

LPD Ship Construction Planning Strategy At A Large-Scale Shipyard In East Java

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Abstract—The construction of the Landing Platform Dock (LPD) 163 M ship in the Warship Division of PT. XXX Indonesia is a project with a high level of complexity that requires effective project schedule control to minimize work delays. This study aims to analyze the construction scheduling of module I and module II using the Critical Path Method (CPM). The research method used is descriptive quantitative through the preparation of network planning and S-Curve analysis. The results of the study show that there are four scheduling alternatives, namely Schedule A (existing) for 59 days in block 122, Schedule B 54 days, Schedule C 57 days, and Schedule D 54 days. Scheduling B and D are the most optimal alternatives because painting, grand assembly, and quality control activities are on a non-critical path so they have slack and can accelerate the project duration. The results of the S-Curve analysis show that the plan progress in September 2025 increased from 65.8% to 99.4% in December 2026, the actual progress achievement (A) in March 2026 was only 31.1% while the plan was 84.6%, the assumed progress of the CPM results (B; D) reached 37.3% so there is a difference in progress achievement of 6.2%.

Keywords—Critical Path Method (CPM), Critical Path, Network Planning, Project Scheduling, LPD 163M Ship

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I. INTRODUCTION

The need for maritime transportation is absolutely essential. Maritime transportation, namely ships, has the advantage of being able to carry very large loads (portable).

PT XXX Indonesia is a state-owned manufacturing company engaged in the production of ships and other supporting components. One of the important projects currently underway is the construction of the Landing Platform Dock (LPD) 163M with a modular system.

This project involves various interrelated work stages ranging from design planning, block fabrication, grand assembly, outfitting, to testing (harbor; sea trial; and sewaco system).

The success of a company or shipyard can be measured by its ability to optimize the use and efficiency of various production factors. This level of success ensures high levels of productivity. According to,

Thorough project scheduling planning will support the achievement of production targets, both in terms of quantity and quality. Scheduling is a crucial part of any shipbuilding project, in addition to prioritizing minimum budgets and maximize project quality.

However, in reality, at PT XXX Indonesia, the implementation of large projects from 2015 to 2025, such as KCR 60M.

Companies often face problems with project completion timelines because the completion time does not match the previously agreed schedule. For example,

SSV 124M; BRS 124M: LPD 163M often experience delays in the completion of block construction from the predetermined schedule of approximately 1-2 months from the schedule. This is due to various technical and operational challenges, including:

- Limited production facilities such as crane capacity and work areas that do not fully support heavy work.
- Complex coordination between divisions, because each stage of work is interdependent on each other.
- Occupational safety risks and obstacles in the field, which hinder productivity and work continuity.
- Delays in procurement of materials and main components, A critical problem is the delay in procurement of upstream project materials, which must be controlled and anticipated to minimize failures in shipyard operations.

This condition has an impact on the delay in completing subsequent work, increasing project costs, as well as decreasing time and resource efficiency.

According to the latest data from PT XXX Indonesia's warship division, the LPD 163M project targeted completion of modules I and II by October 2025, with a total of 53 blocks. However, as of September 2025, only 27 blocks were completed, still in the grand assembly stage.

This condition indicates a significant schedule deviation, requiring anticipatory steps through the implementation of more effective and efficient time management strategies. In addition to the delay factor, the project also faced additional obstacles in the form of the launching schedule for the Frigate 143M which uses the same dock as the LPD 163M ship. This situation requires that modules I and II of the LPD 163M ship can carry out floating activities simultaneously with the Frigate Ship 143M, in order to avoid schedule conflicts and optimize the use of dock facilities.

To address these challenges, a scientific approach to project planning and control is needed that can identify the critical activities that most impact the overall project

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completion time. Currently, the scheduling and progress methods used in the warship division include Microsoft

Project, WBS, and S-Curve.

