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EVALUATION OF COST AND TIME PERFORMANCE CONTROL USING THE CONCEPT METHOD OF EARNED *VALUE* IN THE PURWODADI MARKET DEVELOPMENT PROJECT, ARGAMAKMUR DISTRICT, NORTH BENGKULU REGENCY

Muhammad Anwar[1], Endah Kurniyaningrum[2], Darmawan Pontan[3], Innavona[4]
[1,2,3,4]Universitas Trisakti, Indonesia
Email: kurnianingrum@trisakti.ac.id

ABSTRACT

Construction projects often face challenges in maintaining a balance between execution and planning, especially in terms of time and cost. Delays and cost overruns often hinder project efficiency, which has an impact on the satisfaction of the project owner. This study aims to evaluate the cost and time performance of the Purwodadi Market development project in North Bengkulu Regency using the Earned Value Management (EVM) approach. The EVM method was chosen because of its ability to provide a comprehensive picture of the achievement of project performance in terms of time and cost. Data is obtained from the project's weekly report and analyzed using indicators such as Actual Cost of Work Performed (ACWP), Budgeted Cost of Work Scheduled (BCWS), and Budgeted Cost of Work Performed (BCWP). The results show that in the 9th month, the project achieved faster progress than scheduled with a Schedule Performance Index (SPI) of 1.068 and a Cost Performance Index (CPI) of 1.012. This shows that the project is running more efficiently in terms of time and more cost-effective compared to the planned budget. However, there are several months before (the 5th to 8th month) that show delays and wasted costs. The conclusion of this study is that the EVM method is effective in evaluating project performance and allows for the identification of areas that need improvement. Thus, the application of EVM is recommended to improve the management efficiency of similar construction projects.

KEYWORDS *Earned Value Management, project performance, cost performance index, time performance index, project evaluation*

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INTRODUCTION

Along with the growth of the population and economy, the need for public facilities is very much needed, one of which is the market (Saleh et al., 2020). In the implementation of construction, complex problems often occur, so control is needed to minimize problems that may arise (Stiles et al., 2021). A project owner certainly wants the project being implemented to be completed on time with the most efficient cost possible but still provide quality according to the initial plan (Englund & Graham, 2019).

Construction projects generally have a predetermined duration, meaning that the project must be completed on time or faster than the time that has been set (Del Pico, 2023). In a construction project, there are often delays in the completion of project activities that exceed the time set (Oshungade, 2016). Therefore, the application of time management in a construction project is essential so that all project activities can be completed on time or even faster than the time that has been set (Zunaidah et al., 2024).

Control is needed to ensure that a construction project runs according to plan (Kammouh et al., 2022). Project control is carried out to maintain conformity between implementation and planning by comparing what happens in the field with what should happen (Fleming & Koppelman, 2016). A project should run according to the time, cost, and performance that have been set in the planning because punctuality, cost, and quality are the benchmarks for its success (Brook, 2016).

In addition to quality, cost, and time control, the construction process must be controlled and measured until completion to avoid delays and cost overruns (Taye, 2016). Monitoring must be carried out during the project implementation period to determine the achievements and progress that have been achieved (Muchelule, 2018). This monitoring information is helpful as material for evaluating the performance achieved at the time of reporting (Brunet et al., 2019).

Evaluation is carried out by comparing the progress achieved based on the monitoring results with the standards based on planning (Stelzenmüller et al., 2021). If the work control analysis results do not meet the standards, changes or re-planning will be made for the next job. Thus, planning and control are continuous and repetitive and can only be separated after completing the project (Ervianto, 2004).

Based on the description above, time and cost control must be carried out in an integrated manner. This integrated cost and time control method is the earned value concept. The earned value concept is one of the proper methods to use (Sandriawan et al., 2021) in this study in order to obtain optimal results. Based on the formulation of the problem that has been mentioned, this study aims to evaluate the time and cost performance index in the Purwodadi Market Development project, Argamakmur District, North Bengkulu Regency. The benefits that can be taken

from this research are as reference material for determining the proper steps, providing alternatives regarding cost and time performance control on projects, and knowing the differences in costs and time in planning and implementation conditions.

RESEARCH METHOD

Research Location

The rehabilitation project of Purwodadi Market in North Bengkulu Regency, Bengkulu Province, is an initiative of the Government of Indonesia under the leadership of President Joko Widodo and the Ministry of Public Works and Public Housing (PUPR) led by Minister Basuki Hadimuljono. The market caught fire on April 5, 2021, and is now planned to be rebuilt to be more modern, safe, and comfortable for traders and visitors alike.

