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Acceleration of Late Work on the Middle Cross Road of the East Sea Island (Mount Aru) Using Microsoft Project with the Precedence Diagram Method (PDM)

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ABSTRACT

Delays in the implementation of construction projects are one of the problems that can affect the achievement of project completion time targets. In the East Laut Island Central Cross Road Construction Project (Gunung Aru), implementation delays occurred, causing the project completion to deviate from the planned schedule. This study aims to analyze project delays using the Precedence Diagram Method (PDM), identify activities on the critical path, and evaluate the application of Fast Tracking and Crashing methods through simulation using Microsoft Project as an alternative for project acceleration. The research method used is a quantitative method with a case study approach. The research data consists of the planned schedule, realization schedule, inter-activity dependency relationships, and work durations analyzed using Microsoft Project. The analysis was carried out through the preparation of PDM networks, identification of critical paths, Fast Tracking simulation by modifying predecessor relationships, and Crashing simulation by adding overtime working hours to critical activities. The results showed that the planned project schedule duration was 234 calendar days, while the realized schedule became 328 calendar days, resulting in a delay of 94 calendar days. After conducting simulations using the Fast Tracking and Crashing methods, the project duration was successfully reduced back to 234 calendar days, aligning with the planned schedule. The results indicate that the application of both methods is effective in reducing project delays through the optimization of critical path activities using Microsoft Project

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INTRODUCTION

Road infrastructure development plays a crucial role in improving regional connectivity and supporting sustainable local economic growth. In archipelagic regions such as Pulau Laut, an adequate road network is a strategic factor in connecting community activity centers and facilitating the distribution of goods and services between regions. The Pulau Laut Central Cross-Island Road is one of the infrastructure projects planned to improve inter-regional accessibility on Pulau Laut, thereby boosting community mobility and local economic growth. With good road infrastructure in place, it is expected that travel time will be reduced and logistics costs will decrease, which will have a positive impact on the community.

During implementation, the Pulau Laut Central Cross-Island Road project faced various challenges that caused discrepancies between the planned schedule and on-site progress. Based on an evaluation of the project's S-curve, it was found that work progress experienced delays that first became apparent during the excavation and backfilling phases. What was supposed to reach 55.656% by the fourth week of October had instead reached only 8.391%.

This delay was caused by unfavorable weather conditions, as heavy rainfall persisted, hindering construction work on-site. In addition, muddy road conditions prevented heavy equipment from operating optimally and disrupted material distribution, directly impacting the project's progress. The impact of this delay subsequently led to the postponement of subsequent tasks that were interdependent, thereby affecting the overall progress and completion timeline of the project.

One approach to addressing project delays is to accelerate work by systematically and structurally re-planning the project schedule. In project management, there is a scheduling method known as the Precedence Diagram Method (PDM), which is used to map relationships between tasks in the form of a logical and integrated work network. This method makes it possible to determine the sequence of tasks, the dependencies between activities, and the critical path, which significantly impacts the total project duration. By identifying the critical path, it becomes possible to evaluate and adjust activities that have the potential to cause delays.

With advancements in technology, project scheduling and analysis can be performed using software that enhances the accuracy and efficiency of planning. One of the most commonly used software tools in project management is Microsoft Project, which can automatically calculate project duration and determine the critical path. In addition, this software can also be used to simulate various alternatives for accelerating work, thereby identifying the best scenario for project completion.

The use of Microsoft Project is expected to facilitate more accurate decision-making based on structured data analysis. The East Pulau Laut (Gunung Aru) Central Cross-Island Road Project is an infrastructure project that plays a vital role for the community in supporting social and economic activities in the region.

However, during its implementation, the project has experienced significant delays, necessitating an appropriate solution to make up for the lost time.

LITERATURE REVIEW

The Philosophy of Scheduling and Project Management

According to Syafriandi (2017), a schedule is the most important element in the execution of a project. However, in practice, schedules are often not utilized effectively because their formulation is not based on sound technical logic and due to an inability to control the planned schedule. With a schedule in place for a project, work becomes more systematic; work carried out without a systematic approach will ultimately affect the cost, quality, and duration of a construction project. The purpose of scheduling is to outline the project's activity phases, determine work methods and implementation strategies, and identify the critical path of project activities to clearly and thoroughly understand the logical relationships or dependencies between activities.