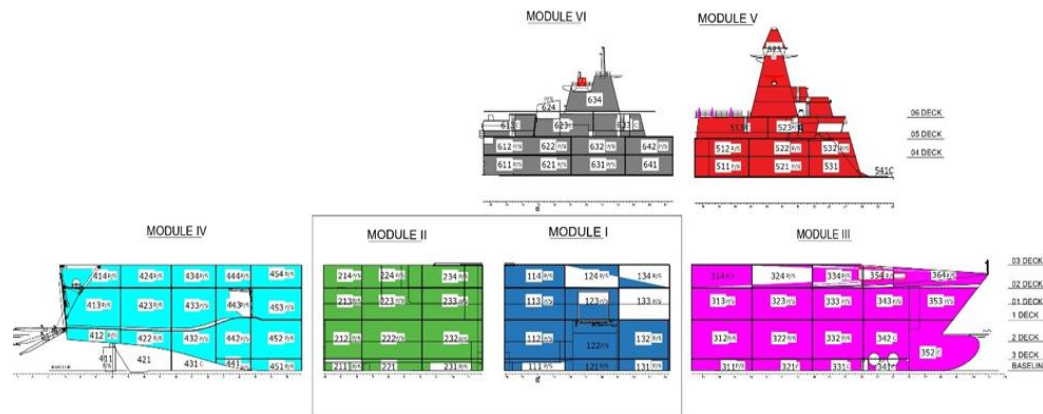


Figure 1. Block Division LPD 163M

One relevant and widely applied method in engineering and construction project management is the Critical Path Method (CPM). CPM is an important technique used to identify the critical path that determines the total project duration. This method helps

project managers prioritize crucial tasks, manage resources efficiently, and anticipate delays. CPM is very effective in large-scale and complex projects to ensure timely completion.

TABLE 1.
SUMMARY OF PREVIOUS RESEARCH

No	Author, Year	Conclution
1.	Romadhona et al., 2021	Based on the analysis results, it can be seen that acceleration using the PDM method with the help of Microsoft Project software to identify critical paths can reduce the work implementation time to 175 days of efficiency calculated based on the comparison ratio of Crash Project costs using PDM costs with RAP costs of less than 1, which can be concluded that implementation using the PDM method is more profitable. Through scheduling analysis using the Precedence Diagram Method (PDM), it was found that there were nine tasks on the critical path. After rescheduling using total float on the duration of non-critical activities, all activities were converted to critical activities. The results of using total float resulted in three different combinations of critical and non-critical paths.
2.	Virginia et al., 2022	Of these three conditions, it can be concluded that the first condition is the best, because in this condition the number of activities on the critical path is the least compared to the second and third conditions. This shows that monitoring work in the first condition is easier and focused, because there is less work to closely monitor to avoid delays This condition reflects the effectiveness in managing the project schedule, so that all work runs according to plan and is completed on time The calculation results using the Precedence Diagram Method (PDM) in this case proved to be much more optimal compared to the calculation results using the Critical Path Method (CPM) or the Bar Chart- S Curve technique.
3.	Amani, 2012	This shows that the PDM method is able to provide a more efficient solution in planning and managing project schedules, especially in utilizing the relationships between activities and time allocation more flexibly. The total durations obtained using the Critical Path Method (CPM) and the Precedence Diagram Method (PDM) showed similar results. However, the durations obtained using the Program Evaluation and Review Technique (PERT) differed from those obtained using the CPM and PDM methods. This difference reflects the advantages of each method in handling uncertainty and variability in project time.
4.	Oktafiana & Baroroh, 2022	By developing a new scheduling plan and comparing it with the shipyard's existing schedule, the results are more effective and efficient. This comparison aims to identify potential improvements in time and resource management, enabling the project to be executed more optimally.
5.	Heldyan, 2021	By implementing the Earned Value Management (EVM) method, potential delays can be predicted early. This allows management to take immediate action to address potential issues. Furthermore, the EVM method facilitates rapid, precise, and accurate project monitoring, enabling more effective and efficient project control.
6.	Juliana, 2016	Costs are highly dependent on decisions regarding time, quality, and scope. This is due to the complexity and importance of the final product to oil and gas companies in ensuring project success.
7.	Samant & Raut, 2022	Conducting research on the Rescheduling Study of Repair Work on the MV Ship. Awu with Network Diagram and Critical Path Method (CPM). This study discusses the overall network diagram of the work, the replating and hull construction work has a duration of 18 days, while after crashing the new work duration is 16 days. The productivity price of the work before crashing is Rp. 4,560 / kg with a work weight productivity of 31.61 kg / person per day, after crashing with the addition of labor, the productivity price is Rp. 5,130 / kg with a work weight of 29 kg / person per day.
8.	Jordan Samuel Tua Hutapea, 2022	Conducting research on Tug Boat Repair Scheduling Using CPM and PDM Methods. This research discusses Scheduling using the CPM method getting a total duration of 18 days with 11 work items that pass the critical path. The tug boat repair scheduling process using the PDM method (precedence diagram method) is depicted with nodes as activities, called AON (Activity on Node), where the arrows are only a connection between work activities. Rescheduling using the PDM method gets a total duration of 18 days with 11 work items that pass the critical path. The same completion time results are due to using finish to start contracts due to the limited number of workers.
9.	(Mochammad Ikhsan Nudin, 2023)	

Schedule delays are generally caused by scope changes, poor procurement, shortage of skilled labor, weak planning, inexperienced subcontractors, and low subcontractor performance.