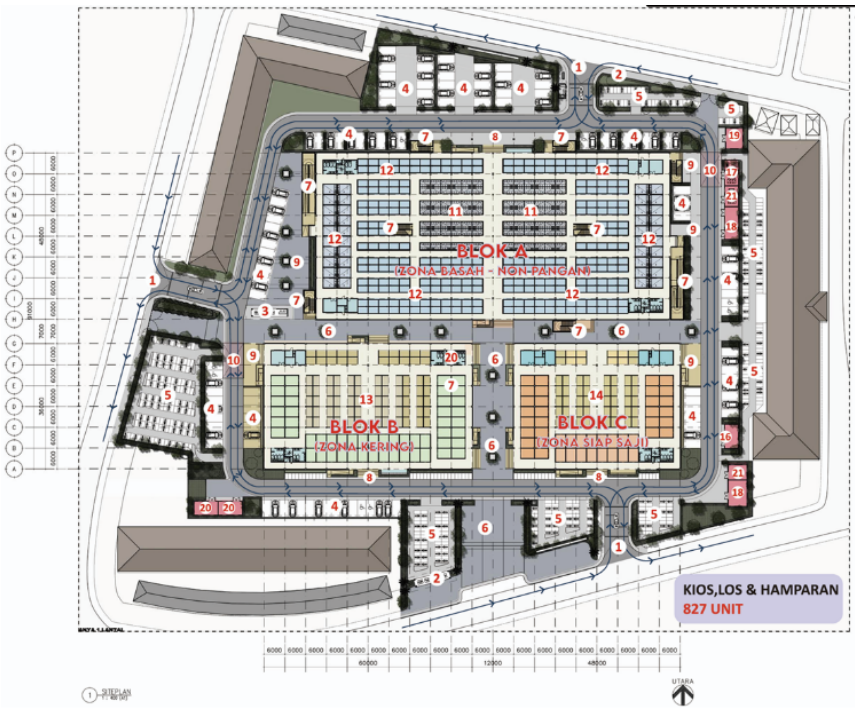

Figure 1. Site plan project

Data Collection

Data Primer

Primary data is data obtained directly from the source. In this study, primary data in the form of project performance information, factors that affect the success of project acceleration, and causes and consequences of project acceleration obtained by interviews with the Project team.

Data Seconds

Secondary data is data in the form of time schedules, project implementation, cost budget plans (RAB), plan reports and project work realization.

Data Processing

To get an evaluation of cost and time control, data must be obtained first. After the data is obtained, then the data processing stage is as follows:

1. Making a Control Project Budget Plan
2. Project Implementation Cost Evaluation
3. Evaluation of Project Progress and Cost Reports
   a. Analysis Budget Cost of Budget Cost Of Work Schedule (BCWS),
   b. Analysis Budget Cost of Work Peformance (BCWP)
   c. Analysis Actual Budget Cost of Work

RESULT AND DISCUSSION

Data Analysis

The planned work time of the Purwodadi – Argamakmur Market Development Project in North Bengkulu Regency is 12 months, namely from December 27, 2023 – December 20, 2024. When the research was carried out in the 9th month, the project achieved 63.146% progress from the plan of 59.141% and experienced a surplus of progress at 4.005%. From the S curve, it can be seen that the implementation is faster than planned. The progress of project work realization on a weekly basis is higher than the project implementation plan and has the potential to cause waste of project final costs. In the reporting period of the 40th week or the 9th month (September 2024), the cumulative value of the realization of project work progress was 63,146%, which was higher than the cumulative project implementation plan of 59,141%.

Therefore, an evaluation is carried out, because in the previous months the implementation was always higher in performance, so there may be waste of money. From some of the information above, it can be known that the time deviation report from the 1st month to the 9th month in the following table 1:

Table 1. Progress recapitulation

Progress	Progress sampai dengan Bulan Ke-9								
	Bulan ke-1	Bulan ke-2	Bulan ke-3	Bulan ke-4	Bulan ke-5	Bulan ke-6	Bulan ke-7	Bulan ke-8	Bulan ke-9
Rencana	0,790	2,899	8,041	11,046	23,732	28,887	39,061	53,403	59,141
Realisasi	0,931	4,065	8,640	11,270	21,557	28,769	36,056	50,455	63,146
Deviasi	0,141	1,166	0,599	0,224	(2,175)	(0,119)	(3,005)	(2,948)	4,005

From the table above, it can be seen that the deviation of the percentage of progress has a positive value in the 1st to 4th month and experiences a negative progress in the 5th to 8th month, but in the 9th month the progress returns to a positive value so that the performance of the implementation time is higher than the performance of the planned time. Therefore, it is necessary to conduct an evaluation in order to find out the time and cost deviations, how much is the difference between the implementation and the plan, and what factors cause the deviations. *Earned Value* analysis is carried out in the 1st to 9th month review.

Performance Evaluation Using the Earned Value Method (EVM)

To determine the performance during the project, three indicators are used, namely *the Actual Cost of Work Performed* (ACWP) from the project financial statements, *the Budgeted Cost of Work Performed* (BCWP) from the cost budget plan (RAB), and the *Budgeted Cost of Work Scheduled* (BCWS) from the *time schedule*.

