

Evaluation of Time Management in the 6-Storey Polyclinic Building Project of QIM Batang Hospital Using the CPM Method

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Abstract — Project time management is the process of planning, organizing and controlling the schedule of project activities. Time management is needed in a project implementation so that the project can run exactly according to the predetermined time. Scheduling is part of controlling time management. Along with the development of technology and science, project scheduling methods are also developing. One of the scheduling methods that is often used is the Critical Path Method, which is a technique of analyzing the activity network to predict the total duration. This research focuses on evaluating time management on the Batang QIM Hospital Polyclinic Building Project with the CPM method to find out the work that crosses the critical path. In the implementation of the Batang QIM Hospital Polyclinic project, several obstacles were encountered which resulted in the delay of work causing the project to be late. These obstacles include labor, materials, and weather. From the analysis that has been done based on the schedule plan that has been made before there are 7 types of work that cross the critical path. The total project duration required after using the CPM method is 43 weeks or one week earlier than the planned schedule of 44 weeks.

Keywords: project time management; cpm; critical path.

I. INTRODUCTION

Infrastructure development from various sectors is one way to improve services and smooth work mobility. The addition of infrastructure such as buildings can expand the range of services and increase the scope of work. One of the things done by QIM Hospital (Qolbu Insan Mulia), is to build a new building located in front of the building, consisting of 6 floors planned on the lower floor as an Emergency Room, then the second to fourth floors as polyclinics, the fifth floor as a delivery room and the sixth as an operating room. The project was planned to be built from January 2023 until the end of October 2023. But in fact, until mid-year, the implementation schedule has been minus 25% of the initial plan. This is due to several obstacles such as material availability, unstable soil conditions during the installation of pile foundations, and changes in plans. These obstacles certainly affect the project completion time. Failure to manage project time will certainly result in the swelling of project resources, especially human resources and project costs. Therefore, project managers must be able to manage project time management well for the success of the project.

Project time management is the process of planning, compiling and controlling the schedule of project activities, time management is included in the process that will be needed to ensure the completion time of a project where planning and

scheduling have provided specific guidelines to complete project activities more quickly and efficiently (Clough and Sears, 1991). The main objective of time management is the implementation of projects that are in accordance with the scope can meet the target time that has been determined. Time management supports the productivity of project work so that it can make reliable and optimum project schedule planning for resources and costs and schedule control that is able to identify early delays for effective and efficient handling. Some important aspects of project time management are; (1) realistic scheduling, (2) identification of critical tasks, (3) clear deadlines, (4) use of time management tools, (5) monitoring and control, and (6) backup plans. The application of time management in a construction project can be done with several stages, namely (1) creating a schedule plan, (2) defining activities, (3) sequencing activities, (4) estimating activity resources, (5) estimating activity duration, (6) developing a schedule, and (7) controlling the schedule.

In the research, the evaluation of time management was carried out using the CPM (Critical Path Method) method. This method is also called the critical path method, which is a technique for analyzing the network of activities when running a project in order to predict the total duration. The critical path is a set of activities that determine the fastest time for project completion.

This path is the longest path on the network diagram and has minimal slack or float (activity delay time/leeway time, without delaying or disrupting the completion of the project as a whole). This method is also supported by Syfa Safitri Aulia's research (2021) which shows that using CPM rather than PERT provides more efficient time estimation results. Therefore, the CPM method is more often used to maximize construction work time.

II. LITERATURE REVIEW

Infrastructure Development and Project Performance

Infrastructure development plays a crucial role in improving service delivery and supporting work mobility across various sectors. The addition of infrastructure such as buildings and other facilities can enhance operational capacity and service coverage, particularly in the health sector where accessibility and functionality are essential (Iman, 1995). Construction projects, especially in healthcare environments, are often complex due to technical, financial, and logistical challenges that may arise during the implementation phase. Delays caused by material shortages, site conditions, or design changes are among the most frequent issues affecting construction schedules (Purba, Sianturi, & Panjaitan, 2024).

Inadequate project time management can lead to cost overruns, inefficient use of human resources, and potential disruption of service delivery. Therefore, project managers must adopt systematic approaches to ensure that project objectives are achieved within the planned duration (Haruna, 2015).

Project Time Management

Project time management refers to the process of planning, organizing, and controlling the schedule of project activities. Effective time management provides specific guidelines to complete project activities more efficiently and ensures that projects are completed within the defined scope, cost, and time (Clough & Sears, 1991). The primary goal of time management is to ensure that project execution aligns with its objectives while optimizing the use of resources and minimizing potential delays.

According to Hidayat and Ramadhany (2021), proper time management involves realistic scheduling, identification of critical tasks, clear

deadlines, the use of time management tools, regular monitoring, and contingency planning. These components enable early identification of potential delays and support decision-making to maintain schedule performance. Time management in construction typically involves several stages: defining activities, sequencing them, estimating durations and resources, developing a schedule, and controlling the execution phase (Perdana, 2020).