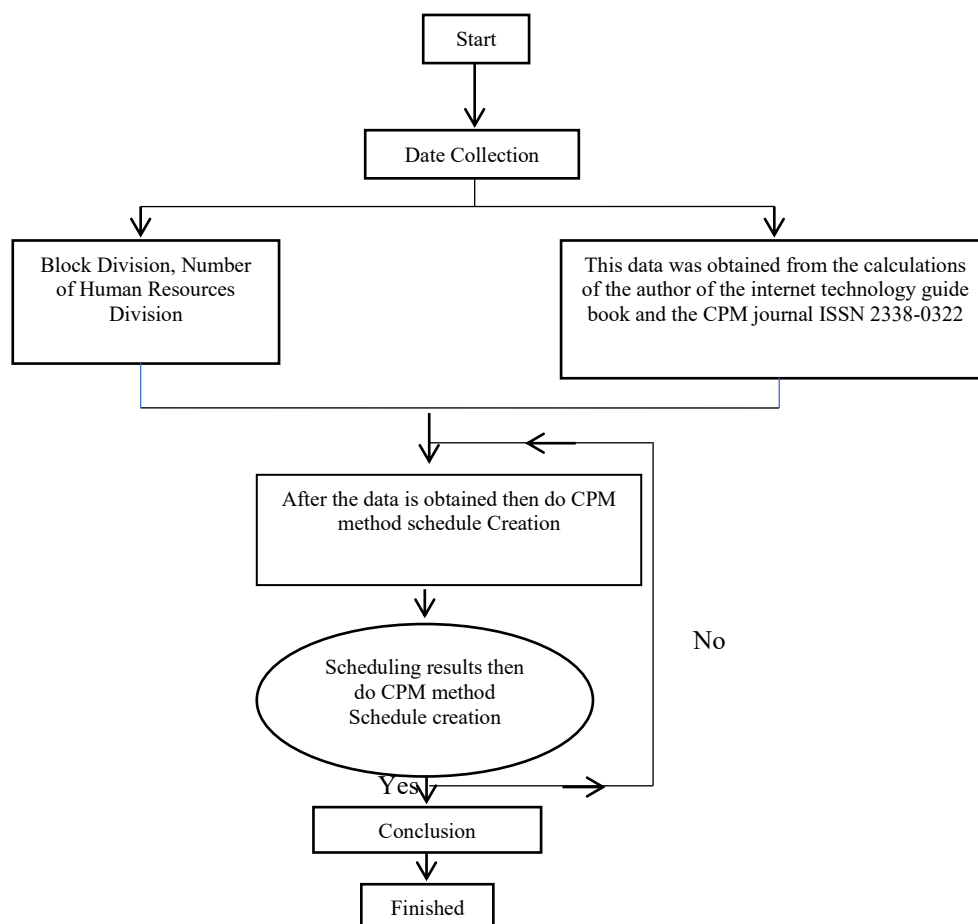
In the following section, we present a summary of previous studies relevant to this research topic. The summary is organized in a table containing information on the author's name, year of publication, and the main conclusions of each study. This table aims to provide an overview of previous findings that support the context and theoretical basis of this research.

II. METHOD

The analysis method used is quantitative calculations. The scheduling and progress methods used in the warship division are Microsoft Project, WBS, and S-Curve in project planning. To further refine the project, additional scheduling and control methods are needed. Several additional methods are available for project control, including CPM, PDM, and PERT.

Critical Path Method (CPM) is an integrated network consisting of a series of activities that are Research Flowchart

The following are the steps in the research process carried out in this thesis.



III. RESULTS AND DISCUSSION BLOCK 122 JOB

SCHEDULING PLANNING

The Critical Path Method (CPM) is a method of analyzing the flow design of a project, where each activity uses a fixed time estimate.

related to each other and are intended to achieve maximum work efficiency.

CPM is a very useful tool in supporting project success, especially in large-scale projects with a high level of complexity.

To help us complete our projects, Microsoft Project offers a variety of useful features for various aspects of project management, such as creating plans, tracking progress, allocating resources, and analyzing project data.