1. Budgeted Cost of Work Scheduled (BCWS)

   Budget Cost Of Work Schedule Analysis is a combination of costs and time that form the characteristics of the "S" curve. Usually, this is done as a target for planning. The analysis is planned for activities, such as the budget amount to complete work according to schedule. Performance analysis with the BCWS indicator in the 1st week can be calculated by multiplying the plan's weight (weekly) in the 1st week by the total budget. Meanwhile, a description of the progress of work from Month 1 to Month 9 can be seen in the following table:

   Meanwhile, for the calculation of BCWS in the 1st to 9th month of each job is as follows:

   BCWS Month 1 = 1st Month Plan Weight X Cost Plan
   = 0.790% X IDR 94,068,325,928.08
   = IDR 743,139,774.83

   BCWS Month 2 = 2nd Month Plan Weight X Cost Plan
   = 2.899% X IDR 94,068,325,928.08
   = IDR 2,727,040,768.66

   BCWS Month 3 = 3rd Month Plan Weight X Cost Plan
   = 6.861% X IDR 94,068,325,928.08
   = IDR 6,454,027,841.93

   BCWS Month 4 = 4th Month Plan Weight X Cost Plan
   = 11.046% X Rp94.068.325.928.08
   = IDR 10,390,787,282.02

   BCWS Month 5 = 5th Month Plan Weight X Cost Plan

= 23,732% X IDR 94,068,325,928.08
= IDR 22,324,295,109.25

BCWS Month 6 = 6th Month Plan Weight X Cost Plan
= 28.887% X IDR 94,068,325,928.08
= IDR 27,173,517,310.84

BCWSmonth 7 = 7th Month Plan Weight X Cost Plan
= 39.061% X IDR 94,068,325,928.08
= IDR 36,744,028,790.77

BCWS Month 8 = 8th Month Plan Weight X Cost Plan
= 53,403% X IDR 94,068,325,928.08
= IDR 50,235,308,095.37

BCWS Month 9 = 9th Month Plan Weight X Cost Plan
= 59.141% X IDR 94,068,325,928.08
= IDR 55,632,948,637.13

The results of the BCWS calculation from Month 1 to Month 9 can be seen Table 2.

Table 2. Monthly BCWS Recapitulation

Month	NK-PPN Final RAB (Rp)	Plan Cost RC (Rp)	Progress Plan (%)	Progress Real (%)	BCWS (RC x Progress Plan) (Rp)
1	2	3	4	5	6 = 3 x 4
Jan-24	104.520.362,14	94.068.325,93	0,790	0,931	743.139,77
Feb-24	104.520.362,14	94.068.325,93	2,899	4,065	2.727.040,77
Mar-24	104.520.362,14	94.068.325,93	6,861	7,391	6.454.027,84
Apr-24	104.520.362,14	94.068.325,93	11,046	11,270	10.390.787,28
May-24	104.520.362,14	94.068.325,93	23,732	21,557	22.324.295,11
Jun-24	104.520.362,14	94.068.325,93	28,887	28,769	27.173.517,31
Jul-24	104.520.362,14	94.068.325,93	39,061	36,056	36.744.028,79
Aug-24	104.520.362,14	94.068.325,93	53,403	50,455	50.235.308,10
Sep-24	104.520.362,14	94.068.325,93	59,141	63,146	55.632.948,64
Oct-24	104.520.362,14	94.068.325,93	71,795	-	67.536.354,60
Nov-24	104.520.362,14	94.068.325,93	89,428	-	84.123.422,51
Dec-24	104.520.362,14	94.068.325,93	100,000	100,000	94.068.325,93
	104.520.362,14	94.068.325,93			

The BCWS analysis is a breakdown of the planned cost usage that will be spent each week on the physical project work on the construction of the Purwodadi market, where the initial contract value is Rp. 116,017,601,978.00, including 10% VAT, and the planned cost is Rp. 94,068,325,928.08.

2. Budgeted Cost of Work Performed (BCWP)

The budgeted Cost Of Work Performance analysis is the value of the results of the work completed against the budget provided to carry out the work. Performance analysis with the BCWP indicator in the 1st month per job can be calculated by

multiplying the weight of the progress of the work realization (monthly) in the 1st month by the total amount of the overall cost plan. The calculation of BCWP in the 1st to 9th months is as follows:

BCWP1st month = 1st Month Realization Weight X Cost Plan
= 0,931% X Rp94.068.325.928,08
= IDR 875,776,114.39

BCWP2nd month = 2nd Month Realization Weight X Cost Plan
= 4,065% X Rp94.068.325.928,08
= IDR 3,823,877,448.98

BCWP3rd month = 3rd Month Realization Weight X Cost Plan
= 7,391% X Rp94.068.325.928,08
= IDR 6,952,589,969.34

BCWP4th month = 4th Month Realization Weight X Cost Plan
= 11,270% X Rp94.068.325.928,08
= IDR 10,601,500,332.09

BCWP5th month = Weight of 5th Month Realization X Cost Plan
= 21,557% X IDR 94,068,325,928.08
= IDR 20,278,309,020.32

BCWP6th month = 6th Month Realization Weight X Cost Plan
= 28,769% X IDR 94,068,325,928.08
= IDR 27,062,516,686.25

