

Productivity Analysis Using the Critical Chain Project Method Management (CCPM) on Repair Projects Geomarin-III ship 649 DWT.

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Abstract—Ship repair project planning still often encountered problems that delay ship repair projects to achieve complete ship repair projects. Delays are due to frequent mismatches between ship repair scheduling and conditions that occur at the shipyard. The most commonly used method is the Critical Path Method (CPM). But in reality, the CPM method is considered less effective because there is still safety time for each job. Technological developments found the latest method, namely Critical Chain Project Management (CCPM). This method removes the safety time contained in the CPM method and replaces it with buffer time which is placed at the end of work activities. This study aims to analyze the duration of the critical path, determine labor costs, and the amount of buffer duration on the repair of the Geomarin-III 649 DWT ship. Based on the calculation results obtained on the repair of the Geomarin-III 649 DWT ship with the Critical Chain Project Management (CCPM) method is 10 days, 10 days faster than the normal duration. The labor cost obtained using the CCPM method is IDR. 54,017,500, saving 35% of the normal cost is IDR. 82,680,000, but if the buffer time is used thoroughly, the total estimated labor cost for the CCPM method will increase due to the addition of labor and the duration of the buffer time obtained by the CCPM method as a substitute for safety time, which is 9 days project buffer and 3 days feeding buffers. Based on this research, it was found that the CCPM method is considered effective and can accelerate the duration of the project and minimize labor costs.

Keywords— Buffer Time; Cost; CCPM; CPM; Project Schedule

I. INTRODUCTION

In carrying out a project, several factors such as time, cost, efficiency, effectiveness, and efficiency must be taken into account, including ship repair, which of course greatly affects the completion of a berth repair project during project implementation, new construction, or ship repair. Ship repair project planning is still often a problem in the process of delaying ship repair projects to complete the ship repair project. Delays are due to frequent mismatches between ship repair scheduling and conditions that occur in the shipyard, therefore the scheduling function in the company plays an important role in completing several jobs within a close time [1]. Based on a previous study entitled Productivity in Shipyard Repair Activities that factors such as the number of workers and effective working hours are two factors in optimizing performance productivity in a shipyard [2]. With the above problems, technological advances and knowledge of project management, especially in ship repair projects. The most frequently used analysis is the Critical Path Method (CPM). CPM is a scheduling method for determining the longest duration of the

longest chain of events to complete a project [3]. However, in reality, what happens in the field, planning using CPM and other traditional methods is considered less effective because it does not take into account individual work productivity and related problems due to human behavior which tends to increase project completion time. Examples are the human behavior of student's syndrome, Parkinson's law, multitasking, and overestimated activity durations [4]. This study aims to analyze the duration of the critical path, determine labor costs, and the amount of buffer duration on the repair of the Geomarin-III 649 DWT ship.

Previous research on the comparison of the CPM method and the CCPM method proved that the CPM method or the traditional method in actualization was less effective due to the addition of buffer time for each project activity. In addition, the traditional CPM technique faced several problems such as student's syndrome, Parkinson's law, multitasking, and deliberate padding. Also, the CPM method in previous studies has an overestimation of 93% so it requires substantial continuous steps for project management knowledge [5]. This method is known as Critical Chain Project Management. Critical Chain Project Management is a method that was first introduced by Eliyahu M. Goldratt in 1997. This CCPM method

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Figure 1. Geomarin-III 649 DWT Ship

applies the steps of the Theory of Constraints in its application in project implementation so that the completion of the project will be faster with minimal costs and without changing the limitations of a project [4]. Referring to previous research, based on the results of the analysis, there was a reduction of 12 days from the normal duration of 60 days to 48 days with changes in project costs from IDR 450,840,000 to IDR 258,995,000 with a reduced cost of IDR 191,845,000 compared to initial costs [6].

Based on the description above, we propose the following hypothesis, this CCPM method will reduce the duration of the repair project, reduce costs and increase productivity.

II. METHOD

In the preparation of this research, it is necessary to develop a basic framework that will serve as a reference for case study analysis. For the process of preparing this Final Project, data on the object to be analyzed is needed, while the process carried out is divided into several stages, including

A. Research Methods

The research method is the main method used by researchers to achieve goals and determine answers to the problems posed [7]. In this study, the authors use quantitative research methods. Quantitative research is a research procedure that produces data in the form of numbers and is generally analyzed using descriptive or inferential statistics [8]. The purpose of this research is to make a repair schedule for the Geomarin-III 649 DWT ship using the Critical Chain Project Management (CCPM) method.

