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CRITICAL PATH METHOD (CPM) APPLICATION IN TIME MANAGEMENT OF THE MALAKA REGENCY OFFICE BUILDING PROJECT

Thomas Aquino Seki*, Andi Patriadi, Sajiyo
Universitas 17 Agustus 1945 Surabaya, Indonesia
e-mail: inoseki310@gmail.com andipatriadi@untag-sby.ac.id sajiyo@untag-sby.ac.id

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ABSTRACT

The construction of the Malaka Regency Regent's Office has faced significant challenges, including frequent delays in project completion due to various factors such as design changes, unpredictable weather conditions, labor shortages, and inadequate materials or equipment. These issues have led to inefficiencies in time and cost management, emphasizing the need for effective project management strategies. This study applies the Critical Path Method (CPM) to analyze the project timeline, identify the critical path, and propose measures for project acceleration. By employing CPM, the project schedule was meticulously reviewed and optimized, resulting in a reduction of the initial planned duration from 180 calendar days to 100 calendar days. This acceleration was achieved by minimizing lag times between critical activities, reallocating resources, and implementing time-cost trade-off strategies, all without compromising the quality or scope of the project deliverables. The results demonstrate the effectiveness of CPM in streamlining construction project timelines and mitigating delays. Additionally, this study provides a practical framework for addressing time and cost overruns in construction projects, particularly in the context of public infrastructure development. By highlighting the integration of project management tools like CPM, this research contributes to the broader understanding of efficient scheduling practices and offers actionable insights for similar projects in the future.

INTRODUCTION

In the implementation of construction work, it is required to pay attention to the quality and timeliness of the completion of a project. Project activities are temporary activities that take place in a limited time with certain resource allocations. Therefore, in the implementation of construction work, appropriate decision-making is needed to determine the targets to be achieved in accordance with the specified standards (ASMI, 2019).

The increasing development of projects in various regions, especially Malaka Regency, has caused various problems including in the management of budget costs and the implementation of work. In addition, inadequate scheduling, the use of equipment that is not properly conditioned and the lack of human resources (workers) can increase costs and extend the time in implementing a project (ASMI, 2019). Good project management is a key factor in ensuring the success of vital infrastructure projects (Wahananto et al., 2024).

Project management is a technique used to plan, work on, and control the activities of a project to meet the constraints of time and project costs. This technique is oriented towards achieving goals, where the goals may be building construction, opening a new office, or controlling research and development activities (Victor & Simanjuntak, 2021).

Construction work is highly dependent on several resources in its implementation consisting of materials, labor, costs, implementation methods and equipment (Chen et al., 2022; Gurmu & Aibinu, 2017; Srivastava et al., 2022). In the era of globalization, construction development is growing rapidly and is accompanied by a variety of construction implementation methods that affect the cost and completion time of the project (Lokajaya, 2019). One example is the Construction of the Malaka Regency Regent's Office. Although the schedule has been prepared, in practice in the field, problems still often arise in the construction process, namely frequent delays in project completion. The causes of delays that often occur are due to design changes, weather factors, labor requirements, inadequate materials or equipment, planning errors or specifications (Klau et al., 2024). To return the level of project progress to the original plan, an effort is needed to accelerate the project duration.

In this case, the Critical Path Method (CPM) is used to analyze the time needed to complete the project, as well as identify critical paths to accelerate project completion. The objective of this research is to analyze the work time of the Malaka Regency Regent's Office Construction project. This research contributes to project management by applying the Critical Path Method (CPM) to analyze and optimize the construction timeline of the Malaka Regency Regent's Office, identifying critical tasks and the minimum project duration. By highlighting delay-prone activities and providing actionable scheduling insights, the study enhances efficiency in government infrastructure projects. The findings demonstrate CPM’s practical utility in public construction, offering a structured approach for future projects to minimize delays and improve time management.

METHODS

The subject of this research is the construction project of the Malacca Regent's office - Jalan Sukabi Hanawa, Kamanasa Village, Kec. Malaka Tengah, Kab. Malacca. The research location is Jalan Sukabi Hanawa, Kamanasa Village, Kec. Malaka Tengah, Kab. Malaka, the effective research time is approximately 3 weeks.

The data used in this research is secondary data obtained from the Malacca Regency Cipta Karya Office, in the form of RAB, Time Schedule and S-Curve data, while primary data is obtained from the results of direct unstructured interviews with the Project Manager of PT TURELOTO BATTU INDAH. For primary data, in addition to direct unstructured interviews, researchers also participated directly in the implementation of the scope of work of the construction of the new building of the Regent's Office of Malacca Regency. The main data required for this research are Schedule and S curve of project implementation plan, Monthly Report, Direct Cost Calculation and Indirect Cost, employee salary data, operator labor wages and others / real data from contractors and not assumptions.

