Productivity Analysis for Performance Measurement by (Earned Value Management) EVM in High-Level Building Projects

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ABSTRACT

The Project scheduling helps show the relationship of each activity to other activities and to the entire project, identifies relationships that should take precedence between activities, and shows a realistic estimated time for each activity. EVM (Earned Value Management) is one of the measurement methods to objectively measure project performance and progress. This method can integrate time and cost so that it can know whether a project is running faster or slower than the schedule that is supposed to and to know whether the project costs are greater or smaller than they should have planned. The steps in the EVM calculation are included in the control process in which the steps are carried out such as calculations, analysis, forecasting, cost reporting and schedule performance for project stakeholder evaluations and actions. This study aims to calculate, analyze and measure the performance of the Wisma Atlet Kemayoran-Central Jakarta project schedule using the EVM method. With the EVM method, it is expected that the costs and time for the project can be controlled so that the project can be completed on time and the costs incurred according to the project budget.

Key Words: *EVM Method, Scheduling, Construction Project, Productivity Analysis..*
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1. INTRODUCTION

a project management information system is needed that can assist project managers in planning project scheduling and controlling project costs to match planned planning. The system used to manage project time and cost management so that the impact does not have too much influence on the project objectives. With the delay analysis applied to the construction project, it is expected that for the weeks that are indicated to be delayed it can be reviewed. It is intended that the next project does not overcost which can cause losses.

2. LITERATURE REVIEW

In this chapter, contains a foundation of knowledge, concepts, as well as theories from a variety of literature used as a basis or to solve problems in research about optimizing time and cost in building projects, The PMBOK® Guide describes the nature of project management processes in terms of the integration between the processes, their interactions, and the purposes they serve. Project management processes are grouped into five categories known as Project Management Process Groups (or Process Groups) [1].
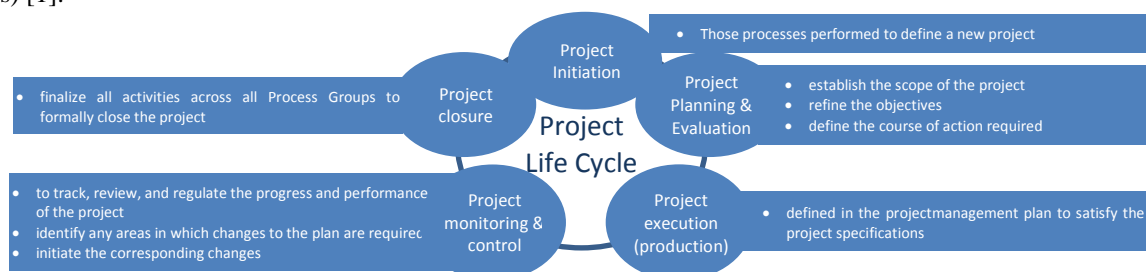

Figure 2.1 Project Life Cycle
Source : Project Management Institute (PMI), USA. Copyright PMBOK 5th edition

2.1 Theoretical Review

In this study will be discussed in depth about project monitoring & control in one of the Project Management Process Groups. in the Project monitoring & control there are tracking, reviewing, and regulating the progress and performance of

the project, identify any areas in which changes to the plan are required, initiate the corresponding changes[1], this process will be analyzed more closely related to scheduling performance and costs to be spent at the project execution (production).

2.1.1 Productivity

"Productivity" is a tool to measure the efficiency of a person, machine, factory or system in converting the Input into the desired Output. It can be said that high productivity is to do the job in the shortest possible time with the use of as little resources as possible without sacrificing the quality specified.
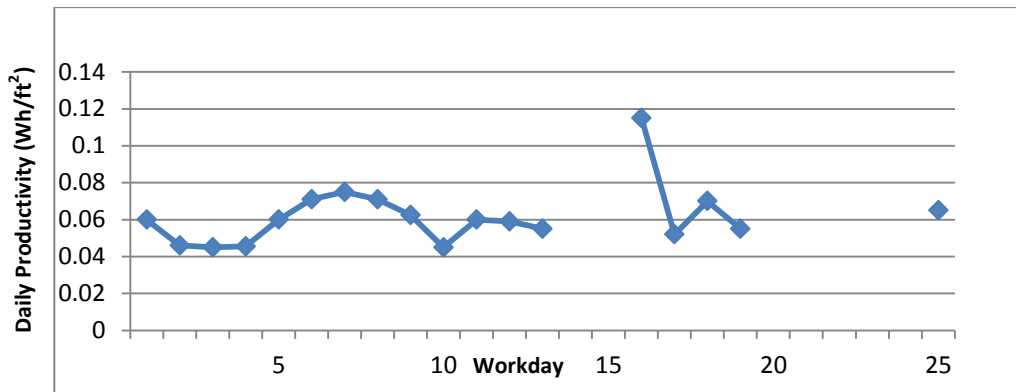