BCWP7th month = 7th Month Realization Weight X Cost Plan
= 36.056% X IDR 94,068,325,928.08
= IDR 33,917,275,596.63

BCWP8th month = 8th Month Realization Weight X Cost Plan
= 50.455% X IDR 94,068,325,928.08
= IDR 47,462,173,847.01

BCWP9th month = 9th Month Realization Weight X Cost Plan
= 63,146% X IDR 94,068,325,928.08
= IDR 59,400,385,090.55

The results of the BCWS calculation from Month 1 to Month 9 can be seen as follows:

Table 3. Monthly BCWP Recapitulation

Month	NK-PPN Final RAB (Rp)	Plan Cost RC (Rp)	Progress Plan (%)	Progress Real (%)	BCWP (RC x Progress Real) (Rp)
1	2	3	4	5	8 = 3 X 5
Jan-24	104.520.362,14	94.068.325,93	0,790	0,931	875.776,11
Feb-24	104.520.362,14	94.068.325,93	2,899	4,065	3.823.877,45
Mar-24	104.520.362,14	94.068.325,93	6,861	7,391	6.952.589,97
Apr-24	104.520.362,14	94.068.325,93	11,046	11,270	10.601.500,33
May-24	104.520.362,14	94.068.325,93	23,732	21,557	20.278.309,02
Jun-24	104.520.362,14	94.068.325,93	28,887	28,769	27.062.516,69
Jul-24	104.520.362,14	94.068.325,93	39,061	36,056	33.917.275,60
Aug-24	104.520.362,14	94.068.325,93	53,403	50,455	47.462.173,85
Sep-24	104.520.362,14	94.068.325,93	59,141	63,146	59.400.385,09
Oct-24	104.520.362,14	94.068.325,93	71,795	-	-
Nov-24	104.520.362,14	94.068.325,93	89,428	-	-
Dec-24	104.520.362,14	94.068.325,93	100,000	100,000	94.068.325,93
	104.520.362,14	94.068.325,93			94.068.325,93

The BCWP table above is a limitation on the expenditures that must be incurred in the current month so that there is no excess in the use of costs planned for the Purwodadi Market Building Construction Project, North Bengkulu. For January 2024, the budget limit is IDR 875,776,114, - with the implementation of preparatory work such as the construction of the director's keet, fences, and other preparation equipment. Meanwhile, the cumulative budget limit in September 2024 is IDR 59,400,385,091, - and the work plan program is that the structural work has been completed, the architectural work and the Mechanical Electrical Plumbing work has begun.

3. Actual Cos t of Work Performed (ACWP)

The actual cost of work performed is the actual cost of work carried out during the period under review. Performance analysis with ACWP indicators from month 1 to month 9 is obtained from the actual project financial report per month. To find out the cost overview per month at the time of the study (from the financial report of the Purwodadi Market Development project, North Bengkulu) can be seen in the following table 4:

Table 4. Recapitulation of Monthly Financial Performance of the Project (ACWP)

Month	NK-PPN Final RAB (Rp)	Plan Cost RC (Rp)	Progress Plan (%)	Progress Real (%)	ACWP (BPP until month) (Rp)
1	2	3	4	5	7
Jan-24	104.520.362,14	94.068.325,93	0,790	0,931	565.528,70
Feb-24	104.520.362,14	94.068.325,93	2,899	4,065	3.709.825,92
Mar-24	104.520.362,14	94.068.325,93	6,861	7,391	9.536.993,76
Apr-24	104.520.362,14	94.068.325,93	11,046	11,270	13.984.584,63
May-24	104.520.362,14	94.068.325,93	23,732	21,557	20.855.219,79
Jun-24	104.520.362,14	94.068.325,93	28,887	28,769	30.448.202,75
Jul-24	104.520.362,14	94.068.325,93	39,061	36,056	39.135.438,84
Aug-24	104.520.362,14	94.068.325,93	53,403	50,455	49.702.464,14
Sep-24	104.520.362,14	94.068.325,93	59,141	63,146	58.678.170,29
Oct-24	104.520.362,14	94.068.325,93	71,795	-	
Nov-24	104.520.362,14	94.068.325,93	89,428	-	
Dec-24	104.520.362,14	94.068.325,93	100,000	100,000	93.572.404,18
	104.520.362,14	94.068.325,93			93.572.404,18

The ACWP table above is the use of realization costs in the field with cumulative budget expenditures up to September 2024 amounting to IDR 58,678,170,294, - which is used for physical work on the Purwodadi Market Building Construction Project, North Bengkulu. The realization costs incurred include:

1. 95% of Structural work
2. 50% of Architectural work
3. 30% of Mechanical, Electrical and Plumbing work

In the first month of January 2024, the realization costs incurred amounted to IDR 875,776,114, - with the implementation of work including:

1. Director's work
2. Fence work
3. Other preparatory work

As for the comparison between ACWP and BCWP, if the ACWP obtained is greater than the BCWP, the project is wasteful and over the budget plan calculated according to the initial agreement. As in the monthly report graph below:

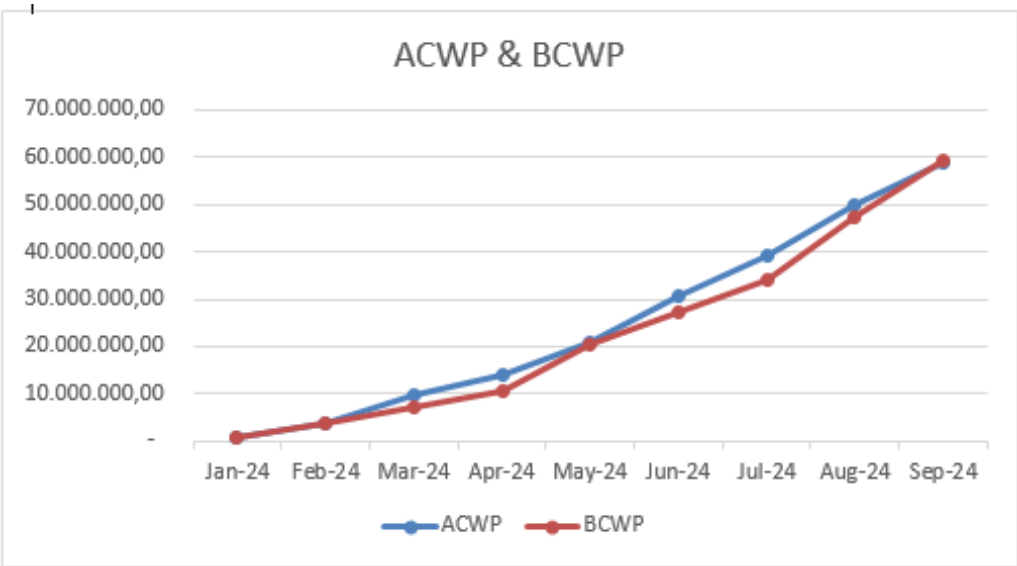

Figure 2. ACWP and BCWP graphic

Based on Figure 2 above from the comparison graph between ACWP and BCWP above, it is explained that the position of the ACWP value whose graph position is above BCWP is a project experiencing waste (deficit) from the budget plan program as stated in table 4.14 Recapitulation of BCWS, BCWP, monthly ACWP. From the results of the evaluation and analysis, the consequences of the ACWP value being more significant than the BCWP value are as follows:

1. The schedule is late
2. Extreme rainy weather in the North Bengkulu area
3. From May to August, there were repairs to the bridge and national road, which were the only access to the project location
4. Equipment rental has been delayed
5. Overhead has increased

Cost Parameter Analysis

The analysis of the value of the results includes deviations against time and deviations against costs. Schedule variance is used to calculate the deviation between BCWA and BCWP. A positive value indicates that the project work packages are implemented faster than planned. Conversely, a negative value suggests poor job performance because the work packages are implemented longer than the planned schedule.

To find out the cost performance during the running of this project, it can be analyzed by calculating *the Cost Variance* (CV), and *the Cost Performance Index* (CPI).

Cost Variance (CV)

The Value of Cost Variance (CV) can be calculated by subtracting the BCWP value by the ACWP in a given month. The calculation of the Cost Variance (CV) in the 1st to 9th months is as follows:

CV1st month = 1st Month BCWP – 1st Month ACWP
= IDR 875,776,114.39 – IDR 565,528,702.02
= IDR 310,247,412.37

CV2nd month = 2nd Month BCWP – 2nd Month ACWP
= IDR 3,823,877,448.98 – IDR 3,709,825,917.58
= IDR 114,051,531.4

CV3 months = 3rd Month BCWP – 3rd Month ACWP
= IDR 6,952,589,969.34 – IDR 9,536,993,756.89
= -Rp2,584,403,787.55

CV4th month = 4th Month BCWP – 4th Month ACWP
= IDR 10,601,500,332.09 – IDR 13,984,584,634.49
= - IDR 3,383,084,302.31

CV5th month = 5th Month BCWP – 5th Month ACWP
= IDR 20,278,309,020.32 – IDR 20,855,219,793.75
= -Rp576,910,773.43

CV6th month = 6th Month BCWP – 6th Month ACWP
= IDR 27,062,516,686.25 – IDR 30,448,202,746.84
= -Rp3,385,686,060.59

CV7th month = 7th Month BCWP – 7th Month ACWP
= IDR 33,917,275,596.63 – IDR 39,135,438,843.09
= -Rp5,218,163,246.46

CV8th month = 8th Month BCWP – 8th Month ACWP
= IDR 47,462,173,847.01 – IDR 49,702,464,144.3
= -Rp2,240,290,297.29

CV9th month = 9th Month BCWP – 9th Month ACWP
= IDR 59,400,385,090.55 – IDR 58,678,170,293.89
= IDR 722,214,796.66