The analysis method used in this research is the Critical Path Method (CPM), using a single duration estimate approach or a single time estimate for each activity. The CPM method has been widely used on large projects, there are many work items, it is necessary to break down their interdependence to facilitate the control of Critical Trajectories as the main activities that cannot be late, it is necessary to control the implementation time so that the project is completed on time, at the right cost, at the right quality and in an orderly administration.CPM is widely known as a project control method with critical trajectory control.

RESULTS

Recapitulation of Duration Requirements for Each Type of Work

The duration of each type of work is obtained from the S-curve of the construction of the Malaka Regent's Office building, there are 4 types of work groups, namely the main building work (Malaka Regent's Office), staff office building 1, staff office building 2, and complementary work. The total duration allocation according to the contract is 760 calendar days, which will be presented in tabulated form.

Table 1. Recapitulation of Duration of Each Type of Work

NO	JOB DESCRIPTION	DURATION
I.	**MAIN BUILDING (MALAKA REGENT OFFICE)**	
A.	Preparatory Work	60
B	Main Building Structure Works	180
C	Main Building Architectural Works	50
D	Mechanical, Electrical and Plumbing Works of Main Building	50
A.	Staff Building Structure Work 1	40
B	Architectural Works of Staff Building 1	40
C	Mechanical, Electrical and Plumbing Works of Staff Building 1	40
A.	Staff Building Structure Work 2	40
B	Architectural Works of Staff Building 2	40
C	Mechanical, Electrical and Plumbing Works of Staff Building 2	50
A.	Connecting Hallway Work	40
B	Landscape Work	50
C	Power House Work	40
D	Guard Post Building Work	40

Creating Network Planning Curve Based on CPM Method Plan S-Curve

The S-curve of the plan from secondary data is not yet in the form of *Network Planning* so that it cannot provide information on the dependency between jobs and *the critical path* is not yet known. By using Microsoft Project 2019 software, scheduling in the form of *Network Planning* (in full in the attachment) with the following provisions:

a. Scheduling using reference : Project Star Date
b. Hours per day of project work : 8 hours
c. Number of days per week : 7 days
d. Hours per week : 56 hours
e. Number of days per month : 30 days (calendar days)
f. Determining predecessors :

Table 2. Details of Predecessors of each type of work

Task Name	Duration	Start	Finish	Predecessors
Construction Of The Malaka Regency Office	1 Day?	Monday, 12/09/22	Monday, 12/09/22	
Main Building (Malaka Regency Office)	230 Days	Tuesday, 06/09/22	Monday, 24/07/23	

Preparation Work	60 Days	Monday, 12/09/22	Friday, 02/12/22	
Structural Work Of The Main Building	180	Tuesday, 06/09/22	Monday, 15/05/23	3ss-4 Days
Architectural Work Of The Main Building	50	Monday, 05/12/22	Friday, 10/02/23	3;4ss
Mechanical, Electrical, And Plumbing Work Of The Main Building	50	Tuesday, 16/05/23	Monday, 24/07/23	3;5
Staff Office Building 1	80	Tuesday, 25/07/23	Monday, 13/11/23	
Structural Work Of Staff Office Building 1	40	Tuesday, 25/07/23	Monday, 18/09/24	3;4;6
Architectural Work Of Staff Office Building 1	40	Tuesday, 19/09/23	Monday, 13/11/23	3;4;6;8
Mechanical, Electrical, And Plumbing Work Of Staff Office Building 1	40	Tuesday, 19/09/23	Monday, 13/11/23	3;4;8;9ss-7days
Staff Office Building 2	90	Tuesday, 14/11/23	Monday, 18/03/24	
Structural Work Of Staff Office Building 2	40	Tuesday, 14/11/23	Monday, 08/01/24	8;9;10ss
Architectural Work Of Staff Office Building 2	40	Tuesday, 14/11/23	Monday, 08/01/24	8;9;10;12ss
Mechanical, Electrical, And Plumbing Work Of Staff Office Building 2	50	Tuesday, 09/01/24	Monday, 18/03/24	8;9;10;12;13ss
Supplementary Works	376	Monday, 12/09/22	Monday, 08/07/24	
Connecting Corridor Work	40	Tuesday, 19/03/24	Monday, 13/05/24	3;4;5;6;8;9;10;12;13;14
Landscape Work	50	Monday, 12/09/22	Friday, 18/11/22	3ss
Powerhouse Work	40	Tuesday, 14/05/24	Monday, 08/07/24	3;4;5;6;8;9;10;12;13;14;16;17ss
Guard Post Work	40	Monday, 12/09/22	Friday, 04/11/22	3ss