Fig. 2.2 Labor Productivity of Panel Erection Crew, Millennium Science Complex

American Society of Civil Engineers, Copyright ASCE

Fig. 2.2 shows the crew productivity for the precast panel erection. As can be seen, the performance for the first 13 workdays was rather consistent, and thereafter it was not so consistent. Lower numbers in Fig. 2.2 are better. The labor inefficiency is estimated to be 32%, and at $35/h (burdened), the contractor suffered a loss of $14,450. This equates to a loss of $722 per workday on a relatively simple activity.

2.1.2 EVM (Earned Value Management)

The use of the concept of earned value began in the late 20th century in the manufacturing industry. An EVM review was included in the PMBOK Guide® First Edition in 1987 and subsequent editions. EVM achieved its momentum in 2000, when several states in the United States required the use of EVM in all government projects. Indicators used in the concept of yield values are:

1. ACWP or actual cost of work performed (total actual cost of work done),
2. BCWP or budgeted cost of work performed (Value of results from the point of view of the value of work completed on the budget provided to carry out the work),
3. BCWS or budgeted cost of work scheduled (budget value for a work package that is integrated with the implementation schedule).

The variance produced from the 3 indicators is the cost variant or CV and the schedule variant or SV. Some terms related to this variation are Cost Variance, Schedule Variance, Cost Performance Index, Schedule Performance Index, Estimation on Completion, and Variance on Completion.

1. Cost Variance (CV) is the difference between the value obtained after completing work packages with the actual costs incurred during project implementation.
   The formula for Cost Variance is

$$CV = BCWP - ACWP \qquad \text{-------------- (1)}$$

2. Schedule variance is used to calculate deviations between BCWS and BCWP.
   The formula for Schedule Variance is

$$SV = BCWP - BCWS \qquad \text{-------------- (2)}$$

3. Cost Performance Index (CPI) is cost efficiency factor that has been incurred can be shown by comparing the value of physically completed work (BCWP) with costs that have been incurred in the same period (ACWP). The formula for CPI is:

$$CPI = BCWP / ACWP \qquad \text{-------------- (3)}$$

a CPI of less than 1 indicates poor cost performance

4. Schedule Performance Index (SPI) is performance efficiency factor in completing work can be shown by the comparison between the value of work that has been physically completed (BCWP) and planned expenditure of expenses based on the work plan (BCWS). The formula for Schedule Performance Index is:

5. $$SPI = BCWP / BCWS \qquad \text{-------------- (4)}$$ etion Costs (EAC) The importance of calculating CPI and SPI is to

Statistically predict the costs needed to complete a project. There are several EAC calculation formulas, one of which is as follows $\qquad$ -------------- (5)

$$EAC = ACWP + ((BAC - BCWP) / (CPI \times SPI))$$

6. From the EAC value, it can be estimated the difference between the cost of the project completion plan (BAC) and the cost of project completion based on the performance of the work that has been achieved (EAC) or the so-called variance at completion (VAC)

$$VAC = VAC = BAC - EAC \qquad \text{-------------- (6)}$$

3. RESEARCH METHOD

The research method determines how a research process is carried out from data collection, data processing into information to be analyzed and finally produces findings that can be drawn conclusions. The data to be used is data in the form of documents, data like this can be used to dig up information that occurred in the past. Researchers need to have a theoretical sensitivity to interpret all these documents so that they are not merely meaningless items. This research will discuss in more depth how the application of earned value management methods in high-rise building projects. There are two data collection techniques commonly used in quantitative research such as the following