Project management involves managing all aspects of a project, including planning, organizing, executing, and controlling.

Therefore, project scheduling, cost budgeting, and control become crucial. This process typically involves a trade-off between time and cost, where accelerating the schedule generally increases project costs.

For this reason, construction projects always require materials, human resources, equipment, implementation methods, time, and costs that can be applied from the beginning to the end of the work.

construction of Scheduling work on the planning of the block module I and module II of the LPD 163M ship is an important stage in ensuring the achievement of the project completion time target. This scheduling is arranged based on the sequence of integrated production

processes, starting from the fabrication, sub assembly, assembly, grand assembly, to erection stages.

The data used in this scheduling planning refers to the established baseline schedule. by the warship division of PT. XXX Indonesia, and supported by actual data on work progress until the period of September 2025. Based on this data, it is known that of the total 53 planned blocks, the realization of work has only reached 27 blocks at the grand assembly stage, thus indicating a deviation from the initial plan.

The results of the scheduling planning show that the assembly and grand assembly stages are activities with a relatively longer duration compared to other stages, so they have the potential to become the main obstacle in completing the project.

4.1. Network Planning in Modules I and II

The preparation of the network plan is done by identifying the sequence of main activities, namely

fabrication, sub-assembly, assembly, painting, grand assembly, erection, quality control, finishing support to final inspection.

Each activity is structured based on a logical relationship, where a task can only begin after the previous task is completed. In addition, there are supporting activities such as quality control and finishing support that can run in parallel and do not directly affect the main project path. In this case, we will use block 122. It can be seen that the item model The main workflow begins with fabrication (A), then continues to sub-assembly (B), assembly (C), and painting (D). After the painting stage, the workflow branches into two, namely the grand assembly (E) activity as the main path, and the quality control activity which runs in parallel. The quality control activity then continues with finishing support (H), before finally rejoining at the final inspection (I) stage.

TABLE 2.
DEPENDENCE OF WORK SEQUENCE MODELS A, B, C, AND D.

NO	ACTIVITY	CODE	MODEL A	MODEL B	MODEL C	MODEL D
1	Fabrication	A	-	-	-	-
2	Sub Assembly	B	A	A	A	A
3	Assembly	C	B	B	B	B
4	Painting	D	C	A	C	B
5	Grand Assembly	E	D	A	C	B
6	Erection	F	E	B, C	D, E	C, D, E
7	Quality Control	G	F	C	F	C, D, E
8	Finishing Support	H	G	F	G	F, G
9	Final Inspection	I	H	G, H	H	H

A. Dependency of Job Sequence Model A

Based on the analysis using the Critical Path Method (CPM), the total project completion time was 59 days. The forward and backward pass calculations showed that all activities had a slack value of 0, thus all activities were included in the project's critical path.

The project's critical path consists of activities A (Fabrication), B (Sub Assembly), C (Assembly), D (Painting), E (Grand Assembly), F (Erection), G (Quality Control), H (Finishing Support), and I (Final Inspection). This condition indicates that all work is sequentially interdependent with no time leeway for each activity. Therefore, a delay in one of the activities will directly cause a delay in the completion of the project as a whole.

Scientifically, the condition of all activities being on the critical path indicates that the project has a very low level of schedule flexibility, requiring strict time control, work coordination, and resource management. Thus, the CPM method can be used as an analytical tool to identify priority activities, systematically determine project duration, and support decision-making in project schedule control so that the project can be completed within the established time target.

B. Dependence on Job Sequence Model B

In this model, project activities are not carried out entirely sequentially, but rather, several tasks can be carried out in parallel after the initial activity is completed. After fabrication (A) is completed, the work branches into several activities, namely sub-assembly (B), painting (D), and grand assembly (E). have different dependency relationships. Next, assembly (C) is performed after subassembly (B) is completed. The erection activity (F) can only begin after the sub

assembly (B) and assembly (C) are completed, while quality control (G) depends on the completion of assembly (C). In the final stage, finishing support (H) is carried out after erection (F) is completed, and the project is closed with a final inspection (I) which can only begin after quality control (G) and finishing support (H) are completed.

This network model demonstrates a combination of serial and parallel activities, resulting in a more flexible workflow than a fully linear model. The advantage of this model is that project completion time can be more efficient because several activities can be carried out simultaneously, thus speeding up the process.