Creating Network Planning

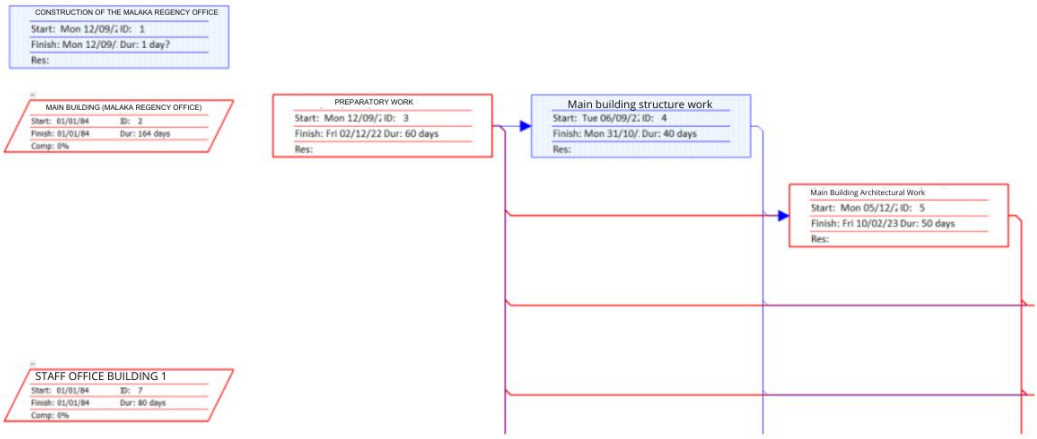

Figure 1. Network Diagram using Microsoft Project 2019

Creating Network Planning Based on S-Curve Plan

After Network Planning is made, the work and critical path can already be known. Using Microsoft Project 2019 software can present a complete *critical path*.

Name	Start	Finish	% Complete	Remaining Work
Preparation work	Mon 12/09/22	Fri 02/12/22	0%	0 hrs
Structural work of the Main Building	Tue 06/09/22	Mon 15/05/23	0%	0 hrs
Mechanical, Electrical, and Plumbing work of the Main Building	Tue 16/05/23	Mon 24/07/23	0%	0 hrs
Structural work of Staff Office Building 1	Tue 25/07/23	Mon 18/09/23	0%	0 hrs
Architectural work of Staff Office Building 1	Tue 19/09/23	Mon 13/11/23	0%	0 hrs
Structural work of Staff Office Building 2	Tue 14/11/23	Mon 08/01/24	0%	0 hrs
Mechanical, Electrical, and Plumbing work of Staff Office Building 2	Tue 09/01/24	Mon 18/03/24	0%	0 hrs
Connecting Corridor work	Tue 19/03/24	Mon 13/05/24	0%	0 hrs
Powerhouse work	Tue 14/05/24	Mon 08/07/24	0%	0 hrs

From the results of the analysis using Microsoft Project 2019, it is found that the types of work that are on the critical trajectory are:

Table 3. Details of predecessors of each type of work

No.	Jobs	Duration
1	Main Building Structure	180 Days

Accelerating 180 Calendar Days to 100 Calendar Days

After knowing the work that is on the Critical Path, the work is accelerated from 180 calendar days (6 months) to 100 calendar days (3.1 months). The discussion steps taken are

1. Reschedule by eliminating the lag time between work activities (especially for work on the critical trajectory).
2. Reschedule the shortening of activity time (especially for work on the critical trajectory).

By using Microsoft Project 2019 software, in accelerating the work as follows:

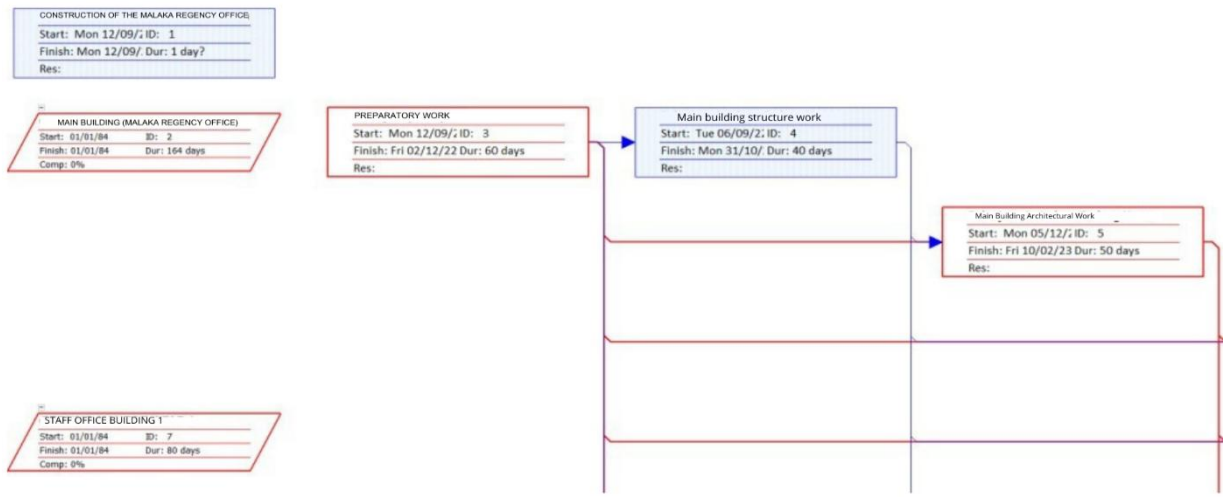

Figure 2. Network planning acceleration using Microsoft Project 2019

Details of Discussion on Accelerating 180 Calendar Days to 100 Calendar Days

Details of the acceleration of work from the plan for 180 calendar days (26 weeks) to 100 calendar days (14 weeks), the discussion steps carried out as follows.

Table 4. Details of work predecessors

Task Name	Duration	Start	Finish	Predecessors
CONSTRUCTION OF THE MALAKA REGENCY OFFICE	1 day?	Mon 12/09/22	Mon 12/09/22	
MAIN BUILDING (MALAKA REGENCY OFFICE)	164 days	Tue 06/09/22	Fri 21/04/23	
Preparation work	60 days	Mon 12/09/22	Fri 02/12/22	
Structural work of the Main Building	100 days	Tue 06/09/22	Mon 23/01/23	3SS - 4 days
Architectural work of the Main Building	50 days	Mon 05/12/22	Fri 10/02/23	3;4;5SS

Mechanical, Electrical, and Plumbing work of the Main Building	50 days	Mon 13/02/23	Fri 21/04/23	3;4;5
STAFF OFFICE BUILDING 1	80 days	**Mon 24/04/23**	**Fri 11/08/23**	
Structural work of Staff Office Building 1	40 days	Mon 24/04/23	Fri 16/06/23	3;5;6
Architectural work of Staff Office Building 1	40 days	Mon 19/06/23	Fri 11/08/23	3;4;6;8
Mechanical, Electrical, and Plumbing work of Staff Office Building 1	40 days	Mon 19/06/23	Fri 11/08/23	3;4;8;9SS-7 days
STAFF OFFICE BUILDING 2	90 days	**Mon 14/08/23**	**Fri 15/12/23**	
Structural work of Staff Office Building 2	40 days	Mon 14/08/23	Fri 06/10/23	8;9;10SS
Architectural work of Staff Office Building 2	40 days	Mon 14/08/23	Fri 06/10/23	8;9;10;12SS
Mechanical, Electrical, and Plumbing work of Staff Office Building 2	50 days	Mon 09/10/23	Fri 15/12/23	8;9;10;12;13SS
SUPPLEMENTARY WORKS	410 days	**Mon 12/09/22**	**Fri 05/04/24**	
Connecting Corridor work	40 days	Mon 18/12/23	Fri 09/02/24	3;4;5;6;8;9;10;12;13;14
Landscape work	50 days	Mon 12/09/22	Fri 18/11/22	3SS
Powerhouse work	40 days	Mon 12/09/22	Fri 05/04/24	3;4;5;6;8;9;10;12;13
Guard Post work	40 days	Mon 12/09/22	Fri 04/11/22	3SS

CONCLUSION

This study concludes that applying the Critical Path Method (CPM) can accelerate the Malaka Regency Regent's Office construction project from 180 days to 100 days by eliminating lag time between critical activities. For future research, it is recommended to (1) explore additional acceleration methods beyond CPM, (2) incorporate work implementation strategies rather than focusing solely on duration and cost, and (3) utilize more advanced software tools instead of Microsoft Excel and Microsoft Project to enhance scheduling accuracy and efficiency.

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