B. Theory and Research References

In the preparation that will be presented in this Final Project from various references such as books, journals, and others. The topics read in the literature study focused on several things, including:

1. Geomarin-III Ship repair list data.
2. Repair schedule realization data.
3. PT. Dok Bahari Nusantara shipyard productivity data.
4. Manual Book and journal on CCPM theories.
5. Manual Book of the software used.

C. Research Data Collection Techniques

Data collection techniques are the most strategic step in research because the main purpose of research is to get data [9]. Data collection is carried out using observation techniques. Observation is a data collection method that uses direct or indirect observation [9]. In this study, the authors made observations on the 649 DWT Geomarin-111 ship. In addition, data collection techniques are also carried out by requesting documents to obtain data in the form of repair lists, Main schedules, and also productivity data of PT Dok Nusantara Bahari shipyard, Cirebon.

D. Primary Data

The data to be processed related to the ship repair project planning is divided into two parts, namely primary data and secondary data. Primary data is data that is directly collected by researchers from question sources [10]. Primary data becomes material for data analysis which is processed using Microsoft Projects such as main ship size data, Geomarin-III Ship Main Schedule, Repair List, and shipyard productivity.

1. Main Particular Ship

TABLE 1.
MAIN PARTICULAR SHIP

<i>Ship Name</i>	<i>Geomarin-III</i>
<i>Length Over ALL (LOA)</i>	<i>61.72 m</i>
<i>Length Between Perpendiculars (LPP)</i>	<i>55.88 m</i>
<i>Breadth Moulded (B)</i>	<i>12 m</i>
<i>DWT</i>	<i>649 ton</i>
<i>Draught (T)</i>	<i>3,70 m</i>
<i>GT</i>	<i>1254</i>
<i>Speed</i>	<i>13.5 knot</i>

MAIN SCHEDULE														
Geomarin III Ship Maintenance Work														
YARD No. :		Not Decided												
NAME OF PROJECT :		Ship Maintenance Work												
OWNER :		MINISTRY OF ENERGY AND MINERAL RESOURCE RI												
Item Pekerjaan	Units	Volume	Weight Each Items (%)	DAY							SEA TRIAL	Number of Days	Manpower Total	Manhour Total
				#	#	#	#	#	#	#				
I. GENERAL SERVICE														
1. Dry Docking				CONTRACT										
Ship docking and undocking	time	1	1									2	12	192
2. Assistensi Docking														
Vessel assistance service when boarding	time	1	1.40									1	5	40
Fresh water is given after docking to fill the fresh water tank and ballast tank	Ton	150	0.80									1	3	24
II. WORK UNDER WATER SURFACE AREA (WSA)														
1. Hull Cleaning (Scrap, fresh water wash,	m2	900	10.43									4	5	160
2. Checking (Ultrasonic and shell exp	point	500	1.40									1	2	16
3. Replacement of good quality zinc anode	piece	65	4.77									3	3	72
4. Underwater hull painting and Draft	m2	900	23.31									9	7	504
5. Propulsion System														
Dismantling and cleaning of 2 propeller blade units (polished, varnished, and static	unit	2	2.82									11	5	440
Replacement of Zinc Anode on 2 good	piece	8	0.44									1	2	16
Steering steering shaft clearance	piece	1	0.17									2	2	32
6. Inspection and repair of AS Thrust												3	4	96
Repair of Thrust Bearing / Plummer Block	unit	1	1.19									6	3	144
Replacement of Plummer Block Mechanical	piece	2	1.39									3	2	48
Replacement of Retaining Seal /	piece	2	1.04									4	5	160
7. Revocation of the right AS Propeller to support the repair of the thrust bearing housing	LS	1	1.60									2	2	32
Measuring the propeller shaft clearance and	unit	1	0.16									9	3	216
8. Disassembly and cleaning of Bow	LS	1	2.88									8	7	448
III. PAINTING ON THE WATER SURFACE														
1. Painting the hull on the water, Ship	m2	425	6.51											
IV. DECK WORK														
A. Winch Anchor														
1. Cleaning and painting of 2 anchors,	seal	14	0.63									7	5	280
2. Replacement of the left and right anchor	piece	2	0.67									2	4	64
3. Repair / replacement of anchor oil seals	set	2	0.06									2	2	32

Figure 2. Screenshot from Ms. Excel showing part of the ship repair main schedule.