C. Dependency of Job Sequence Model C

In the network model based on the table, the entire series of project activities takes place sequentially on the main line, starting from fabrication (A), continuing to sub assembly (B), then assembly (C). After assembly activity (C) is completed, the work flow branches into two parallel activities: painting (D) and grand assembly (E), which can be executed concurrently because they share the same initial dependency. These two activities then become prerequisites for starting erection (F). The work then proceeds sequentially through quality control (G), finishing support (H), and finally, final inspection (I), which completes the project.

This model shows a combination of series and parallel flows, where most activities are carried out sequentially, but there is one parallel work stage in the painting (D) and grand assembly activities. This pattern provides the advantage of project completion time efficiency, because two activities can be These activities

are executed simultaneously without having to wait for each other to complete. Furthermore, the network structure remains relatively simple, making project monitoring and control relatively easy. However, synchronization of parallel activities must still be considered, as a delay in one activity (D or E) will delay the start of the subsequent erection activity (F).

D. Dependency of Job Sequence Model D

In the work network model based on the table, the project activity sequence begins sequentially from fabrication (A) to sub- assembly (B) as the initial work stage. Once sub-assembly (B) is completed, the work flow branches into three parallel activities: assembly (C), painting (D), and grand assembly (E). can be executed

simultaneously because they have the same initial dependencies. These three activities then become prerequisites for starting the next two activities, namely erection and quality control (G). After these two activities are completed, the project proceeds to the finishing support stage (H), which depends on the completion of F and G, then ends with final inspection (I) as the final stage.

project completion.
This model shows a network pattern with a more complex combination of serial and parallel activities, where several jobs take place simultaneously and are interconnected.

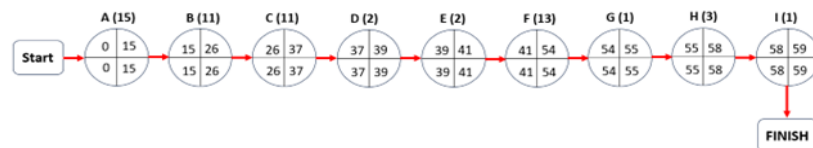


Figure 2. Network Planning Scheduling A (Existing)

A. Critical path scheduling model A

Based on the results of the project scheduling analysis using the Critical Path Method (CPM) on block 122 (block image attached), it was obtained that the total duration of project completion was 59 days. The results of the forward pass and backward pass calculations showed that all activities had a slack value = 0, which means there was no time slack for each activity in the project network. Thus, all activities are included in the critical path and have a very high level of time dependency.

(Painting) – E (Grand Assembly) – F (Erection) – G (Quality Control) – H (Finishing Support) – I (Final Inspection). All of these activities are arranged sequentially without any parallel activities, so that each job can only begin when the previous activity has been completed. This condition results in a lack of time flexibility in project implementation, so that delays in one activity will directly affect the delay in the completion of the project as a whole.

TABLE 3.
NETWORK PLANNING CALCULATION SCHEDULING MODEL A

NO	ACTIVITY	CODE	WORK	DAY	FD PASS		BD PASS		SLACK
					ES	EF	LS	LF	
1	Fabrication	A	-	15	0	15	0	15	0
2	Sub Assembly	B	A	11	15	26	15	26	0
3	Assembly	C	B	11	26	37	26	37	0
4	Painting	D	C	2	37	39	37	39	0
5	Grand Assembly	E	D	2	39	41	39	41	0
6	Erection	F	E	13	41	54	41	54	0
7	Quality Control	G	F	1	54	55	54	55	0
8	Finishing Support	H	G	3	55	58	55	58	0
9	Final Inspection	I	H	1	58	59	58	59	0

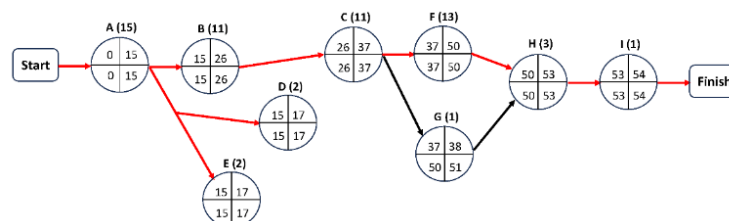


Figure 3. Network Planning Scheduling Model B

B. Critical path scheduling model B

Based on the results of the network analysis using the Critical Path Method (CPM), the total project completion time is 54 days. Based on the CPM diagram above, there are activities that are carried out in parallel, namely activity D. (painting) panel on the turntable and E (grand

assembly) on the hinge side rumpdoor with block contouring that runs simultaneously after activity A (fabrication) is completed.