When implemented effectively, these processes enhance productivity, reduce risks of schedule slippage, and contribute to project success (Astari, Subagyo, & Kusnadi, 2021).

Critical Path Method (CPM) in Construction Scheduling

The Critical Path Method (CPM) is one of the most widely used techniques in construction project scheduling. It involves analyzing the network of project activities to predict the total project duration and identify activities that directly influence project completion (Clough & Sears, 1991). The critical path represents the sequence of activities that determines the minimum completion time for a project. Any delay in these critical activities will delay the entire project (Aulia, 2021).

Compared to the Program Evaluation and Review Technique (PERT), the CPM method provides a more precise and deterministic approach to time estimation. Research conducted by Aulia (2021) demonstrated that CPM yields more efficient and reliable scheduling results for construction projects. This finding is also supported by studies from Wiranata, Dewi, and Nuryawan (2009), which highlighted that CPM-based scheduling allows for more effective control of repetitive construction activities and resource allocation.

Therefore, the CPM method is considered highly effective for managing construction project schedules, minimizing delays, and optimizing overall project performance (Yustika, 2022).

III. METHOD

In this study, the research object is the QIM Hospital Polyclinic Building Construction Project, Batang, with the research subject being the application of time management on the construction project, as well as determining the critical path of the observed work. This construction was carried out with self-managed

implementation. Factors that are considered to have a significant impact on the implementation of project time management are unfinished design or design changes, implementation time, number of workers, labor productivity, work volume, availability of materials, and inadequate available work equipment. The data methods collected are survey results, observations, and interviews. The data analysis methods used include:

1. Identify the scope of the project, break it down into activities that are components of the project, and collect all the necessary data, both primary and secondary data;
2. Data analysis using the Critical Path Method (CPM) using POM QM V.5 network planning software;
3. Reorganize the components into links in the appropriate order and provide estimated timelines for each of the resulting activities;
4. Calculate LET and EET to determine the project implementation time and critical path of the project, and determine the critical path based on float time ($EET = LET$).

IV. RESULTS AND DISCUSSION

The QIM Hospital Polyclinic building construction project began on January 7, 2023 and is targeted for completion on November 3, 2023. However, the actual progress in the field against the planned time schedule is minus or can be said to be late. The planned project time schedule was not in accordance with the implementation in the field. Although periodic

rescheduling, monitoring of each work implementation, and evaluation of monitoring results have been carried out, the implementation of time management is not effective. Factors that influence the delay of the project include material and labor factors and the work that influences the delay includes structural and foundation work. There is also the MEP work, which affects the delay, namely telephone work due to other constraints.

A. CPM Analysis

In the Batang QIM Hospital Polyclinic Building project, PT Medikons as the Planning Consultant has carried out project planning with a period of 44 weeks. Many work items amounted to 41 pieces. The planning consultant made a project schedule with the S curve scheduling method. In the research, critical path method analysis was carried out. The CPM method has two ways that can be used to analyze the optimal time, namely, using forward calculations (Forward Pass) from the initial activity to the final activity, and backward calculations (Backward Pass) from the final activity back to the initial activity.

B. Forward Pass Analysis

Forward count analysis is performed to obtain the final time of the completed series of activities. Forward count analysis is done from the beginning by taking the value 0 and then sorted to the end. If there are or more time events then the largest value is taken. The results of the analysis can be seen in table 1 as follows.

Table 1. Results of forward count analysis

Activities	Duration	ES (<i>Earliest Start</i>)	EF (<i>Earliest Finish</i>)
A	2	0	2
B	8	2	10
C	7	2	9
D	8	2	10
E	5	2	7
F	2	10	12
G	6	2	8
H	4	10	14
I	2	14	16
J	6	10	16
K	4	7	11
L	2	12	14
M	6	9	15
N	4	14	18
O	2	14	16
P	6	14	20
Q	4	16	20
R	2	16	18
S	6	16	22
T	4	18	22

Activities	Duration	ES (<i>Earliest Start</i>)	EF (<i>Earliest Finish</i>)
U	2	18	20
V	6	15	21
W	4	20	24
X	2	20	22
Y	2	22	24
Z	14	20	34
AA	6	34	40
AB	22	9	31
AC	15	18	33
AD	17	21	38
AE	13	22	35
AF	7	33	40
AG	4	35	39
AH	15	24	39
AI	14	24	38
AJ	18	21	39
AK	11	24	35
AL	16	24	40
AM	2	41	43
AN	16	18	34
AO	7	34	41

Based on the data in Table 1, using forward counting to identify the critical path, the project completion time is 43 weeks. This proves that for the earliest start time, the next activity is determined by the completion of the predecessor activity, in other words, the predecessor activity must have been completed before the next activity begins.

