



Analysis of the Accelerated Implementation of the North Boulevard Paramount Petals Road and Canal Project Using CPM, PERT And Time Cost Trade Off Integration Methods

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INTRODUCTION

As a result of delays in construction work, contractors can lose both time and costs because the contractor's expected profits are reduced, the contractor's expected profits are not achieved, or the same profits are not obtained at all. For the owner or owner of the project, delays in project completion can result in loss of time in operating the project results, which can result in obstruction or delay in the utilization of project development results. Problems in work can result in delays and losses. Every means is used to avoid a problem that causes delays and losses (Casa et al., 2020).

Paramount Petals Curug North Boulevard Road & Canal Project, Tangerang Regency, Banten 15810. The project will start from 03 June 2024 to 30 September 2024. It is reported that the project will only have its first handover on 14 April 2025. This is caused by several delay factors, both work time management and late processing of final quantity documents. The owner of the North Boulevard Road & Canal Project is PT. PEI-P Paramount Petals with the assignee namely CV. Bayan Mandiri Sejahtera.

The author uses the CPM and PERT scheduling methods to research the North Boulevard Road and Canal Project in the South Petals Area. Then, to accelerate the duration of the project, the TCTO (Time Cost Trade Off) method is used.

Abstract: The North Boulevard Road and Canal Project in the South Petals area is a project that has been under construction since June 2024 and is the main route for the Paramount Petals neighborhood. This project has a work time agreement of 120 normal days. For this reason, it is very important for the project to be completed on time or faster and not experience delays. In this final project, an analysis of project acceleration is carried out using the Critical Path Method scheduling method to determine the activities that are on the critical path and the Program Evaluation and Review Technique to determine the probability that the project can be completed on time. Based on the analysis carried out, it was found that the CPM duration is 120 days with the probability that it can be completed in 120 days is 50.38%. Then the results of the acceleration analysis using the Time Cost Trade Off method show that the optimal project duration is 100 working days with a normal reduction of Rp. 76,604,480.00 in addition to 1 hour of overtime work.

Keywords: Development Project, Critical Path Method, Program Evaluation and Review Technique, Time Cost Trade Off

RESEARCH METHOD

The stages involved in research, concept development, or case resolution are written in. This research uses a quantitative approach with analytical descriptive methods. A quantitative approach was chosen because this research focuses on collecting and processing numerical data to analyze cost and time efficiency in implementing the North Boulevard Road and Channel project in the South Petals area. Numerical data used includes work volume, unit price, duration of construction activities, and allocation of resources used during the implementation process. The combination of descriptive and analytical methods allows the preparation of conclusions that are not only informative, but also evaluative, so that the research results can be used as recommendations for improvements in similar projects in the future.

Data Source

Primary data was taken directly from CV. Bayan Mandiri Sejahtera author. This data includes the S curve and project cost budget plan, as well as other data related to the author's research. Secondary data comes from literature related to the author's research; This literature can be in the form of books, lecture notes, or journals.

Data Analysis

A list of work activities for the entire project can be created using a work fraction structure. Information about the sequence and duration of work can be added in the next step. After determining the relationship between activities, the next step is to create a network scheme. In this final project, the author creates a CPM network scheme with activities on the arrow or Activity On Arrow. To get an estimate of the expected time, view each activity using three time scopes: optimistic time, pessimistic time, and realistic time. By using the PERT method analysis, the result is the possibility that the project will be completed on time. The author uses the Trade Off Time Cost method to speed up project time. Activities that are on the critical path are compressed to carry out Time Cost Trade Off analysis.

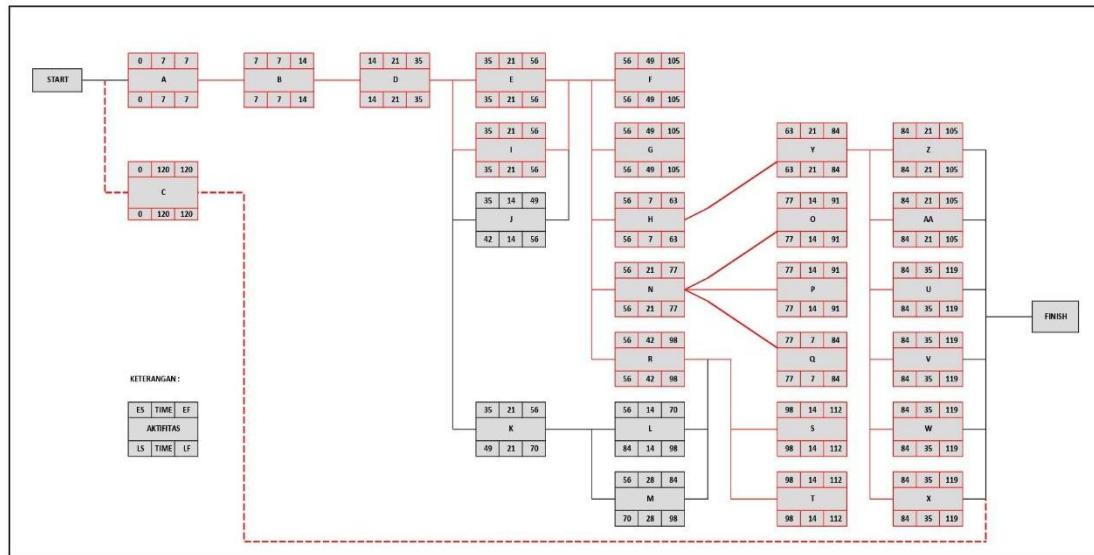
RESULT AND DISCUSSION

Critical Path Method (CPM)

Deterministic scheduling analysis is carried out using the CPM (Critical Path Method) method. The goal of this method is to identify what activities are included in the project's critical path.