In addition, after activity C (assembly) is completed, activities F (erection) and G (quality control) can also be carried out in parallel. Even though there is work

parallel, the project's critical path remains on path A–B–C–F–H–I. The results of the forward pass and backward pass calculations show that the project's critical path consists of activities A (Fabrication), B (Sub Assembly), C (Assembly), F (Erection), H (Finishing), and I (Final Inspection). This series of activities has a slack value of 0, which indicates that any delay in one of the critical activities will directly cause a delay in the overall project completion time.

In addition, the CPM analysis indicates the presence of a non- critical activity, namely G (Quality Control), with a slack value of 13 days. This slack value indicates a degree of time flexibility in implementing the activity without affecting the total project duration. Theoretically, the presence of slack in non-critical activities provides opportunities for optimization in resource allocation, adjustment of operational schedules, and mitigation of the risk of delays at certain work stages. Scientifically, the application of the CPM method

in project planning has been proven to be able to identify dependency relationships between activities, determine the critical path, and measure the efficiency of project implementation time through the parameters of Earliest Start (ES), Earliest Finish (EF), Latest Start (LS), Latest Finish (LF), and Slack. Thus, the CPM method can be used as an effective analytical instrument in supporting data-based managerial decision making, increasing the effectiveness of project time control, and minimizing potential delays in project completion.

Table 4.
NETWORK PLANNING CALCULATION SCHEDULING MODEL B

NO	ACTIVITY	CODE	WORK	(DAY)	FD PASS		BD PASS		SLACK
					ES	EF	LS	LF	
1	Fabrication	A	-	15	0	15	0	15	0
2	Sub Assembly	B	A	11	15	26	15	26	0
3	Assembly	C	B	11	26	37	26	37	0
4	Painting	D	A	2	15	17	15	17	0
5	Grand Assembly	E	A	2	15	17	15	17	0
6	Erection	F	B,C	13	37	50	37	50	0
7	Quality Control	G	C	1	50	38	50	51	13
8	Finishing Support	H	F	3	50	53	50	53	0
9	Final Inspection	I	G,H	1	53	54	53	54	0

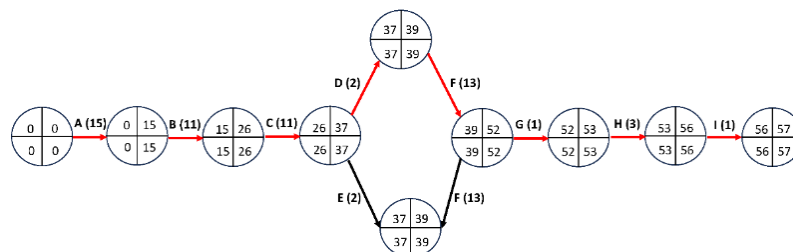


Figure 4. Network Planning Scheduling Model C

C. Critical path scheduling model C

Based on the results of the project scheduling analysis using the Critical Path Method (CPM), the project's critical path is on the A–B–C–D–F–G–H–I route with a total project completion duration of 57 days. Activities on the critical path are indicated by the red line and have a slack value = 0 so they have no time slack. In addition, there are parallel activities on the D (painting) panel on the turntable and E (grand assembly) on the hinge side rumpdoor with block contouring after activity C (assembly) is completed, but activity E (grand assembly) is not included in the critical path because it still has time slack without affecting the total duration of the project. It was obtained that the total duration of project completion is 57 days. The results of the forward pass calculation show the earliest start time (Earliest Start/ES) and the latest finish time. The Earliest Finish (EF) for each activity, while the backward pass calculation produces the latest start time (LS) and latest

finish time (LF) that still allow the project to be completed on time.

these parameters, the slack value for all activities is 0 days, which indicates that there is no time slack for each activity in the project network.

Critical path analysis shows that the series of activities A (Fabrication) – B (Sub Assembly) – C (Assembly) – D (Painting) – F (Erection) – G (Quality Control) – H (Finishing) – I (Final Inspection) form the project's critical path with a total duration of 57 days. In addition, activity E (Grand Assembly) also has a slack value = 0, so theoretically this activity is included in the parallel critical path which has the same duration as the main path. This condition indicates that the project has more than one critical path, so the level of sensitivity to delays is higher because delays in one of the critical activities, either on the main path or the parallel critical path, will directly impact the delay in the completion of the project as whole.

Table 5.