Every project has specific objectives, each of which is subject to fundamental constraints: the budgeted cost, the scheduled time, and the required quality. These three constraints are commonly known as the "triple constraint." These three factors are interrelated and interdependent; therefore, a change in one factor will affect the other two. Project control is a systematic effort to establish standards aligned with planning objectives, compare actual performance against those standards, analyze potential deviations, and then take the necessary corrective actions.

Time Acceleration

The basic definition of time acceleration is an effort to complete a project earlier than the normal completion time. Acceleration can be achieved in various ways, including: adding qualified resources, increasing working hours (overtime), rescheduling delayed tasks, or swapping workers with equivalent skills. However, in this study, acceleration will be achieved solely through the method of increasing working hours (overtime).

The Precedence Diagram Method (PDM)

The PDM method is a network diagram that incorporates the Activity On Node (AON) approach, in which nodes are represented as rectangles and arrows indicate the relationships between the relevant activities. PDM distinguishes between activities and their sequence, where activities are displayed as nodes and their dependencies are depicted by arrows. With this approach, dummy activities—as used in the Activity on Arrow (AOA) method—are not required.

In the PDM method, each node has two points: the Start (S) point and the Finish (F) point. Consequently, there are four types of overlapping relationships: Finish to Start (FS), Start to Start (SS), Finish to Finish (FF), and Start to Finish (SF). Constraint lines include information regarding lead and lag. Lead is the lead time, which is the time difference by which an activity can begin before the preceding activity is completed, while lag is the waiting time.

The critical path is the path that passes through activities with zero float. Every critical activity must be carried out according to the predetermined schedule. Total Float (TF) is the maximum amount of delay that can be allowed for an activity without hindering the completion of the entire project.

TFij = LSj - ESi - durasiij = LF - EF = LS - ES

1. Microsoft Project

Microsoft project is a project management software designed to create schedule development, assign resources to tasks, track progress, manage budgets, and analyze workloads. Microsoft Project software makes the process of re-evaluating and revising created schedules easier. The application supports the PDM method with features such as network diagram generation, critical path identification, and automatic resource allocation.

2. Fast Tracking and Crashing Methods

The Fast Tracking method is one of the project acceleration techniques that is carried out by carrying out two or more activities in an overlapping manner without changing the scope of work. This method is applied by modifying the dependency relationship (predecessor) between activities so that the work that was originally done in sequence can be done simultaneously if technically possible.

The Crashing method is a project acceleration technique that is carried out by reducing the duration of activities through the addition of resources, such as overtime working hours, labor, or equipment, especially in activities that are on a critical trajectory. The main goal of this method is to speed up project completion time without changing the scope of the planned work.

METHODOLOGY

Research Locations and Data Types

The location of the Central Island Cross Road construction project to be built is in East Laut Island District, Kotabaru Regency, South Kalimantan. The type of data used in this study is secondary data obtained from the construction of the East Sea Island Central Cross Road (Gunung Aru). The data used includes the S-curve of plans and realizations, methods of execution of work, and weekly reports of projects.

1. Data Processing Process

The data processing process in this study is carried out through several systematic stages as follows:

1. Data Collection: The first stage was carried out by collecting secondary data obtained from the East Sea Island Central Cross Road Construction Project.
2. S-Curve Analysis: S-curve data of plans and realizations is compared to determine the progress of project implementation and determine the magnitude of delays.
3. Identification of Delays: Based on the weekly report of the project and the results of the S-Curve analysis, the identification of activities that experience delays is carried out.
4. Preparation of the PDM Method Work Network: All work activities are arranged into a work network using the PDM method to determine the critical trajectory.
5. Preparation of Plan Schedules Using Microsoft Project: Data is input into Microsoft Project to generate a project plan schedule for comparison.

6. Preparation of Realization Schedules Using Microsoft Project: Realization schedules are compiled based on the actual progress of the weekly reports to find out the actual field conditions.
7. Critical Path Analysis: Identify activities that are on a critical trajectory on the planned and realization schedule.
8. Project Acceleration Solution Simulation: Acceleration simulation is carried out using Microsoft Project through the application of the Fast Tracking method and the Crashing method (adding overtime working hours) to critical activities.
9. Comparison of Plan, Realization and Solution Schedules: Simulation results were compared to determine the effectiveness of the acceleration method.
10. Drawing Conclusions: The last stage is carried out by drawing conclusions based on the results of the analysis obtained.