A. Survey method

B. Case Study Analysis Method

in the picture below will be shown how this research process. The reason for using earned value analysis to identify the weeks that are considered to have been delayed in the hope that for future projects the progress of the weeks that are experiencing delays can be minimized so that they do not experience delays again especially in high-rise building projects.
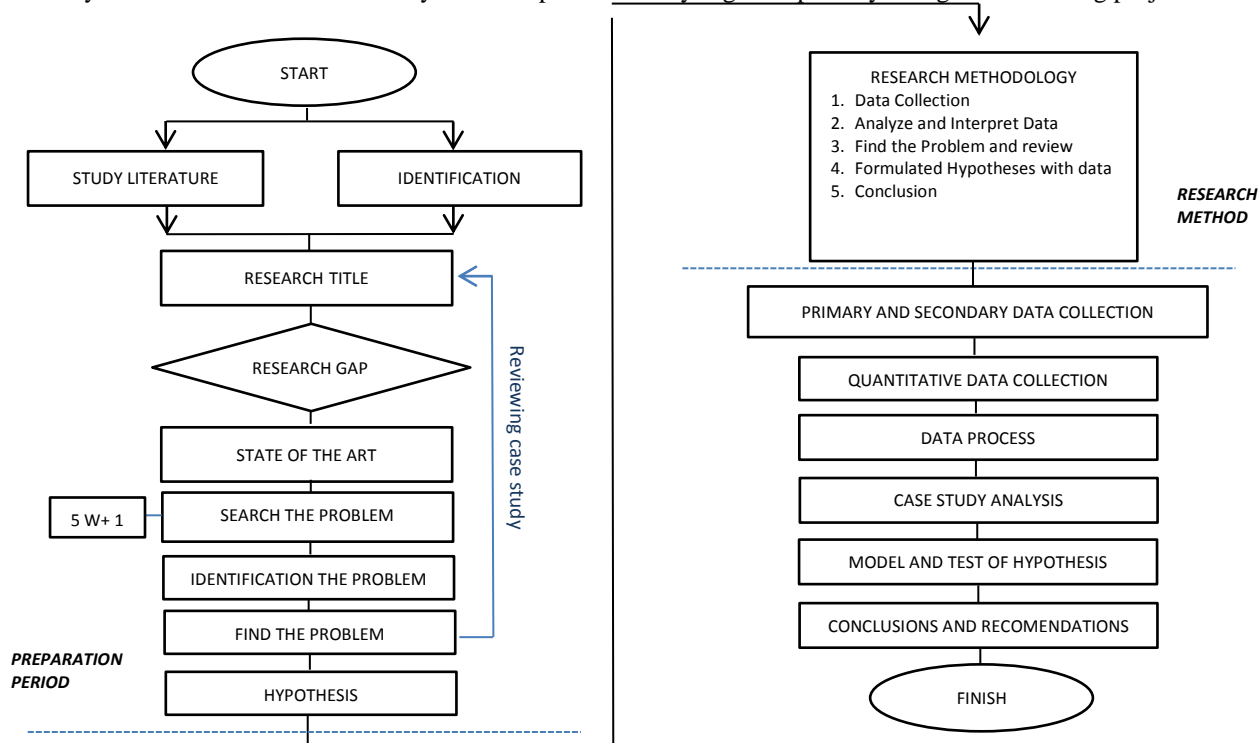
Figure 3.1 General details of research stage flow Diagram

The quantitative research technique is a research method that emphasizes aspects of measuring objectively the social phenomena. To make measurements, each social phenomenon is described in several components of the problem and indicators, and using descriptive research methods, namely the type of method that describes an object and subject being studied without engineering.

The relationship of activities, views, attitudes and processes that occur to the performance of the project in the construction of High-Risk Buildings are studied.

4. ANALYSIS

Case study in this study is a high-rise building with analysis using Earned Value Management where this method is based on the concept of the value of results for each week the progress of work that has been completed based on the theory of Quentin W. Fleming and Joel M.Koppelman in the Earned Value Project Edition Book (2000). This research activity is limited to the implementation stage from the viewpoint of Management Construction in adjusting project progress time.

4.1. Data Collection
4.1.1. Project Characteristic

Wisma Atlet Kemayoran is located on Jalan Benyamin Suaeb, Kemayoran, Central Jakarta. For Block C-2.3 consists of 18 floors with a number of residential units 524 residential units intended for official and press organizing committee of ASIAN games. The apartment has type 36 equipped with two bedrooms, a living room, a kitchen, a bathroom and a laundry area. It is estimated that in one flats unit can be inhabited by three people, so that the total capacity of the athlete's total flats reaches 22,272 people.

4.1.2 Budget and Schedule for Each Job

In this project the price of the project contract value calculated at the planning stage is Rp. 293,327,000,000 including 10% VAT, the progress of each work will be calculated for each percentage of the project increase. The following budget for each job

Table4.1. Budget and Schedule for Each Job

Number	Job description	Cost	Time (workday)
A	Preparatory work	Rp. 15.411.727.263	27
B	Planning Work	Rp. 1.885.589.805	3
C	Licensing	Rp. 2.017.735.016	4
D	Structural Work	Rp. 85.919.068.425	149
E	Architectural Work	Rp. 85,888,835,673	149
F	MEP Work	Rp. 65.921.254.626	107
G	Infrastructure Work	Rp. 31.671.441.746	60
H	Commisioning Test	Rp. 4.611.401.125	8
amount		Rp. 293.327.053.679	
simplified		Rp. 293.327.000.000	

After the research is carried out, the results for the realization of physical implementation will be almost the same as planning because using the standard implementation guidelines and RKS while maintaining the quality of the results of activities and time plans.

