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Integrate Fast Tracking Techniques with the Critical Path Method (CPM) to Accelerate Project Timelines

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Abstract

Project fast-tracking involves executing project activities sequentially and in parallel, accelerating completion time. In this research, the Critical Path Method (CPM) was used to analyze and schedule a residential complex construction project through systematic analysis of project tasks and identification of critical paths, which enables project managers to optimize project schedules and compress the schedule effectively. Fast-tracking also enables simultaneous tasks and overlapping sequential activities, thus helping compress project timelines without compromising on quality, ultimately accelerating project timelines.

Subject Classification: *46N10, 47N10, 90C30*

Keywords: - Residential complex projects, Critical path method (CPM), Project scheduling, Fast-tracking.

I. INTRODUCTION

Establishing residential complexes represents a significant investment, effective scheduling of residential complex projects represents a considerable challenge, and project performance directly affects its successful completion [1, 2]. Typically, all projects are bound by delivery deadlines, requiring completion before or at the agreed time. However, in practice, many projects still face delays or fail to meet their scheduled completion dates [3, 4].

A construction project involves various activities coordinated using different techniques to ensure timely completion and quality standards. The critical path method (CPM) stands out as the cornerstone of project scheduling [5, 6], as it provides a structured approach to analyzing project tasks, identifying critical activities [7], and improving the project schedule. As for fast-tracking the implementation of activities, initially viewed as sequential, they are implemented in parallel through overlapping [8].

This work reviews the critical path method (CPM), which represents the longest path in a network diagram. Delays in essential path activities directly affect project completion time [9, 10]. Conversely, accelerating tasks along this path can speed up project completion. Then, we apply fast-tracking techniques in analyzing and scheduling the project, where we implement the tasks in parallel. That is, the activities are overlapping and, at the same time reduce the project implementation time, which leads to improving the project efficiency [11, 12].

II. METHODS

The difficulty lies in the difference between the expected duration of the initial project plan and the time required to implement the project. The period allocated for project planning is usually shorter than the time frame necessary for project implementation [13, 14].

1. Definition of scope:

We begin the work by first defining the scope of the residential complex project, as this includes defining every task and activity to complete the project, including the stages of site preparation, design, construction, and finishing. We describe a logical sequence of tasks that must be performed, considering constraints and dependencies. We use techniques such as precedence charts or activity diagrams to visualize task dependencies.

2. Critical Path Analysis:

Network analysis seeks to speed up the overall project time by creating a network diagram that represents the project activities and identifying Completion time, as the project network diagram always starts with an event that indicates the start of the project and ends with an event that means the end of the project, along with the latest start and finish time for each task [15, 16].

3. Fast implementation:

Fast-tracking is the performance of activities, initially perceived as serial, in parallel by overlapping implementation. The sequencing of these tasks is critical, considering their interdependencies and limitations. Task dependencies can be visualized through techniques such as precedence charts or node-based activity diagrams [17, 18].

III. RESULTS

First, we must provide a list of the activities or works required in the project or process plan, and the project scope is implemented by describing them and dividing them into activities or groups of activities that make up the components of the project. This ranking is based on experiences [19, 20]. Details of their activities are shown in Figure 1 below.

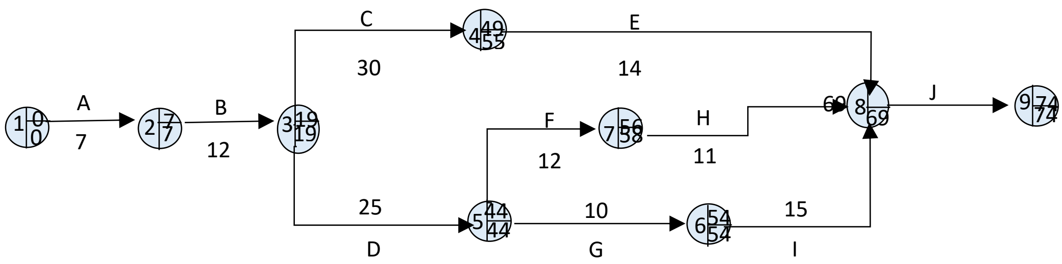
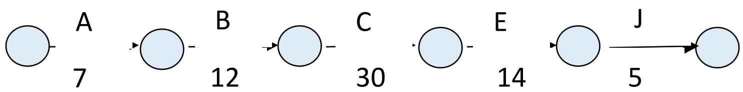


Figure 1. Project Work Network

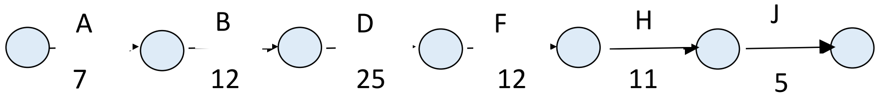
We define paths that start from the start point and end at the endpoint. There are three methods identified for the specific project.

Path I



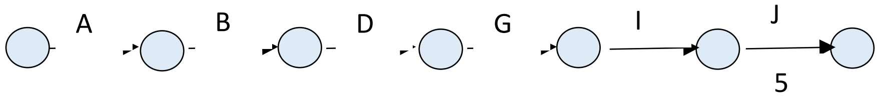
Time for the path: 7+12+30+14+5=68 weeks

Path II



Time for the path: 7+12+25+12+11+5=72 weeks

Path III



7 12 25 10 15

Time for the path: 7+12+25+10+15+5=74 weeks

Compare the durations of the three paths: Maximum of {68,72,74}=74. It is observed that path III has the most extended duration. Therefore, it is the critical path, and the essential activities are A, B, D, G, I, and J. They are explained according to the following tables to find the critical path and critical activities; the correlations between tasks and their respective durations within the project can be observed in Table 1.