NETWORK PLANNING CALCULATION SCHEDULING MODEL C									
No	ACTIVITY	CODE	WORK	(DAY)	FD PASS		BD PASS		SLACK
					ES	EF	LS	LF	
1	Fabrication	A	-	15	0	15	0	15	0
2	Sub Assembly	B	A	11	15	26	15	26	0
3	Assembly	C	B	11	26	37	26	37	0
4	Painting	D	C	2	37	39	37	39	0
5	Grand Assembly	E	C	2	37	39	37	39	0
6	Erection	F	D,E	13	39	52	39	52	0
7	Quality Control	G	F	1	52	53	52	53	0
8	Finishing Support	H	G	3	53	56	53	56	0
9	Final Inspection	I	H	1	56	57	56	57	0

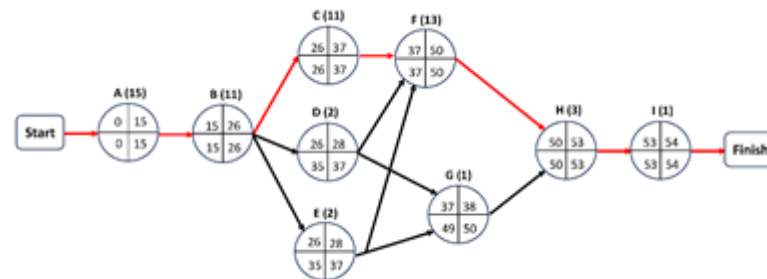


Figure 5. Network Planning Scheduling Model.

Based on the results of the project scheduling analysis using the Critical Path Method (CPM), there are activities that are carried out in parallel, namely activities D (painting) panels on the turntable and E (grand assembly) on the hinge side rumpdoor with block contouring that run simultaneously after activity B (sub assembly) is completed. In addition, after activity F (erection) is completed, activity G (quality control) can also run towards activity H simultaneously with the main flow of the project. Even though there are parallel jobs, the project's critical path remains on the A–B–C–F–H–I path. It is obtained that the total duration of project completion is 54 days. The results of the forward pass calculation show the Earliest Start (ES) and Earliest Finish (EF) values as the fastest time an activity can be started and completed, while the backward pass calculation produces the Latest Start (LS) and Latest Finish (LF) as the latest deadline for activities that can still be implemented without causing project delays. From the analysis of these parameters, a slack value is obtained which indicates the level of time slack for each activity in the project work network.

The results of the critical path identification show that path A (Fabrication) – B (Sub Assembly) – C (Assembly) – F (Erection) – H (Finishing) – I (Final Inspection) is the project's critical path with a total duration of 54 days. The activities on this path have a slack value of 0, which indicates that these activities have no delay tolerance. Theoretically, even the slightest delay in any of the critical activities will directly shift the overall project completion time.

In addition to critical activities, there are non-critical activities, namely D (Painting) and E (Grand Assembly) which each have a slack of 9 days, as well as G (Quality Control) with a slack of 12 days. The slack value indicates the flexibility of time in the implementation of non-critical activities, so that delays in these activities can still be tolerated as long as they do not exceed the available slack limit. From a project management perspective, this condition provides an opportunity to optimize resource allocation, adjust work schedules, and control risks more adaptively without affecting the project completion target.

Table 6.
NETWORK PLANNING CALCULATION SCHEDULING MODEL D

NO	ACTIVITY	CODE	WORK	(DAY)	FD PASS		BD PASS		SLACK
					ES	EF	LS	LF	
1	Fabrication	A	-	15	0	15	0	15	0
2	Sub Assembly	B	A	11	15	26	15	26	0
3	Assembly	C	B	11	26	37	26	37	0
4	Painting	D	B	2	26	28	35	37	9
5	Grand Assembly	E	B	2	26	28	35	37	9
6	Erection	F	C,D,E	13	37	50	37	50	0
7	Quality Control	G	C,D,E	1	37	38	49	50	12
8	Finishing Support	H	F,G	3	50	53	50	53	0
9	Final Inspection	I	H	1	53	54	53	54	0