4.1.3 Analysis with EVM (BCWS, BCWP, ACWP, SV, CV, CPI, ETC AND EAC)

Based on the data that has been obtained, the following analysis results are obtained for each - every week that is indicated to have delayed progress:

Table4.2. EVM (BCWS, BCWP, ACWP, SV, CV, CPI, ETC AND EAC) Analysis on weeks that are experiencing delays

WEEK	BCWS (Million Rp.)	BCWP (Million Rp.)	ACWP (Million Rp.)	SV(Million Rp.)	CV(Million Rp.)	SPI (Schedule Performance Index)	CPI (Cost Performance Index)	ETC (Million Rp.)	EAC (Million Rp.)
9	4,106.58	9,093.14	9,647.17	4,986.56	-554.03	2.21	0.94	301,551.83	311,199
10	4,106.58	1,143.98	1,213.68	-2,962.60	-69.70	0.28	0.94	309,985.32	311,199
11	4,106.58	1,143.98	1,213.68	-2,962.60	-69.70	0.28	0.94	309,985.32	311,199
12	4,106.58	2,346.62	2,489.60	-1,759.96	-142.98	0.57	0.94	308,709.41	311,199
13	4,106.58	2,287.95	2,427.35	-1,818.63	-139.40	0.56	0.94	308,771.65	311,199
14	4,106.58	3,490.59	3,703.27	-615.99	-212,68	0.85	0.94	307,495.73	311,199
15	4,106.58	4,135.91	4,387.90	29.33	-252,00	1.01	0.94	306,811.09	311,199