RESULTS

1. S-Curve Analysis

The S Curve analysis is carried out by comparing the progress of the plan and the progress of the project realization. Based on the results of the analysis, it was obtained that the progress of project realization was below the progress of the plan, thus indicating a delay in work. Delays began to occur in the implementation of excavation and earthenware work so that other works could not be completed according to the planned schedule. In addition, weather conditions with high rainfall caused the work of the heap and the preparation of the road body to experience obstacles. As a result, some of the subsequent jobs were delayed because they were interrelated with each other.

2. Job Item Description

Job description is a fundamental stage in construction project management that serves to classify the entire complex set of activities into more systematic and measurable work units. Below is a description of the work and duration of the East Sea Cross Road Construction (Gunung Aru).

Table 1. Job Item Description

No	Job Description	Duration (Days)	Predecessor	Lag / Lead Time
1	DIVISION 1. GENERAL	234		
2	Mobilization	40		
3	Occupational Safety and Health	234	2SS	
4	DIVISION 2. DRAINASE	59		
5	Excavation for Drainage Sewers and Waterways	59	3SS+41 days	41 days
6	DIVISION 3. EARTHWORKS AND GEOSYNTHETICS	190		
7	Ordinary Excavations	59	5SS	
8	Structural Excavation with a Depth of 0-2 Meters	30	7FS+71 days	71 days

9	Selected Deposits from Excavated Sources	45	7FS+16 days	16 days
10	Preferred Stockpile from Excavated Source (Negotiated Price)	69	9SS-38 days	38 days
11	Selected Stacks from Excavations	38	9SS	
12	Road Body Preparation	61	3SS+11 days	11 days
13	DIVISION 5. GRANULAR PAVEMENT AND CEMENT CONCRETE	54		
14	Class B Aggregate Foundation Layer	33	9	
15	Class B Aggregate Foundation Layer (Negotiated Price)	37	14SS+10 days	10 days
16	Class A Cement Aggregate Foundation Layer (CTB)	30	15SS+14 days	14 days
17	DIVISION 6. ASPHALT PAVEMENT	17		
18	Binding Diffusion Coating - Molten/Emulsified Asphalt	17	16	
19	Adhesive Coating - Liquid Asphalt/Emulsion	17	18SS	
20	Laston Lapis Off (AC WC)	17	19SS	
21	Laston Layered Antara (AC-BC)	17	20SS	
22	Anti-Exfoliating Ingredients	17	21SS	
23	DIVISION 7. STRUCTURE	47		
24	Concrete structure, fc' 30 MPa	47	16SS-7 days	7 days
25	Concrete Structure, fc' 30 MPa (Negotiated Price)	47	24SS	
26	Concrete structure, fc' 20 MPa	47	25SS	
27	Concrete Structure, fc' 20 MPa (Negotiated Price)	47	26SS	
28	Concrete, fc' 10 MPa	47	27SS	
29	Concrete, fc' 10 MPa (Negotiated Price)	47	28SS	
30	Plain Rebar Steel-BjTP 280	47	29SS	
31	Plain Rebar Steel-BjTP 280 (Negotiated Price)	47	30SS	
32	BjTS 420A Fin Reinforcement Steel	47	31SS	
33	BJTS 420A Fin Rebar Steel (Negotiated Price)	47	32SS	
34	Stone Pairs	47	33SS	
35	DIVISION 9. DAY JOBS AND OTHERS	9		
36	Thermoplastic Road Markings	9	34	

1. Schedule a Plan Using Microsoft Project

The plan data processing stage is carried out by utilizing the Microsoft Project 2016 application to compile a project implementation schedule based on the available S Curve data. The initial step is taken by entering all work items for the East Sea Cross Island Road Construction (Gunung Aru) into the Task Name column. The implementation of the work begins on April 15, 2025. The work calendar is set every day without holidays with a working time of 8 hours per day, namely at 08.00-12.00 WITA and continued at 13.00-17.00 WITA.