The Geomarin-III ship is a ship belonging to the Marine Geology Research and Development Center of the Ministry of Energy and Mineral Resources which is carrying out the repair process at PT Dok Bahari Nusantara, Cirebon. Based on the work contract entered into by PT Dok Bahari Nusantara with the Ministry of Energy and Mineral Resources, the Geomarin-III ship repair project was carried out for 20 days.

2. Main Schedule

The main schedule is a ship repair schedule made by the shipyard, an example of some of this data can be seen in Figure 2. Data from the shipyard is not fully displayed in this study because it is company data.

3. Shipyard Productivity

At the PT Dok Bahari Nusantara Shipyard, there are two cranes used as lifting aids with a capacity of 75 tons and 50 tons, and the Bahari Nusantara Dock itself does not have a graving dock but instead repairs the Geomarin III ship. , the owner rented a graving dock at the adjacent wharf. PT Dok Bahari Nusantara repairs around 10 ships and 6 new ships a year.

E. Secondary Data

Secondary data is data obtained or collected by people conducting research from existing sources. This data is used to support primary information that has been obtained, namely from library materials, literature, previous research, books, etc [11]. Secondary data is needed to complement existing primary data, some supporting documents such as journals, manuals, articles, and research data have been researched previously to examine previously studied problems, problems, and solutions.

F. Research Data Processing Technique

The steps taken in data processing begin with data collection from ships that refer to primary data. Human resource productivity analysis and critical path analysis are then applied to Microsoft Project Software.

G. Research Step

1. Scheduling Analysis using Network Diagram

The use of a Network Diagram using WBS in scheduling makes it easier to divide work activities into more detail so that the existing work trajectory is known as well as the critical trajectory so that the priority of work activities can be managed first, then the Earliest Event Time (EET) or Latest Event Time (LET) can also be determined to determine the overall project duration.

2. Analysis of Scheduling Calculations Using CCPM

This method is a development method of the Critical Path Method (CPM) and also this method optimizes workers and eliminates the safety time contained in the CPM method and replaces it with buffer time which is placed at the end of work activities. Buffer Time consists of feeding buffer and project buffer. A feeding buffer is a time buffer that relates non-critical activities to critical activities. Its function is as a backup time if there is a delay in non-critical activities. Project Buffer is a spare time that is placed at the end of all project activities as a time reserve for the entire project.



Figure 3. Shipyard Layout

Task Mode	Task Name	Duration	Start	Finish	Predecessors
1	Geomarin-III Ship Project	20 days	Sat 20/03/21	Thu 08/04/21	
2	General Service	20 days	Sat 20/03/21	Thu 08/04/21	
3	Docking Assistant	1 day	Sun 21/03/21	Sun 21/03/21	
4	Docking	1 day	Mon 22/03/21	Mon 22/03/21	3
5	Undocking	1 day	Tue 06/04/21	Tue 06/04/21	21;23
6	Docking report	16 days	Tue 23/03/21	Wed 07/04/21	4
7	Fresh water provider after docking (ballast tank)	1 day	Wed 07/04/21	Wed 07/04/21	5
8	II. Underwater Hull Repair				
9	Hull Cleaning	4 days	Mon 22/03/21	Thu 25/03/21	4FS-1 day
10	Ultrasonic Checks and Expansion shell reports	1 day	Tue 23/03/21	Tue 23/03/21	4

Figure 4. Duration and Predecessor

In the calculation of the buffer in this study using the Root Square Error Method (RSEM). The calculation of the buffer time can be seen in equation 1.

This method uses two time parameters, namely the safe estimation time (S) and the fastest time (A) which is assumed without backup time. Both estimates are 50% of the work duration. Supporting data for conducting this research are the repair list, main schedule, number of workers and working hours, labor costs, volume and weight of each job, and data on the main size of the Geomarin-III 649 DWT ship.

$$2\sigma = \sqrt{(S_1 - A_1)^2 + \dots + (S_n - A_n)^2} \quad (1)$$

3. Labor Cost Analysis

After calculating the total duration of the method and Critical Chain Project Management (CCPM), the next calculation of direct labor costs is based on data on working hours and the number of workers (manpower).