Table 1. illustrates the activities and their corresponding relationships and durations

No	the description	the activities	Duration(week)
1	Site cleaning	A	7
2	Foundation floor structure works	B	12
3	Building the structure	C	30
4	Roof and Canopy Jobs	D	25
5	Floor and Wall Coating Work	F	12
6	Fence Work	E	14
7	Electric Work.	G	10
8	Drainage Work	H	11
9	Doors and Windows Works	I	15
10	Finishing	J	5

To determine the critical path, we compute the forward time, which represents the minimum duration for project completion, using $Ef = Es + D$ ... (1) [21, 22], then the forward time value is obtained as in Table 2.

Table 2. Results of Forward Time Calculation

the activities	the description	Duration(week)	ES	EF
A	Site cleaning	7	0	7
B	Foundation floor structure works	12	7	19
C	Building the structure	30	19	49
D	Roof and Canopy Jobs	25	19	44
F	Floor and Wall Coating Work	12	44	56
E	Fence Work	14	49	63
G	Electric Work.	10	44	54
H	Drainage Work	11	56	67
I	Doors and Windows Works	15	54	69
J	Finishing	5	69	74

Inverse time calculation is employed to identify the maximum time required to complete a project, determined by the formula $Ls = Lf - D$ ... (2) [23, 24]. Subsequently, the countdown time is determined as presented in Table 3.

Table 3. Results of Countdown Time Calculation

the activities	the description	Duration(week)	LS	LF
A	Site cleaning	7	0	7
B	Foundation floor structure works	12	7	19
C	Building the structure	30	25	55
D	Roof and Canopy Jobs	25	19	44
F	Floor and Wall Coating Work	12	45	57
E	Fence Work	14	55	69
G	Electric Work.	10	44	54

H	Drainage Work	11	47	58
I	Doors and Windows Works	15	54	69
J	Finishing	5	69	74

The critical activities were obtained based on the calculations in Tables 2 and 3 [25, 26]. The analysis results of the project's essential tasks are presented in Table 4.

Table 4. Project Critical Job Analysis Results

the activities	the description	Duration(week)	Jobs Status
A	Site cleaning	7	Critical activate
B	Foundation floor structure works	12	Critical activate
C	Building the structure	30	—
D	Roof and Canopy Jobs	25	Critical activate
F	Floor and Wall Coating Work	12	—
E	Fence Work	14	—
G	Electric Work.	10	Critical activate
H	Drainage Work	11	—
I	Doors and Windows Works	15	Critical activate
J	Finishing	5	Critical activate

IV. DISCUSSION

the critical path method (CPM) was applied in analyzing and scheduling residential complex projects. Project activities are sequenced by determining the critical path and understanding task dependencies.

1. Optimal Project Sequencing:

The critical path, representing the longest sequence of dependent activities, was identified through CPM analysis. This critical path served as a roadmap for project scheduling, enabling project managers to prioritize activities and allocate resources efficiently. Sequencing tasks in the most logical and efficient manner minimized project duration, contributing to overall project time reduction.

2. Identification of Critical Activities:

CPM analysis made identifying important activities that directly affected the project completion time easy. The critical time to complete the project was 74 weeks. These vital activities were monitored and managed to ensure timely implementation, thus minimizing delays and preventing schedule slippage. Project managers could accelerate project delivery and maintain project momentum by focusing resources on critical tasks.

3. Implementation of Fast Tracking Techniques:

Fast-tracking techniques have been successfully implemented to compress project timelines without compromising quality. This is done through sequential overlapping activities, where painting and flooring are carried out with sanitation. The time will be shortened by 11 weeks. Likewise, doors and windows will be carried out in conjunction with the electrical works Therefore, the time of the second track will be reduced by ten weeks. The construction time of the fence will also be carried out in conjunction with the structure. The time will be shortened by 14 weeks. At the same time, the project duration is reduced, allowing the project to be completed faster. The project was completed in 64 weeks. This approach has enabled project teams to respond to tight deadlines and market demands more effectively, so the schedule is updated with new times and after using fast schedule tracking.

Table 5. Results calculate time after using Fast-track

No	the description	Simultaneous description	the activities	Duration(week)
1	Site cleaning		A	7
2	Foundation floor structure works		B	12

3	Building the structure	Fence Work	C, E	30
4	Roof and Canopy Jobs		D	25
5	Floor and Wall Coating Work	Drainage Work	F, H	12
6	Doors and Windows Works	Electric Work.	I, G	15
7	Finishing		J	5

V. CONCLUSION

Using the Critical Path Method (CPM) helps in identifying essential activities and prioritizing activities, which helps reduce project completion time. When fast-tracking techniques are combined with the Critical Path Method, timelines are accelerated through overlapping activities, enabling project teams to achieve rapid project delivery while maintaining quality standards by reducing 13% of the time after implementing the Critical Path Method (CPM). These methodologies can improve project schedules, reduce completion times, and achieve successful outcomes.

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