The results of the calculation of the Cost Variance (CV) from the 1st to the 9th month can be seen in the following table:

Table 5. Cost Variance (CV) and Schedule Variant (SV) value from month 1 to month 9

ACWP (BPP until month) (Rp)	BCWP (RC x Progress Real) (Rp)	CV (BCWP - ACWP) Indek Biaya (Rp)	SV (BCWP - BCWS) Indeks Waktu (Rp)
7	8 = 3 X 5	9 = 8 - 7	10 = 8 - 6
565.528,70	875.776,11	310.247,41	132.636,34
3.709.825,92	3.823.877,45	114.051,53	1.096.836,68
9.536.993,76	6.952.589,97	- 2.584.403,79	498.562,13
13.984.584,63	10.601.500,33	- 3.383.084,30	210.713,05
20.855.219,79	20.278.309,02	- 576.910,77	- 2.045.986,09
30.448.202,75	27.062.516,69	- 3.385.686,06	- 111.000,62
39.135.438,84	33.917.275,60	- 5.218.163,25	- 2.826.753,19
49.702.464,14	47.462.173,85	- 2.240.290,30	- 2.773.134,25
58.678.170,29	59.400.385,09	722.214,80	3.767.436,45
	-	-	- 67.536.354,60
	-	-	- 84.123.422,51
93.572.404,18	94.068.325,93	495.921,75	-
93.572.404,18	94.068.325,93	495.921,75	-

A positive cost variance (CV) result means that the actual cost incurred to complete the work is less than the planned cost budget. Meanwhile, a negative cost variance (CV) indicates the actual cost incurred more than the planned budget to carry out the work.

From table 5, it can be seen that the actual costs incurred in the 3rd to 8th month are negative, so that the project is wasted. However, in the 9th month, it has a positive value again, so that the project does not experience waste.

Cost Performance Index (CPI)

The Cost Performance Index (CPI) can be calculated by dividing the value of the cubic BCWP by the cumulative ACWP. The CPI value shows the weight value obtained in the period the researcher reviews against the costs incurred. A CPI value of less than 1 (<1) indicates poor performance because the costs incurred by ACWP are significant compared to the value obtained by BCWP or, in other words, waste. Conversely, with a CPI value> 1, the project performance is better than the planner. The calculation of the Cost Performance Index (CPI) from the 1st month to the 8th week is as follows:

SPI1st month = 1st Month BCWP / 1st Month ACWP
= IDR 875,776,114.39 / IDR 565,528,702.02
= 1,549

SPI2nd month = 2nd Month BCWP / 2nd Month ACWP

= IDR 3,823,877,448.98 / IDR 3,709,825,917.58
= 1,031

SPI3rd month = 3rd Month BCWP / 3rd Month ACWP
= IDR 6,952,589,969.34 / IDR 9,536,993,756.89
= 0,729

SPI4th month = 4th Month BCWP / 4th Month ACWP
= IDR 10,601,500,332.09 / IDR 13,984,584,634.49
= 0,758

SPI Month 5 = 5th Month BCWP / 5th Month ACWP
= IDR 20,278,309,020.32 / IDR 20,855,219,793.75
= 0,972

SPI6th month = 6th Month BCWP / 6th Month ACWP
= IDR 27,062,516,686.25 / IDR 30,448,202,746.84
= 0,889

SPI7th month = 7th Month BCWP / 7th Month ACWP
= IDR 33,917,275,596.63 / IDR 39,135,438,843.09
= 0,867

SPI8th month = 8th Month BCWP / 8th Month ACWP
= IDR 47,462,173,847.01 / IDR 49,702,464,144.3
= 0,955

SPI9th month = 9th Month BCWP / 9th Month ACWP
= IDR 59,400,385,090.55 / IDR 58,678,170,293.89
= 1,012

A cumulative cost performance index (CPI) result of more than 1 (>1) means that the cost to complete the work is less than the overall planned cost budget. Meanwhile, the cost performance index (CPI) whose value is below 1 (<1) means that the implementation cost is greater than the planned cost budget.

In this project, a Cost Performance Index (CPI) value of 1,012 was obtained in the 9th month, this value shows that the costs incurred during the 9 (Nine) month period lasted less than the planned cost budget.

The results of the calculation of the Cost Kinerka Index (CPI) per job from Month 1 to Month 9 can be seen in the following table:

Table 6. Cost Performance Index (CPI) and Schedule Performance Index (SPI) value from the 1st month to the 9th month

ACWP (BPP until month) (Rp)	BCWP (RC x Progress Real) (Rp)	INDEKS	
		CPI (BCWP/ACWP)	SPI (BCWP/BCWS)
7	8 = 3 X 5	9 = 8 : 7	10 = 8 : 6
565.528,70	875.776,11	1,549	1,178
3.709.825,92	3.823.877,45	1,031	1,402
9.536.993,76	6.952.589,97	0,729	1,077
13.984.584,63	10.601.500,33	0,758	1,020
20.855.219,79	20.278.309,02	0,972	0,908
30.448.202,75	27.062.516,69	0,889	0,996
39.135.438,84	33.917.275,60	0,867	0,923
49.702.464,14	47.462.173,85	0,955	0,945
58.678.170,29	59.400.385,09	1,012	1,068
	-	0,000	0,000
	-	0,000	0,000
93.572.404,18	94.068.325,93	1,005	1,000
93.572.404,18	94.068.325,93		

Time Parameter Analysis

To determine the cost performance during the running of this project, it can be analyzed by calculating *the Schedule Variance* (SV), and *the Schedule Performance Index* (SPI).