The following labor costs are applied at the PT Dok Bahari Nusantara Cirebon shipyard on the Geomarin-III 649 DWT survey ship repair project. As for the working day in the geomarin ship repair project, it is carried out from Monday to Sunday with working hours of 8 hours per day, starting from 08.00 WIB-17.00 WIB. The following is labor data on the Geomarin-III Ship repair project obtained from the shipyard. In working on a project, the role of labor is a very large influence on the shipyard company, the better the workforce, the higher the company's income. On that basis, the selection of workers according to the project becomes very important. Often, human resource constraints hinder project work, such as a lack of qualified labor, which is caused by a lack of trained and qualified labor in their fields, but it is not surprising that this can be overcome thanks to work experience. Some time, labor cost data is obtained from the shipyard and differs depending on the region.

TABLE 2.
LABOR ON GEOMARIN-III SHIP REPARATIONS

No	Type of Worker	Number of Workers
1	General worker	26
2	Welder	5
3	Painter	7
4	Sandblasting	5
5	Mechanic	5
6	Surveyor	2
7	Administrative	3

TABLE 3.
LABOR COST

Labor Cost	Cost
Normal day cost	IDR 16,250/hour
Overtime day cost	IDR 32,500/hour

TABLE 4.
CRITICAL PATH ACTIVITY AT NORMAL DURATION

No	Job Name	LS	ES	TF
1	Docking Assistant	0	0	0
2	Docking	1	1	0
3	Hull cleaning	1	1	0
4	Propeller retraction	1	1	0
5	Ultrasonic check	2	2	0
6	Underwater hull painting	5	5	0
7	Thrush-bearing home repair	5	5	0
8	Painting the hull over water	8	8	0
9	Disassembly and cleaning of the propeller	8	8	0
10	Undocking	18	18	0
11	Class supervision	18	18	0
12	Sea trial	18	18	0
13	Delivery	19	19	0

4. Results of Data Analysis

After the calculation of CCPM, the results obtained can be reviewed from the steps given above, the duration of the work with the CCPM method is known as also the cost of the workers involved.

III. RESULTS AND DISCUSSION

The data that has been obtained is then analyzed using the help of the Microsoft Project application so that results and discussions are obtained. The followings are the results and discussion based on the analysis conducted in this study.

A. Project Scheduling Using the Critical Chain Project Management (CCPM) Method

The first step in planning scheduling is to determine the order between work activities on the repair project with the help of a project management application, namely Microsoft Project. The operation of this software has flexibility that allows users to handle projects easily because there are features such as Gantt charts, flowcharts, and resource handling that can help projects run more efficiently. With the help of this

software, it will also facilitate the use of unequal resources and obtain the essential duration for the repair project [12]. In determining the sequence of work activities, it is necessary to pay attention to the relationship between jobs so that there is continuity and does not cause conflicts between jobs. The purpose of determining the relationship between activities is to determine the sequence of activities from the beginning of the start of the work to its completion as a whole so that it can be known which work must be done first.

The predecessor is activity before or that precedes the activity in question, while for Successor is all activity after or after the activity in question. The critical path contains work activities if the implementation is late it will cause the project to experience overall delays. Determining the work contained in the critical path requires counting forward and counting backward to determine the values of ES, EF, LS, and LF. These values are known, so it can calculate the total slack time for each activity. Critical path jobs are jobs that have a total slack value = 0 [13].

		Resource Name	Type	Initials	Peak	Max.
1		Worker	Work	W	28	26
2		Welder	Work	W	5	5
3		Painter	Work	P	14	7
4		Sandblaster	Work	S	5	5
5		Mechanic	Work	M	12	5
6		Surveyor	Work	S	2	2
7		Administrator	Work	A	1	3