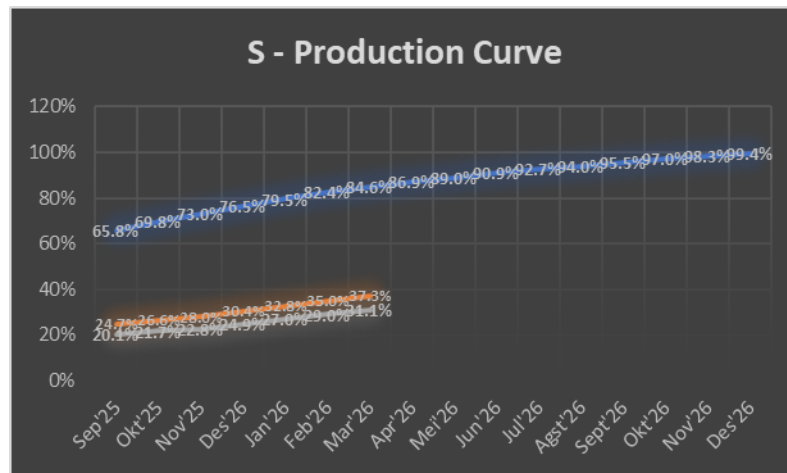


Figure 6. Production S-curve

Based on the analysis results using the Critical Path Method (CPM), four alternative scheduling methods for the LPD 163M shipbuilding project were obtained with different completion durations. In scheduling A, the project was completed in 59 days with a critical path of A–B–C–D–E–F–G–H–I, where all activities have a slack value = 0 so that there is no time slack for each job.

Based on the results of the S curve, Scheduling B and D are the most optimal alternatives because they are able to complete the block within 54 days through arranging non-critical activities that have time leeway to catch up with the lagging schedule. Scheduling B and D can cut significant time, so that project implementation becomes more efficient without affecting the total duration of the project.

Meanwhile, scheduling C requires 57 days because the painting and grand assembly activities are part of the critical path which causes the work path to be longer. The results of the analysis are reinforced through.

The production S-Curve graph which shows the comparison between the plan progress, CPM results (B/D model), and the actual progress of the project. The plan curve shows that the target progress increased from 65.8% in September 2025 to 99.4% in December 2026. Meanwhile, the CPM results in the B/D model show progress of 24.7% to 37.3% during the period of September 2025–March 2026, while the actual progress only reached 20.1% to 31.1% in the same period. This condition indicates that

The actual progress of the project is still below the results of the CPM optimization and the project plan target. Overall, the research results show that the CPM method is able to identify critical paths and produce more effective scheduling alternatives in accelerating project completion time. Scheduling B and D are the best alternatives because they provide a project completion time efficiency of 54 days. However, based on the S-Curve analysis, the actual project implementation is still experiencing delays due to various production and operational constraints. Work coordination. Therefore, more optimal project control is needed, such as adding work shifts, optimizing outdoor assembly areas, and assisting with cross-divisional cutting processes to

ensure actual progress approaches project planning targets.

IV. CONCLUSION

Based on the results of research and discussion regarding the application of the Critical Path Method (CPM) in the construction of module I and module II of the LPD 163 M ship in the Warship Division of PT XXX Indonesia, the following conclusions can be drawn:

1. Based on the results of the analysis using the Critical Path Method (CPM), the results of the analysis show that each scheduling alternative has a different critical path according to the activity arrangement and work dependency relationship. In scheduling A, the critical path A–B–C–D–E–F–G–H–I with a duration of 59 days is obtained, while in scheduling B and D, the critical path changes to A–B–C–F–H–I with a shorter completion duration of 54 days.
2. The results of the CPM analysis of Scheduling B and D are the most optimal alternatives because the painting, grand assembly, and quality control activities are on the non-critical path so they have slack and do not affect the total duration of the project. With this arrangement, the project duration can be accelerated from 59 days in scheduling A to 54 days in scheduling B and D, while scheduling C requires 57 days because the painting and grand assembly activities still affect the project's critical path.
3. The application of the CPM method has been proven to help project management control schedules, improve work efficiency, and support the achievement of project completion targets on time. By identifying critical paths and activities with time allowances, project management can determine work priorities, optimize resource utilization, and implement work acceleration strategies without delay. reducing the quality of project implementation. Thus, the CPM method can be an effective alternative schedule control method for the LPD 163M shipbuilding project in the warship division of PT XXX Indonesia.

Suggestions

Based on the results of the research that has been carried out, there are several suggestions that can be given as follows:

1. PT XXX is expected to be able to apply the Critical Path Method (CPM) more optimally as a schedule control method for ship building projects to minimize the risk of work delays and increase the effectiveness of monitoring critical activities.
2. Supervision of activities on the critical path needs to be carried out more intensively because delays in these activities will have a direct impact on delays in the completion of the project as a whole.

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