Schedule Variance (SV)

The Schedule Variance (SV) value can be calculated by subtracting the BCWP value by the BCWS in a given month. The calculation of Schedule Variance (SV) in the 1st to 9th months is as follows:

SV1st month = 1st Month BCWP – 1st Month BCWS
= IDR 875,776,114.39 – IDR 743,139,774.83
= IDR 132,636,339.56

SV2nd month = 2nd Month BCWP – 2nd Month BCWS
= IDR 3,823,877,448.98 – IDR 2,727,040,768.66
= IDR 1,096,836,680.32

SV3rd month = 3rd Month BCWP – 3rd Month BCWS
= IDR 6,952,589,969.34 – IDR 6,45,402,7841.93
= IDR 498,562,127.41

SV4th month = 4th Month BCWP – 4th Month BCWS
= IDR 10,601,500,332.09 – IDR 10,390,787,282.02
= IDR 210,713,050.07
SV5th month = 5th Month BCWP – 5th Month BCWS
= IDR 20,278,309,020.32 – IDR 22,324,295,109.25
= -Rp2,045,986,088.93
SV6th month = 6th Month BCWP – 6th Month BCWS
= IDR 27,062,516,686.25 – IDR 27,173,517,310.84
= -Rp111,000,624.59
SV7th month = 7th Month BCWP – 7th Month BCWS
= IDR 33,917,275,596.63 – IDR 36,744,028,790.77
= -Rp2,826,753,194.14
SV8th month = 8th Month BCWP – 8th Month BCWS
= IDR 47,462,173,847.01 – IDR 50,235,308,095.37
= -Rp2,773,134,248.36
SV9th month = 9th Month BCWP – 9th Month BCWS
= IDR 59,400,385,090.55 – IDR 55,632,948,637.13
= IDR 3,767,436,453.42

The results of the calculation of Cost Variance (SV) from the 1st to the 9th month can be seen in the following table 5.

Results The results of the schedule variance (SV) with a positive value mean that the work implementation time is faster than the planned time. Meanwhile, a negative schedule variance (SV) indicates that the time to carry out the work is longer than the planned schedule.

From table 5, it can be seen that the work from the 3rd month to the 8th month has a negative value, which means that the project is delayed. However, in the 9th month, it has a positive value again, meaning that the project is accelerating work.

Schedule Performance Index (SPI)

The Cost Performance Index (SPI) can be calculated by dividing the value of the cumulative BCWP by the cumulative BCWS. The calculation of the Jadwa Performance Index (SPI) from the 1st month to the 9th week is as follows:

SPI1st month = 1st Month BCWP / 1st Month BCWS
= IDR 875,776,114.39 / IDR 743,139,774.83
= 1,178
SPI2nd month = 2nd Month BCWP / 2nd Month BCWS
= IDR 3,823,877,448.98 / IDR 2,727,040,768.66
= 1,402
SPI3rd month = 3rd Month BCWP / 3rd Month BCWS
= IDR 6,952,589,969.34 / IDR 6,45,402,7841.93

= 1,077
SPI4th month = 4th Month BCWP / 4th Month BCWS
= IDR 10,601,500,332.09 / IDR 10,390,787,282.02
= 1,020
SPI Month 5 = 5th Month BCWP / 5th Month BCWS
= IDR 20,278,309,020.32 / IDR 22,324,295,109.25
= 0,908
SPI6th month = 6th Month BCWP / 6th Month BCWS
= IDR 27,062,516,686.25 / IDR 27,173,517,310.84
= 0,996
SPI7th month = 7th Month BCWP / 7th Month BCWS
= IDR 33,917,275,596.63 / IDR 36,744,028,790.77
= 0,923
SPI8th month = 8th Month BCWP / 8th Month BCWS
= IDR 47,462,173,847.01 / IDR 50,235,308,095.37
= 0,945
SPI9th month = 9th Month BCWP / 9th Month BCWS
= IDR 59,400,385,090.55 / IDR 55,632,948,637.13
= 1,068

The results of the calculation of the Schedule Kinerka Index (SPI) per job from the 1st to the 9th month can be seen in the following table 6. The result of the schedule performance index (SPI) with a value of more than 1 (>1) means that the work implementation time is faster than the planned schedule. Meanwhile, the schedule performance index (SPI) whose value is below 1 (<1) means that the work is delayed from planned.