Figure 3. Screenshot Resource Sheet from Ms. Project

TABLE 5.
 CALCULATION OF PROJECT BUFFER

No	Job Name	Normal Duration (S)	Fastest Duration (A)	$(S - A)^2$	$(S - A)^2$
1.	Docking Assistant	1	0,5	0,5	0,25
2.	Docking	1	0,5	0,5	0,25
3.	Hull cleaning	1	0,5	0,5	0,25
4.	Propeller retraction	4	2	2	4
5.	Ultrasonic check	1	0,5	0,5	0,25
6.	Underwater hull painting	9	4,5	4,5	20,25
7.	Thrush-bearing home repair	3	1,5	1,5	2,5
8.	Painting the hull over water	4	2	2	4
9.	Disassembly and cleaning of the ropeller	9	4,5	4,5	20,25
10.	Undocking	8	4	4	16
11.	Class supervision	2	1	1	1
12.	Sea trial	1	0,5	0,5	0,25
13.	Delivery	1	0,5	0,5	0,25
<i>Total</i>					69,25

To determine the completion time, there are several terms as follows: ES (Earliest activity start time) is the earliest time an activity starts. EF (Earliest activity finish time) is the earliest completion time of an activity. LS (Latest activity start time) is the latest time when activities can be started without causing delays in the project completion process. LF (Latest activity finish time) is the latest time when the activity is completed without creating a delay in the project completion process [14].

As the next step, after obtaining the critical path from the initial duration, the safety time cut for each project activity is cut by 50%. Cutting safety time aims to eliminate time wastage and reduce the impact of constraints so that the application of the Theory of Constraints will get a significant acceleration of work and project completion [15].

Slack Time means the amount of time allowed for a job to be delayed, provided it does not affect the total duration of the project. There are two types of Slack Time (Float), namely total float and free float. The slack time that will be used in this project scheduling calculation is Total Float. The critical path obtained previously did not change after cutting the duration, the only difference being that the duration became faster.

This method is the development of the Critical Path Method and considers the effects due to resource transfer, resource optimization, resource sharing, and duration of activities from the critical path determined by the Critical Path Method. To make this happen, CCPM uses the concept of buffer and buffer management. CCPM uses activities that do not include safety time or safe time but replace it with buffer time or reserve time. Buffer Time consists of feeding buffer and project buffer. A feeding buffer is a time buffer connecting non-critical activities with critical activities. Its function is as a reserved time if there is a delay in non-critical activities. Project Buffer is a spare time that is placed at the end of all project activities as a reserve for the entire project [16]. In Figure 4 there is a predecessor and duration of the Geomarin-III 649 DWT ship repair project

The results obtained after determining the relationship between work activities will form a critical path / critical path which can be seen in table 4.

B. Reducing Safety Time with the Root Square Error Method (RSEM).

This method uses two time parameters, namely the safe estimation time (S) and the fastest time (A) which is assumed without backup time. Both estimates average 50% of the work duration. This method is used to determine the project buffer and feeding buffer. The Project Buffer is used to protect the final project completion time from schedule uncertainty in critical path activities. The project buffer is placed at the end of the project after the activity in the last critical network. In this case, the cut in duration used a 50% presentation to determine the fastest duration. Feeding Buffer is a time buffer that connects non-critical activities with critical activities.

Its function is as a backup time if there is a delay in non-critical activities. For feeding buffers on non-critical jobs, the following is done following the calculation of feeding buffers on replating jobs. For feeding buffers on non-critical jobs, the following is done following the calculation of feeding buffers on replating jobs. The following is the calculation of the project buffer contained in table 5.

Project Buffer:

$$\begin{aligned} 2\sigma &= \sqrt{(S_1 - A_1)^2 \dots + (S_n - A_n)^2} \\ &= \sqrt{69,25} \\ &= 8,321 \approx 9 \text{ Working Days.} \end{aligned}$$

The Project Buffer is placed at the end of the critical path (Critical Chain). Based on the calculation of buffer time in scheduling using the Critical Chain Project Management (CCPM) method, the repair duration is 10 days, with a 9 days project buffer and 3 days feeding buffer.

C. Identifying and Eliminating Workforce Multitasking.

After reducing the activity duration by 50% from the next schedule, namely eliminating multitasking activities or doing two or more jobs at one time. This is done by using the resource leveling method when resources perform the same activity at the same time or commonly.

The painter added 7 workers to eliminate the error, because the painter's job was on the critical path. Added so as not to change the critical path of the scheduling results. While the mechanical workers added 7 workers. Where the 7 additional mechanics is a minimum of workers to minimize worker costs.