16	4,106.58	1,554.63	1,649.35	-2,551.94	-94,72	0.38	0.94	309,549.64	311,199
17	2,053.29	-	-	-	-	-	-	309,829.72	311,199
18	2,053.29	1,290.64	1,369.28	1,270.10	-78,64	0.63	0.94	307,371.25	311,199
19	4,106.58	3,607.92	3,827.75	-498,66	-219,82	0.88	0.94	306,842.21	311,199
20	4,106.58	4,106.58	4,356.79	0	-250,21	1.00	0.94	296,572.65	311,199
21	2,933.27	1,378.64	1,462.63	-498,66	-839,98	4.70	0.94	283,191.09	311,199
22	21,266.21	26,399.43	28,007.91	5,133.22	2.359.86	1.24	0.94	307,838.05	311,199
23	997.31	3,167.93	3,360.95	2,170.62	-193.02	3.18	0.94	308,055.89	311,199
24	2,258.62	2,962.60	3,143.11	2,703.99	-180.51	1.31	0.94	308,616.05	311,199
25	2,258.62	2,434.61	2,582.95	176.00	-148.34	1.08	0.94	307,464.61	311,199
26	3,461.26	3,519.92	3,734.39	58,665.40	-214.46	1.02	0.94	307,433.49	311,199
27	3,461.26	3,549.26	3,765.51	88.00	-216.25	1.03	0.94	307,838.05	311,199
28	3,901.25	3,167.93	3,360.95	-733.32	-193.02	0.81	0.94	307,184.53	311,199
29	3,343.93	3,783.92	4,014.47	4,399.90	-230,55	1.13	0.94	307,713.57	311,199
30	3,255.93	3,285.26	3,485.43	2,933.27	-200,17	1.01	0.94	307,869.17	311,199
31	3,138.60	3,138,60	3,329.83	0	-191,23	1.00	0.94	306,375.41	311,199
32	3,725.25	4,546.57	4,823.58	821,32	-277,02	1.22	0.94	308,180.37	311,199
33	3,725.25	2,845.27	3,018.63	-879.98	-173,36	0.76	0.94	307,246.77	311,199
34	3,725.25	3,725.25	3,952.23	0	-226,97	1.00	0.94	305,161.74	311,199
35	3,725.25	5,690.54	6,037.26	1,965.29	-346,72	1.53	0.94	306,188.70	311,199
36	3,725.25	4,722.56	5,010.30	997,31	-287,74	1.27	0.94	306,126.46	311,199
37	4,429.24	4,781.23	5,072.54	351,99	-291,31	1.08	0.94	305,410.70	311,199
38	6,042.54	5,455.88	5,788.30	-586,65	-332.42	0.90	0.94	304,788.30	311,199
39	6,042.54	6,042.54	6,410.70	0	-368.16	1.00	0.94	305,908.62	311,199
40	7,626.50	4,986.56	5,290.38	-2,639.94	-303.82	0.65	0.94	303,419.02	311,199
41	10,031.78	7,333.18	7,779.98	-2,698.61	-446.80	0.73	0.94	295,078.89	311,199
42	9,474.46	15,194.34	16,120.11	5,719.88	-925.77	1.60	0.94	309,643.00	311,199
43	7,333.18	1,466.63	1,556.00	-5,866.54	-89.36	0.20	0.94	305,970.86	311,199
52	4,693.23	4,927.90	5,228.14	234.66	-300.25	1.05	0.94	304,165.90	311,199
53	5,573.21	6,629.19	7,033.10	1,055.98	-403.91	1.19	0.94	303,325.67	311,199
54	5,719.88	7,421.17	7,873.33	1,701.30	-452.16	1.30	0.94	295,981.37	311,199
55	5,690.54	14,343.69	15,217.63	8,653.15	-873.94	2.52	0.94	305,597.42	311,199
56	6,071.87	5,279.89	5,601.58	-791.98	-321.70	0.87	0.94	307.028.93	311,199
57	6,071.87	3,930.58	4,170.07	-2,141.29	-239.49	0.65	0.94	306,001.98	311,199
58	6,511.86	4,898.56	5,197.02	-1,613.30	-298.46	0.75	0.94	304,259.26	311,199
59	6,511.86	6,541.19	6,939.74	29.33	-398.54	1.00	0.94	304,259.26	311,199
60	6,511.86	6,541.19	6,939.74	29.33	-398.54	1.00	0.94	304,290.38	311,199
61	6,511.86	6,511.86	6,908.62	0	-396.76	1.00	0.94	304,414.86	311,199
62	6,394.53	6,394.53	6,784.14	0	-389.61	1.00	0.94	304,570.46	311,199
63	6,247.87	6,247.87	6,628.54	0	-380.67	1.00	0.94	306,531.01	311,199
64	6,159.87	4,399.90	4,667.99	-1,759.96	-268.08	0.71	0.94	305,410.70	311,199
65	6,159.87	5,455.88	5,788.30	-703.98	-332.42	0.89	0.94	305,130.62	311,199
66	6,482.53	5,719.88	6,068.38	-762.65	-348.50	0.88	0.94	309,829.72	311,199
67	0	-	-	-	-	-	0.94	-	311,199
68	0	-	-	-	-	-	0.94	-	311,199
69	6,541.19	4,898.56	5,197.02	-1,642.63	-298.46	0.75	0.94	306,001.98	311,199
70	6,541.19	2,581.28	2,738.55	-3,959.91	-157.27	0.39	0.94	308,460.45	311,199

72	6,541.19	6,541.19	6,939.74	0	-398.54	1.00	0.94	304,259.26	311,199
73	6,570.52	6,453.19	6,846.38	-117.33	-393.18	0.98	0.94	304,352.62	311,199
74	4,429.24	-	-	-	-	-	-	-	311,199
75	3,050.60	-	-	-	-	-	-	-	311,199
76	529.04	2,141.29	2,271.75	1,612.25	-130.47	4.05	0.94	308,927.25	311,199
77	1,089.20	381.32	404.56	-707.87	-23.23	0.35	0.94	310,794.44	311,199
78	933.60	527.99	560.16	-405.61	-32.17	0.57	0.94	310,638.84	311,199
79	1,493.75	3,079.93	3,267.59	1,586.18	-187.66	2.06	0.94	307,931.41	311,199
80	1,493.75	1,085.31	1,151.43	-408.44	-66.13	0.73	0.94	310,047.56	311,199
81	1,462.63	1,349.30	1,431.51	-113.33	-82.21	0.92	0.94	309,767.48	311,199
82	1,431.51	762.65	809.12	-668.87	-46.47	0.53	0.94	310,389.88	311,199
83	1,400.40	2,170.62	2,302.87	770.22	-132.25	1.55	0.94	308,896.13	311,199
84	1,400.40	703.98	746.88	-696.41	-42.89	0.50	0.94	310,452.12	311,199
85	1,369.28	1,290.64	1,369.28	-78.64	-78.64	0.94	0.94	309,829.72	311,199
86	1,182.55	1,202.64	1,275.91	20.08	-73.28	1.02	0.94	309,923.08	311,199
87	591.28	674.65	715.76	83.37	-41.10	1.14	0.94	310,483.24	311,199
88	-	117.33	124.48	-	-7.15	-	0.94	311,074.52	311,199
89	-	88.00	93.36	-	-5.36	-	0.94	311,105.64	311,199
90	-	58.67	62.24	-	-3.57	-	0.94	-	311,199
91	-	2,141.29	2,271.75	1,612.25	-130.47	4.05	0.94	-	311,199
92	-	381.32	404.56	-707.87	-23.23	0.35	0.94	311,136.76	311,199