In this project, a Cost Performance Index (CPI) value of 1,068 (>1) was obtained in the 9th month, this value shows that the work implementation schedule is faster than planned (the project accelerates) even though in the last 4 (four) months the project experienced delays.

Discussion

Based on analysis of BCWS, BCWP, ACWP, CV, SV, CPI and SPI indexes it can provide an overview of cost and time achievement. That in the 9th month (September) the project experienced acceleration and cost savings. An evaluation was carried out by collecting data on the results of the weekly routine meeting of the Purwodadi North Bengkulu Market Development project. According to the Contractor and Consultant of the Constitutional Court, the project can catch up and even faster than planned due to the conditions in the field that support to fill more workers and bring in manufacturing materials so that they are installed

immediately. The progress of the work progress that occurred in the field was caused by several other supporting factors, including:

a. Implementation method factors

The implementation method is essentially an elaboration of the procedures and techniques for the implementation of the work which is the core of all activities in the construction management system. The implementation method is the key to being able to realize all planning into a physical building form and is basically the application of engineering concepts based on the relationship between the requirements in the contract document, the technical and economic conditions in the field, and all resources including the contractor's experience. In the implementation in the field, the contractor applies an efficient implementation method by working on work items that can be done simultaneously to shorten the time. When the implementation team is added and the workforce is added, the work is done simultaneously with the division of zoning areas. From the method of adding the implementation team and manpower, the project cost performance is always higher than the planned cost, but the project time performance increases.

b. Labor factor

The number of manpower required for a project requires planning, namely by converting the project scope from the number of man-hours to the number of manpower. The main factor that affects the number of workers is labor productivity. The amount of labor productivity depends on the location, natural conditions, work groups, length of time, labor density, and others. And to pursue the target with acceleration, the workforce is increased both in terms of the number and working hours.

The workforce employed in the Purwodadi North Bengkulu Market Project Development project is currently in accordance with each work item and to add to the acceleration, the number of workers and also the overtime system are added.

c. Material factors

The implementation of each development project includes the procurement of materials that will be part of the building (e.g. mix concrete, reinforcing steel, etc.). In addition to the materials that are part of the building, it is also necessary to procure and use a large number of materials that will not be part of the building, but are used in the implementation of the construction (e.g. fuel, spare parts for construction tools, etc.). In the conditions in the field, before building materials will be used, checks are always carried out to maintain specifications and if forced to use poor materials, it will have an impact on the quality of the building later. In this project, the material is managed by the contractor himself, even for *ready mix* concrete, the contractor has *his own batching plant* so that the contractor also

knows the production capacity and can prepare a material procurement plan both in terms of production and delivery to the location efficiently.

d. Equipment factor

Another resource that must be available when carrying out project activities is construction equipment (construction plant). Various types and sizes of equipment to be used must be available, of course, adjusted to the needs in the field. From equipment that can be provided by construction workers in the form of cethoks, hoes, and crowbars to heavy equipment in the form of excavators, bulldozers, draglines, and so on are the requirements for an activity to be carried out. To keep the equipment in production according to its specifications, every day before the work is carried out, control will be carried out which includes engines, buckets, fuel and others. In this project, equipment including the fleet is also the contractor's inventory, so that the advantages in terms of time and cost can also be optimized.

e. Cost factor

Project costs or project finances need to be managed carefully so that at the end of the project the projected profits that have been planned can be achieved as expected. Cash inflows and cash outflows must be reported correctly and carefully so that each periodic report can provide accurate and auditable information with a good level of fairness and be considered in making the next decision. Every material and non-material expenditure on the Purwodadi North Bengkulu Market Development project is kept very well so that cost overruns on certain work items can be overcome and for term billing is always billed according to the progress to avoid the implementing party from making loans.

f. Time factor

Project timing is synonymous with scheduling. Project scheduling is one of the elements of planning results, which can provide information about the plan schedule and project progress in terms of resource performance in the form of costs, labor, equipment, and materials as well as project duration and time progress for project completion. Scheduling is the allocation of time available to carry out each work in order to complete a project until optimal results are achieved by taking into account existing limitations. The implementation in the field did not experience delays because the acceleration with the addition of workers was carried out.

CONCLUSION

The results show that in the 9th month, the project achieved faster progress than scheduled with a Schedule Performance Index (SPI) of 1.068 and a Cost Performance Index (CPI) of 1.012. This project significantly impacted the company's performance, but in months 6, 7, and 8, the Schedule Performance Index (SPI) and Cost Performance Index (CPI) values were less than 1, indicating time delays and cost overruns. The four main factors causing these dynamics were Delays in material delivery, Field conditions that did not match tender specifications, Running out of project materials in the middle of the period, Bad weather that stopped work, and Environmental factors beyond initial estimates.

To maintain and improve SPI and CPI until the end of the project, including Calculating the remaining work costs in detail, Adjusting expenses with work progress, avoiding excessive payments to third parties, Creating efficient work stages to prevent repetition of work, Planning the procurement of workers, tools, and materials according to field needs to avoid idle tools, excess material stock, or workers waiting for land.

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