D. Labor Cost Calculation.

The calculation of direct costs is obtained from collecting data on wages applicable to the Geomarin-III 649 DWT ship repair project. The amount paid depends

on the location of the shipyard because each region has a minimum wage paid to each worker. Cost budget analysis was carried out using the Microsoft Excel application to make it easier for writers to calculate labor costs and Microsoft Project as a planning application regarding workforce needs. In the CCPM method, there is a 10% increase in labor wages due to the application of the Theory of Constraints to reduce human error, namely Parkinson's law.

The following is the result of calculating normal duration labor costs and calculating labor costs using the CCPM method. based on the duration of each activity with the number of workers in that activity. The following is the calculation of labor costs for Docking work:

- Number of Workers = 12 people
- Activity duration = 1 day
- Total Mandays = Job Duration x The number of workers
- Total Mandays = 1 x 12 = 12 Mandays.
- Manhour fee = (Cost of work per day)/(total working hours per day)
- Manhour fee = IDR 130,000/8 hours = IDR 16.250/hour

In this repair project, Saturdays and Sundays are included in overtime work. The cost of labor on overtime is IDR. 32,500/hour. The total duration of docking activity is 1 day using 1 worker per day and the labor cost per day is IDR. 130,000 and overtime wages of IDR. 260,000, so the total cost of painting the water hull is IDR. 1,560,000. In the CCPM method, there is an increase in workers' wages by 10% based on the application of the Theory of Constraints. The labor cost that has been calculated by the CPM method is IDR. 82,680,000 and the CCPM method is IDR. 54,017,500 with a cost difference of IDR. 28,677,500 and the percentage comparison is 35%. The average cost per day using the CCPM method is IDR. 947,558.63. The following is the estimated buffer calculation time when used. Calculation of estimated buffer time = average daily labor cost x duration of buffer time

- Calculation of estimated buffer time =
IDR. 947,558.63 x 9 days = IDR 8,528,027.

If the buffer is consumed for 9 days the fee paid will increase by 14% from the CCPM method, due to the addition of labor and an increase in worker wages by 10%. The use of buffer time is adjusted to the needs if there is a delay in both the critical and non-critical paths. In this CCPM method, the buffer time is placed at the end of work activities to prevent work delays from the schedule that has been made.

TABLE 6.
 COMPARATIVE CALCULATION OF LABOR PRODUCTIVITY

No	Job Name	CPM Labor Productivity (m ² /day)	CCPM Labor Productivity (m ² /day)
1.	Hull Cleaning	45	90
2.	Underwater hull painting	3,376	6,752
3.	Painting hull over the water	7,589	15,178
	Average	18,655	37,310

E. Productivity

Productivity describes the ability of workers to complete a quantity of work per unit of time. Productivity in repairs is broadly defined as the output per day of labor, so it can be formulated as follows:

$$\text{Productivity} = \frac{V}{T \times n} \quad (1)$$

An example of calculating worker productivity in one of the work activities in the upper water painting section where (v) = quantity of work, (T) = duration of work, (n) = a number of workers as follows:

$$\begin{aligned} \text{Productivity} &= \frac{V}{T \times n} \\ &= \frac{425 \text{ m}^2}{8 \times 7} \\ &= 7,589 \text{ m}^2/\text{day} \end{aligned}$$

The calculation of labor productivity for each job can be seen in table 6. After doing the calculations, the average value of normal duration productivity is 18.655 m²/ day while the productivity of duration using the CCPM method is 37.310 m²/ day. So, with the Critical Chain Project Management (CCPM) method, workers become more productive than before.

IV. CONCLUSION

The results and conclusions obtained after processing the data on the Geomarin-III 649 DWT ship repair Comparison in terms of time the results of the Geomarin-III ship repair project duration on schedule with the Critical Chain Project Management (CCPM) method are 10 working days, 10 days faster work of normal duration. The labor cost obtained by using the Critical Chain Project Management (CCPM) method is IDR. 54,017,500 save 35% of the normal cost, which is IDR. 82,680,000, but if the buffer time is consumed for 9 days, the labor cost will increase by 14% due to an increase in the number of workers and an increase in worker wages by 10%.

Based on the results of calculations on the total duration using the CCPM method, the duration that will be obtained will be faster than the normal duration because it uses the Root Square Error Method (RSEM) method in determining the amount of buffer time with a 50% cut percentage to eliminate safety time for each activity and the duration of the buffer time obtained by the CCPM method as a substitute for safety time is 9 days of project buffer and 3 days of feeding buffer.

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