Based on the results of data processing in Microsoft Project, a total of 28 work activities were obtained consisting of 19 critical jobs and 9 non-critical jobs. From the results of the analysis, it was obtained that jobs that have a Total Slack value of 0 days are included in the critical path so that there should be no delays. This plan schedule results in an implementation duration of 234 days which is projected to be completed on December 4, 2025.

2. Realization Schedule Using Microsoft Project

The stage of input realization data was carried out to model the conditions of project implementation in the field into the Microsoft Project 2016 application. Based on the weekly progress report, updates are made (updating) to the actual start date, percentage of progress (% complete), and remaining duration on work items that have been carried out and that are running until the review deadline.

Based on field realization data, it is known that the project experienced delays triggered by the postponement of the project start date (actual start) to May 17, 2025 and the duration swelling due to bad weather factors. The results of the recalculation show that the total duration of project completion has swelled to 328 days with an estimated completion of April 9, 2026. There was a change in the critical trajectory pattern due to the domino effect of the initial delay in work, where crucial items such as Mobilization and Safety and Occupational Health underwent significant schedule adjustments.

3. Project Delay Acceleration Solutions

Considering that the prediction of project completion in the condition of realization is backward until April 9, 2026 with a total duration of 328 days, corrective action is needed in the form of schedule compression. The method applied in this analysis is a combination of Fast-Tracking and Crashing.

The acceleration process with the Fast-Tracking Method is carried out by evaluating the logic of linear road work, then changing the Predecessor value on critical work by adding Lead Time or Negative Lag. For example, the predecessor value is changed to FS-16 days for stone pair work, and FS-5 days for road marking work. This simulates overlapping work implementation without having to wait for the previous work to be completed 100%.

The acceleration process with the Crashing Method is carried out by creating a special calendar to accommodate the addition of working hours (overtime) and applying the overtime hours to critical work. The duration of completion in the system is automatically reduced without changing the total volume of work.

4. Comparison of Scheduling Results

After the Fast-Tracking modification and the addition of overtime hours (Crashing) are input into the schedule, a recalculation is carried out to produce a new schedule trajectory. The scheduling results show that the critical trajectory has been successfully optimized. The application of this combination of methods was able to significantly reduce the duration of project completion from the predicted 328 days to exactly 234 days. Thus, the estimated completion date of the project, which previously fell on April 9, 2026, has been successfully advanced to January 5, 2026.

Table 2. Comparison of Scheduling Results

Schedule Conditions	Start Date	Finish Date	Total Duration
Plan (Baseline)	April 15, 2025	4 December 2025	234 days
Actual Realization	May 17, 2025	April 9, 2026	328 days
Solutions (Acceleration)	May 17, 2025	5 January 2026	234 days

Based on the comparison table above, it can be seen that the solution simulation is able to reduce the project duration by 94 days compared to the realization condition, which is from 328 calendar days to 234 calendar days. The results show that the application of Fast Tracking and Crashing methods is effective in accelerating the completion of work on critical trajectories so that the project duration can be returned according to the planned schedule. This acceleration is achieved through resetting the dependency relationship between activities and adding working hours to critical activities, without changing the scope of work.

CONCLUSION

Based on the results of the scheduling analysis of the East Sea Island Central Cross Road Construction Project (Gunung Aru) using the Precedence Diagram Method (PDM) method with the help of the Microsoft Project application, the following conclusions can be drawn:

1. Based on the results of the analysis using the Precedence Diagram Method (PDM) method in Microsoft Project, activities that are on a critical path are obtained. These activities are jobs that do not have a time allowance (float = 0), so any delays that occur on critical trajectories will have a direct impact on the overall project completion delay.
2. The analysis of project acceleration using the PDM method with the help of Microsoft Project was carried out through the application of the Fast Tracking method by changing the previous relationship so that several activities can be done overlapping, as well as the Crashing method through the addition of overtime working hours to activities that are on a critical trajectory. The simulation results show that the combination of the two methods is effective in reducing project delays.

The duration of the project that was originally planned for 234 calendar days was delayed to 328 calendar days, resulting in a delay of 94 calendar days. After an acceleration simulation using the Fast Tracking and Crashing method on Microsoft Project, the project duration was successfully accelerated back to 234 calendar days, so that the delay of 94 calendar days could be eliminated and the target project completion time returned to the planned schedule.

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