Based on the above calculation, values from BCWS, BCWP, ACWP, CV and SP can be obtained from each delay point in the 9th week to the 22nd week, 22nd week to 41st week, 41st week to week 43, 52nd week to 70th week, and 72nd to 92nd weeks, after the values obtained from BCWS, BCWP, ACWP, CV and SP are used as calculations to calculate the CPI and SPI percentage index as a basis for assessment the productivity performance of the project. ETC and EAC are used as a foundation or cost estimate that has been used in the project work.

4.1.4   EVM CHARTS AND GRAPHS (ACWP, BCWP & BCWS)

Analysis of the amount of budget allocated based on work plans that have been prepared against time (ACWP, BCWS and BCWS). ACWP, BCWS and BCWS values per week can be obtained based on weekly weights in the Time Schedule budget, calculated as follows:
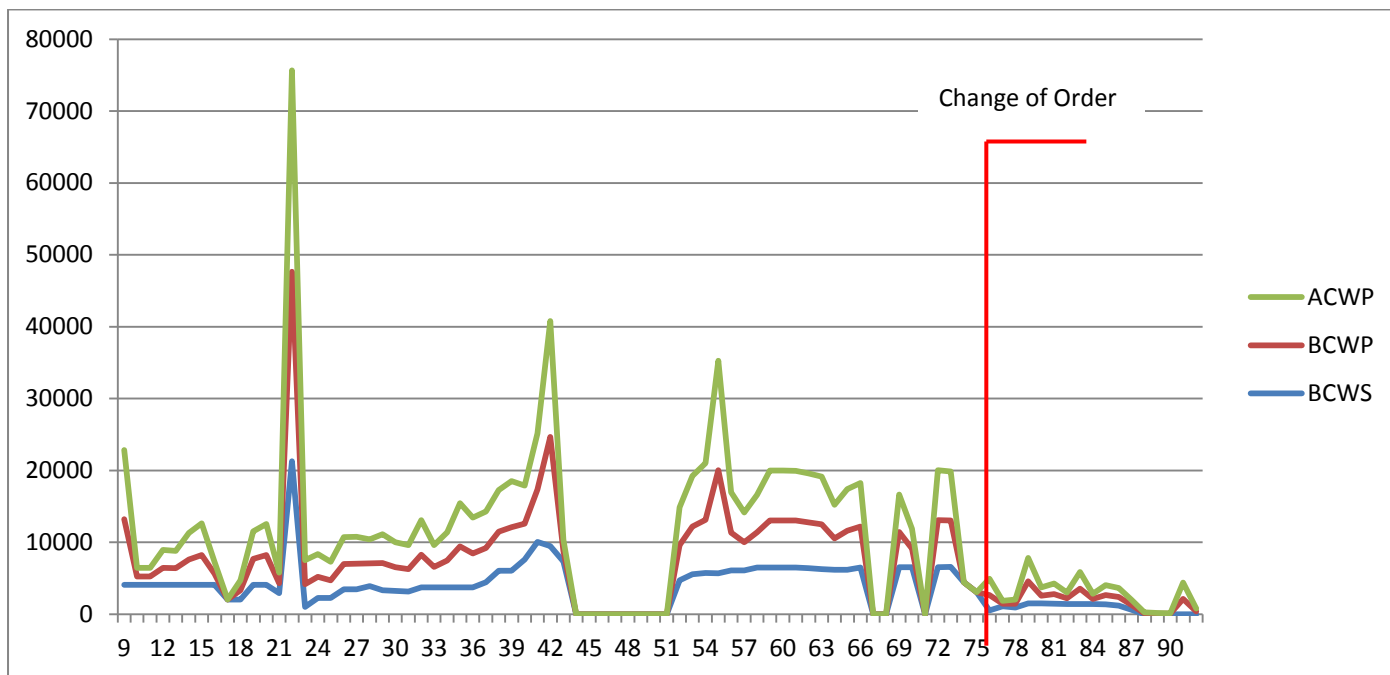
Figure4.1: EVM CHARTS AND GRAPHS (ACWP, BCWP & BCWS) Analysis on weeks that are experiencing delays