1. Create a work sequence and work duration
2. Arrange activity relationships
3. Identify Critical Paths and Slack

From the results of the total slack calculation that has been carried out, the critical path can be determined. The critical path has total slack = 0, so the critical path is in activities A, B, C, D, E, F, G, H, I, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA. With the work completion time calculated deterministically and obtained via the critical path, it is 120 days.

**Figure 1.** Network Diagram CPM Method**Program Evaluation and Review Technique (PERT)**

To determine the probability that a project will be completed on time, the PERT method is used. If CPM uses exact time, the PERT method uses three time estimates, namely optimistic time (a), most likely time (m) and pessimistic time (b). Results of analysis of optimistic time, most likely time, and pessimistic time for the North Boulevard Road and Canal project in the South Petals Region.

1. Time Estimation Using the PERT Method
2. Determining TE Values
3. Calculation of Standard Deviation and Variance Values

Table 1. Standard Deviation and Variance Values

Code	Activities	A	M	S	V(te)
		Day	Day	$\frac{b-a}{6}$	S^2
A	Equipment Mobilization and Demobilization	5	7	0.83	0.69
B	Measurement, Benchmarking, Cleanliness, etc	5	7	0.83	0.69
C	Location Coordination & Security	60	120	10.83	117.36
D	Excavation of the road body	17	21	1.83	3.36
E	Leveling + sub base compaction	17	21	1.83	3.36
F	Base Course B ex Sudamanik,	38	49	2.83	8.03
G	Base Course A ex Sudamanik,	38	49	2.83	8.03
H	Test CBR (3 layer)	5	7	0.83	0.69
I	Concrete pipe type NR & R Ø800	17	21	1.83	3.36
N	Soil excavation	17	21	1.83	3.36
O	Soil compaction	11	14	1.33	1.78
P	Dolken wood cerucuk Ø8-10cm, L=150cm	11	14	1.33	1.78
Q	Work floor t=5cm	5	7	0.83	0.69
R	River stone channel 1:3 Including 2" pipe flute (1 point/m ²)	37	42	2.83	8.03

After getting the standard deviation value, the probability that the Tanjung Priok Port pier construction project can be completed on time can be determined using the formula.

$$Z = \frac{T_d - T_e}{S}$$

$$Z = \frac{145 - 120}{9,35}$$

$$Z = 2,675$$
(1)

If the Z value in the normal distribution list is 2.675, then the result is 0.4962. Thus, the chance that the project can be completed within 120 days is $1 - 0.4962 = 0.5038$, which means the chance that the project can be completed within 120 days is 50.38%.

Time Cost Trade Off (TCTO)

Time Cost Trade Off Method Analysis is an analysis that involves sacrificing time and cost to speed up project completion, even though it can increase costs. In this research, project time acceleration was carried out for activities on the critical path by increasing workers' overtime hours.

Type of Worker	Workers' wages per day	Hourly Worker Wages
worker	Rp. 150.000	Rp. 21.428,571

Crash Duration

Crash Duration is a limit within which time expenditure is reduced; crossing this threshold will become inefficient again. Work productivity for 1 hour of overtime is 90%, for 2 hours of overtime is 80%, and for 3 hours of overtime is 70%.

Table 2. Recap of Results The duration calculation is accelerated by adding 1-3 hours

No.	Information	Normal Duration (Days)	Duration Of Crasing (Days)
Paramount Petals Boulevard Street Project			
1	Additional 1 Hour of Overtime	120	100
2	Additional 2 Hour of Overtime	120	91
3	Additional 3 Hour of Overtime	120	87

Crashing Cost

After obtaining the value of daily productivity and the acceleration of the crash duration work, the next step is to calculate the direct costs of the accelerated crash cost.

Table 3. Crashing cost calculation results with the addition of 1 – 3 hours of overtime

No.	Information	Crashing Cost
Paramount Petals Boulevard Street Project		

1	Additional 1 Hour of Overtime	Rp. 166,500,000.00
2	Additional 2 Hour of Overtime	Rp. 458,843,023.26
3	Additional 3 Hour of Overtime	Rp. 722,719,780.22

Direct and Indirect Costs

Direct costs are accurately traced to cost objects and can be recognized directly for producing a unit of output. Cost objects can be materials, wages or salaries that can be specifically used for the work of a project. Then indirect costs are costs that cannot be directly linked to a particular object. These costs include insurance costs, electricity costs, supervisory costs, etc.

Table 4. recap of direct and indirect costs

No.	Information	Direct Cost	Indirect Cost	Total
Paramount Petals Boulevard Street Project				
1	Normal Cost	4,979,139,922.97	2,133,917,109.84	7,113,057,032.81
2	Additional 1 Hour of Overtime	5,145,639,922.97	1,890,812,628.98	7,036,452,551.94
3	Additional 2 Hour of Overtime	5,437,982,946.22	1,736,909,275.45	7,174,892,221.68
4	Additional 3 Hour of Overtime	5,868,359,703.19	1,641,474,699.88	7,509,834,403.07

Comparison Graph

A comparison graph of direct, indirect and total costs for the Paramount Petals Boulevard Road project can be seen below.





CONCLUSION

Based on the analysis of the Paramount Petals Boulevard Road work, it can be concluded that, using the CPM method for the Boulevard Road project, it is known that the critical paths are at activities A, B, C, D, E, F, G, H, I, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA. Using the PERT method, the probability that the Jalan Boulevard project can be completed on time, namely within a period of 120 days, is 50.38%. Using the TCTO method of Crash Duration and Crashing Cost analysis, it was found that the most optimal duration for the Jalan Boulevard project was 100 working days with the addition of 1 hour of overtime work, and there was a cost savings of Rp. 76,604,480.00.

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