A countdown analysis is conducted to obtain the starting time of a series of activities. Countdown analysis is done from the end by taking the finished value and then sorted to the beginning. If there are two or more time events then the smallest value is taken. The results of the analysis can be seen in Table 2 below.

C. Backward Pass Analysis

Table 2. Backward count analysis results

Activities	Duration	LS (<i>Lastest Start</i>)	EF (<i>Lastest Finish</i>)
A	2	0	2
B	8	2	10
C	7	6	13
D	8	5	13
E	5	8	13
F	2	13	15
G	6	8	14
H	4	10	14
I	2	18	20
J	6	13	19
K	4	15	19
L	2	15	17
M	6	13	19
N	4	14	18
O	2	17	19
P	6	18	24
Q	4	20	24
R	2	19	21
S	6	19	25
T	4	39	43
U	2	21	23
V	6	19	25
W	4	24	28
X	2	28	30
Y	2	2	27
Z	14	23	37
AA	6	37	43

Activities	Duration	LS (<i>Lastest Start</i>)	EF (<i>Lastest Finish</i>)
AB	22	21	43
AC	15	21	36
AD	17	26	43
AE	13	30	43
AF	7	36	43
AG	4	39	43
AH	15	15	43
AI	14	14	43
AJ	18	18	43
AK	11	11	39
AL	16	16	43
AM	2	2	43
AN	16	16	34
AO	7	7	41

Based on the data in Table 2, using forward calculation to identify the critical path, the project completion time is 43 weeks. This proves that it is possible to find out the start and end times of activities without delaying the timeframe of the entire project.

D. Analysis of Total Float Count

Total float is the amount of time allowed for an activity to be postponed, without affecting the overall project completion schedule. The results of the total float count analysis can be seen in Table 3.

Table 3. Total float analysis results

Activities	Duration	TF (<i>Total Float</i>)
A	2	0
B	8	0
C	7	4
D	8	3
E	5	6
F	2	3
G	6	6
H	4	0
I	2	4
J	6	3
K	4	8
L	2	3
M	6	4
N	4	0
O	2	3
P	6	4
Q	4	4
R	2	3
S	6	3
T	4	21
U	2	3
V	6	4
W	4	4
X	2	8
Y	2	3
Z	14	3
AA	6	3
AB	22	12
AC	15	3
AD	17	5
AE	13	8

Activities	Duration	TF (<i>Total Float</i>)
AF	7	3
AG	4	4
AH	15	4
AI	14	5
AJ	18	4
AK	11	4
AL	16	3
AM	2	0
AN	16	0
AO	7	0

Table 3 shows the results of the count analysis above, it can be seen that the total float (TF) whose value = 0 is activity A, B, H, N, AM, AN and AO. This indicates that these activities do not have a grace period to be late so they are called critical activities and activities that have a grace period are activities C, D, E, F, G, I, J, K, L, M, O, P, Q, R, S, T, U, V, W, X, Y, Z, AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK and AL. The project activity schedule can be seen in Figure 1 below.

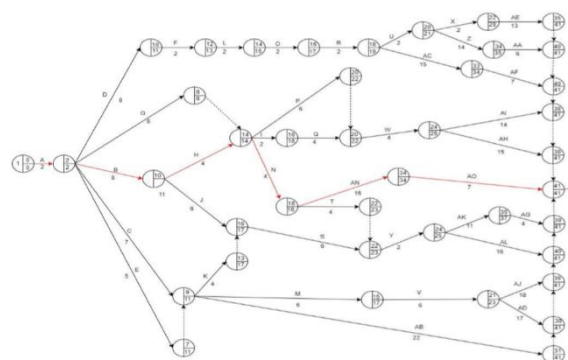


Figure 1. Forward and backward count results

Based on Figure 1 shows the shape of the work network with the CPM method, namely the activities located on the arrows, while the circle is an event in which there are ES, EF, LS, and LF values and activity numbers. The difference in

activity time from before CPM analysis is 44 weeks and after CPM analysis is 43 weeks. Therefore, CPM Analysis in scheduling construction project activities can provide efficient and effective start and end times so that there are no delays in project work.

V. CONCLUSION

Based on the results of interviews with planning consultants, of all structural work, the foundation work is the most delayed. While from the results of the analysis using the CPM method, the work that has a critical path includes earthwork (A), pile work (B), 2nd floor column work (H), 4th floor column work (N), fire extinguisher work (AM), clean water and dirty water work and rainwater and hot water work (AO). The work should be prioritized so that it can be completed on time and does not result in project delays then the total project duration required after using the CPM method is 43 weeks or a week earlier than the planned S curve of 44 weeks.

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