in the 9th to 22th of the work done includes the Design Concept Phase, Designing, Design Development and Planning Work, Preparation, some of the Detailed Design and Periodic Control Stages, In the 22nd to 41st week the work undertaken includes several Detailed Design Stages, Periodic Supervision Stages and Lower Floor Structure Work, 1st to 16th floors, Some Architectural and Mechanical Electrical work, planning and preparation work, In the 41st to 43rd week the work undertaken includes several Detailed Design Stages, Periodic Supervision Stage, Structural Work 16th to 18th floor, Some Architectural and Mechanical Electrical work, Basic Facilities and Infrastructure, In the 52nd to 70th week the work undertaken includes several Detailed Design Stages, Periodic Oversight Phase, Architectural, Electrical Mechanical, Planning and preparation stages, Basic Facilities and Infrastructure, In the 72nd to 92th week the work undertaken includes some architectural work, electrical mechanical, basic infrastructure and facilities, procurement and installation of AC utilities, landscaping, addition of procurement and installation of AC utilities. Due to the addition of work items to Addendum 04, there was an addition to the initial project value of Rp. 293,327,000,000 to Rp. 311,199,000,000 and the previously planned progrees had reached 100% in the 75th week to 95.56% in the 76th week.

4.1.5   SPI and CPI PIE CHART DIAGRAM

SPI and CPI assessments are needed to assess project performance every week, both cost and schedule progress as follows:
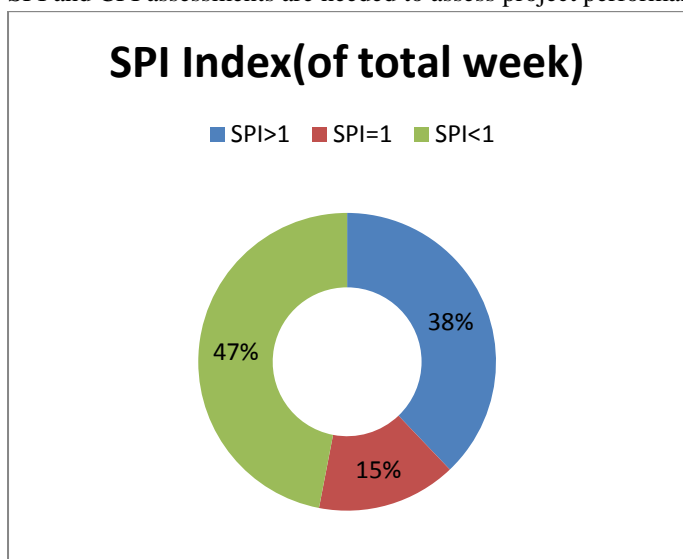

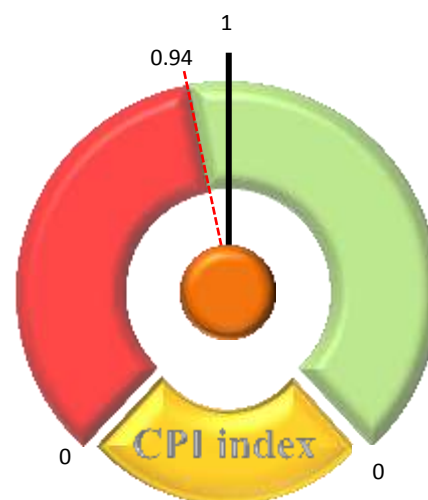**Figure 4.2 . SPI Index PIE Chart Diagram**

Figure 4.3 CPI Index PIE Chart Diagram

In the 9th week until the 22nd week the SPI index is considered unstable because some work is required to be completed on time as scheduled, in the 15th week to the 17th week, 19th to 20th week and the 21st to 22nd week has decreased significant performance. For the performance of the cost itself is considered quite stable. The decrease occurred on weeks 16 to 17 and the increase occurred on weeks 17 to 18, The increase in schedule performance occurred in the 22nd to 23rd week, 28th to 29th week, 31st to 32nd week and 33rd to 35th week, the decline occurred in 23rd to 26th week, 32nd to 33rd week, 35 to 38 and 39 to 40 weeks. For costs incurred based on CPI in the 23rd to 41st week suffered a loss with a CPI value <1 that is equal to 0.9,

The increase in performance of the scheduled schedule occurs in weeks 41 to 42 weeks and then decreases in 42 weeks to 43 weeks. For costs incurred losses due to CPI <1 is equal to 0.94. with SPI and CPI <1 required a review of work in these weeks,

