned with planned objectives, develop an information system, assess the execution against these benchmarks, and subsequently implement necessary corrective

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measures. This process ensures that all resources are utilized effectively and efficiently to meet the established goals.

The concept of earned value introduces a third dimension alongside actual costs and planned costs. This additional dimension represents the physical progress of work completed, referred to as earned value or percent complete (Fleming dan Koppelman 1994). By incorporating this third dimension, project managers can gain a clearer understanding of the performance outcomes achieved relative to the costs incurred.

Research conducted by (Marhaendra dan Qomariyah 2013), with the title "Analysis of Yield Value Against Time in Construction Projects (Case Study of the Eastparc Yogyakarta Hotel Construction Project)". The aim of this research is to find out how to apply EVA (Earned Value Analysis) in estimating the final project completion time for each week.

Research conducted by (Taufan, Paryati, dan Yulius 2018), with the title "Evaluation of the Work Implementation of the Building Rehabilitation Project for the Department of Population and Civil Registry and Bappeda of Bekasi City". This research aims to evaluate a project to identify and anticipate delays in project progress. To evaluate the performance of a project and ensure it aligns with the planned targets, the Earned Value Method (EVM) is employed, utilizing key indicators such as the Actual Cost of Work Performed (ACWP), Budgeted Cost of Work Performed (BCWP), and Budgeted Cost of Work Scheduled (BCWS). Based on the EVM calculations, the ACWP amounted to IDR 430,164,472, representing the actual costs incurred by the 15th week, accompanied by a delay of -22.385%. The BCWP for implementation costs up to the 15th week was IDR 452,804,707, while the BCWS indicated that achieving 36.478% progress by the 15th week would require a budget of IDR 1,172,029,385. Consequently, this study concluded that the project faced a delay of -22.385% by the 15th week and was projected to incur a financial loss of IDR 946,370,216.

2. METHODS

2.1 Cost/Schedule Control System Criteria

The Earned Value concept is also known as C/SCSC (Cost/Schedule Control System Criteria). In the earned value concept, several parameters are known to control project costs, including:

1. **BCWS (Budgeted Cost Work Schedule)**

   BCWS represents the planned budgeted cost based on the project implementation schedule. It serves as a benchmark for evaluating the time performance of project execution. BCWS

reflects the cumulative planned cost absorption for each work package in sequence according to the scheduled plan.

2. **BCWP (Budgeted Cost for Work Performed)**

   BCWP represents the value earned from the completion of work within a specific time period, often referred to as earned value. It is calculated based on the cumulative amount of completed work. The primary challenge in calculating BCWP lies in estimating the progress of work that has been initiated but remains incomplete within the reporting period.

3. **ACWP (Actual Cost of Work Performed)**

   ACWP refers to the total expenditure incurred for completing work within a given time period. It may represent either the cumulative cost up to the performance calculation date or the expenses incurred during a specific reporting period.

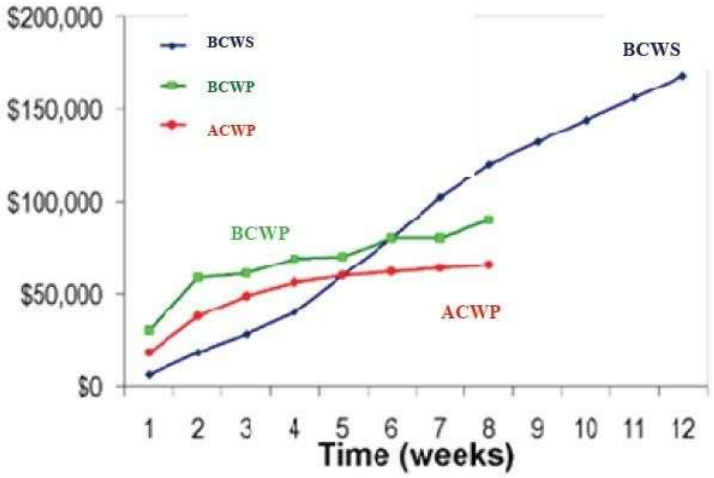

Fig. 1 BCWP, BCWS, and ACWP Graphics

2.2 Earned Value Concept

Schedule Variance (SV) refers to the difference between the actual progress of work and the planned progress within a specific time frame, indicating the status of work progress during that period.

$$SV = BCWP - BCWS \quad (1)$$

SV with a positive value signifies that more project work packages have been completed than initially planned. Conversely, a negative value indicates subpar performance, as fewer work packages were completed than scheduled.