In the 52nd to 70th week the SPI index is considered unstable because some work is required to be completed on time as scheduled, at 55th week to 57th week, 63rd to 64th week, 66th week to 67th week and week 69 to 70 experienced a significant decrease in performance. For the performance of the cost itself, the costs incurred are incurred due to a CPI <1 of 0, In the 72nd to 92nd week the SPI index is considered unstable because some work is required to be completed on time as scheduled, at weeks 76, 77, 79 to 80, weeks 81 to 82, weeks 83 to to 84, and weeks 87 to 88 experienced a significant decrease in performance. Costs incurred incur losses due to a CPI <1 of 0.9

5. CONCLUSION

Delay in progress can be seen through SPI and CPI Based on the analysis in chapter IV, the following conclusions are obtained:

1. Earned Value Management (EVM) is applied to the weeks indicated experiencing delays in the 9th to 22nd weeks, 22nd to 41st weeks, 41st to 43rd weeks, 52nd to 70th weeks and weeks 72 to weeks 92.
2. Project progress schedule index (SPI) based on the analysis results obtained delays occur in weeks as in the following table

Table4.2. SPI Index based on weeks of delay

Week number	SPI Index
28, 33, 58, 69	0.8
38, 56, 65, 66, 81, 85	0.9
40, 41, 57, 64, 80	0.7
43	0.2
57, 64, 80	0.7
70, 77	0.4
78	0.6
82, 84	0.5

3. Factors that cause delays and cost increases are relatively short time for the calculation process, material prices fluctuate so that they cannot predict material prices during implementation, limited implementation time so as to enable the contractor to be fined, conditions in the field are different from the picture is in the contract, ordering goods that are not according to plan, the billing process takes longer because they have to check the quantity of work first by the project owner.
4. From the statement number 2 above there are 21 weeks which are fully delayed with the lowest SPI delay being 0.9 at weeks 38, 56, 65, 66, 81 and week 85, the biggest SPI delay is 0.2 occurring at week 43, seen in weeks the week above the project has been delayed. In the costs incurred can be seen based on the CPI, namely in the 9th week until the 22nd week the costs incurred showed a profit with a CPI> 1 which is 9.43. On the 23rd week the CPI was seen to have decreased, in this case on the 23rd to 92nd week the costs incurred were greater with a CPI <1 of 0.94, which means the project suffered losses that week.
5. Over cost issued based on the Cost Performance Index (CPI) which occurs in the 41st week to 43rd week and 52nd week to 70th week with a CPI index of 0.94 for each week.

REFERENCES

1. Subandiyah Azis et al, ' Optimization of Rescheduling and Economy Analysis of the Implementation of Kwitang Office Park Building Construction Project in Jakarta', *Contemporary Engineering Sciences*, Vol. 10, 2017, no. 7, 317 – 333

2. S.M.B.Jaswanth et al, OPTIMIZATION OF PLANNING, SCHEDULING, AND CONTROL OF HIGH RISE CONSTRUCTION PROJECTS, *International Journal of Civil Engineering and Technology (IJCIET)*, Volume 9, Issue 4, April 2018

3. Wallace Agyei, Project Planning And Scheduling Using PERT And CPM Techniques With Linear Programming: Case Study, *INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH*, VOLUME 4, ISSUE 08, AUGUST 2015

4. Rama.S et al , A Study on Project Planning Using the Deterministic and Probabilistic Models by Network Scheduling Techniques, *Int. Journal of Engineering Research and Application*, Vol. 7, Issue 3, (Part -4) March 2017

5. de Souza, A. D., et. al. , 2015. A Proposal for the Improvement of Project s Cost Predictability Using Earned Value Management and Historical Data of Cost An Empirical Study. International Journal of Software Engineering and Knowledge Engineering.

6. Khesal, T., et. al. 2018. Integrated cost, quality, risk and schedule control through Earned Value Management (EVM). *Journal of Engineering, Design and Technology*. https://doi.org/10.1108/JEDT-07-2018-0119

7. Yoga Tryas Pratama & Budi Susetyo, 2019. Cost Analysis of Facade Work in High-Rise Building by Value, *International Journal of Engineering Research and Advanced Technology (IJERAT)*, Volume 5.

8. Padhye, S.L. (2000). Implementation: A Problem For Value Management Pratitioner. SAVE International Confrence Proceeding

9. Adi Lukman Amir & Budi Susetyo, 2019. EVALUATION OF COST AND TIME USING EARNED VALUE METHOD (EVM) AND STRUCTURAL EQUATION MODELING (SEM) IN PARKING BUILDING PROJECTS, *https://repository.mercubuana.ac.id/view/divisions/557/2019.default.html*