Schedule Performance Index (SPI) is a measure used to evaluate actual progress against the planned goals within a given time frame. It gauges the efficiency of task completion by comparing the value of the work that has been physically completed (BCWP) to the planned costs as outlined in the project schedule (BCWS).

$$SPI = BCWP / BCWS \quad (2)$$

SPI value reflects the proportion of work completed compared to the total work planned for the project. A value below 1 suggests underperformance, indicating that progress is lagging behind the established goals. By assessing the SPI, it is also possible to estimate the Estimated Temporary Schedule (ETS) and the Estimated At Schedule (EAS).

$$ETS = (Time\ Remaining) / SPI \quad (3)$$

$$EAS = Time\ Finished + ETS \quad (4)$$

3. RESULTS AND DISCUSSION

3.1 Project Data

Table 1. Project Data

BLESSCON
Pilihan Tepat, Membangun Cepat

Project : BLESSCON
Location : lamongan
Scope : Pekerjaan Bangunan Mess Alu Plant 2 Lamongan

Estimasi Biaya :

No.		Pekerjaan	Jumlah	Total
A				1.008.084.965
	I	PEKERJAAN PERSIAPAN	1.250.000	
	II	PEKERJAAN TANAH	10.696.693	
	III	PEKERJAAN PONDASI	61.463.626	
	IV	PEKERJAAN STRUKTUR	727.772.525	
	V	PEKERJAAN ATAP	162.024.047	
	VI	PEKERJAAN TANGGA	29.398.425	
	VII	PEKERJAAN SAPITENK & SUMUR RESAPAN	15.479.649	
B		PEKERJAAN ARSITEKTUR & MEP		645.495.383
	I	PEKERJAAN TOPI-TOPI & MEJA DAPUR	6.534.264	
	II	PEKERJAAN DINDING	195.958.832	
	III	PEKERJAAN PLAFOND	69.821.900	
	IV	PEKERJAAN FINISHING LANTAI & DINDING	170.126.988	
	V	PEKERJAAN PINTU & JENDELA	94.272.000	
	VI	PEKERJAAN PLUMBING	63.769.900	
	VII	PEKERJAAN INSTALASI AC DAN EXHAUST FAN	21.951.500	
	VIII	PEKERJAAN ELECTRICAL	23.060.000	
TOTAL				1.653.580.348
PPN 11%				181.893.838
GRAND TOTAL				1.835.474.186

3.2 *Planned Value (PV)*

The calculation of Planned Value (PV) is performed by converting the cumulative percentage of planned progress for each week into a monetary value, achieved by multiplying it with the BAC.

The total percentage of planned progress is calculated based on the S-curve graph, which incorporates task descriptions, work weight percentages, and the planned progress percentages.

The Budget At Completion (BAC) represents the total contract value excluding value-added tax (VAT). This value is derived from the recapitulation of the Budget Plan (RAB). The calculation of the Planned Value (PV) for week 10 is as follows:

PV = cumulative plan x BAC (5)

Table 2. Planned Value from week 10 – week 15

Week	%Progress Percentage	Planned Value
10	67,46%	IDR 1.115.505.302,68
11	80,02%	IDR 1.323.194.994,37
12	87,13%	IDR 1.440.764.557,10
13	94,30%	IDR 1.559.326.268,05
14	96,97%	IDR 1.603.476.863,34
15	98,82%	IDR 1.634.068.099,77

Earned Value is calculated by multiplying the cumulative percentage of progress made by the total budgeted cost for a task (BAC). The cumulative progress percentage indicates the milestones reached in the project during a specific week, based on the weekly progress report. The Budget at Completion (BAC) represents the total contract value, excluding Value Added Tax (VAT). The BAC value is derived from the summary of the Budget Plan, as shown below:

EV = Cumulative Progress Percentage x BAC (6)

Table 3. Earned Value from week 10 - 15

Week	Cumulative Progress Percentage	EV
10	24,73%	IDR 408.930.420,03
11	37,36%	IDR 617.777.617,97
12	42,29%	IDR 699.299.129,12
13	46,22%	IDR 764.284.836,79
14	50,79%	IDR 839.853.458,69
15	54,14%	IDR 895.248.400,34

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3.3 Schedule Performance Index (SPI)

Calculation of the Schedule Performance Index (SPI) for the 10th week is as follows:

SPI = Earned Value (EV) / Planned Value (PV) (7)

Table 4. Schedule Performance Index (SPI) from week 10 -15

Week	Earned Value (EV)	Planned Value (PV)	SPI
10	Rp 408.930.420	Rp 1.115.505.303	0,37
11	Rp 617.777.618	Rp 1.323.194.994	0,47

12	Rp	699.299.129	Rp	1.440.764.557	0,49
13	Rp	764.284.837	Rp	1.559.326.268	0,49
14	Rp	839.853.459	Rp	1.603.476.863	0,52
15	Rp	895.248.400	Rp	1.634.068.100	0,55

4. CONCLUSION

The results of the project cost performance index (SPI) analysis at the 15th week of review were 0.55, indicating that the project was having delays. At the 15th week of review, the project cost performance index (SPI) analysis revealed a value of 0.55, indicating that the project was experiencing delays. This finding highlights the need for immediate attention to address schedule inefficiencies and implement strategies to bring the project back on track. Without corrective measures, the delays could impact overall project timelines and potentially lead to additional challenges in achieving the intended objectives.

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