DESIGN OF A PROJECT MANAGEMENT SYSTEM AT CV. KHARISMA KARYA NUSANTARA USING THE CRITICAL PATH METHOD (CPM)

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ABSTRACT

Project delays have a substantial impact on overall implementation performance; therefore, effective control and scheduling mechanisms are essential to ensure time efficiency throughout every phase of work. CV. Kharisma Karya Nusantara frequently encounters delays caused by excessive overtime and an unstructured reporting system that cannot be evaluated in real time. This study aims to design a project management system and analyze the scheduling impact using the Critical Path Method (CPM). The CPM analysis identified a critical path consisting of preparatory work, lower structure levels 1 to 3, ground floor work, upper structure levels 1 and 2, first, second, and third floor structural works, walls and partitions of the second floor, first floor finishing, and final work. The total project duration calculated using CPM was 588 days. When recalculated using Microsoft Project, the duration was reduced to 337 days, resulting in a time efficiency of 251 days. These findings demonstrate that implementing a well-structured and integrated project management system can significantly enhance scheduling efficiency, minimize delays, and optimize overall resource utilization.

KEYWORDS Delays, impact, Critical Path Method, Microsoft Project

INTRODUCTION

Global competition demands high levels of effectiveness and efficiency in project implementation, especially for companies in the construction and project services sectors. Effective project control, including human resource management and structured scheduling, is crucial to project success (Widyaningsih & Utami, 2021). Delays are a common problem in project completion, impacting all aspects of the project, including cost and quality. Inaccurate project planning often leads to cost overruns and reduced project quality (Tech et al., 2021).

CV Kharisma Karya Nusantara, a construction and project services company in Surakarta, faces significant challenges in project implementation, including the coordination and management of activities that depend on costs and materials. Their current manual system, which still relies on simple spreadsheets, hinders comprehensive and real-time project monitoring and evaluation. This results in inefficient and inaccurate project reporting, frequent delays (15-20 weeks per project), and communication barriers between field operations and management (Ahmada et al, 2024). These issues lead to project delays, cost overruns, reduced project quality, and increased safety risks.

To address these challenges, this study proposes the development of a Project Management System integrated with the Critical Path Method (CPM). CPM is a network analysis technique that optimizes the total project cost by reducing the overall completion time (Widyaningsih & Utami, 2021). Its application in construction projects provides a systematic approach to scheduling, formulating, and processing various activities, utilizing experience-based and observation-based timelines. By implementing CPM, CV Kharisma Karya Nusantara can achieve better planning, minimize the difference between plans and reality, and simplify the digital reporting process.

RESEARCH METHOD

This research was conducted at CV Kharisma Karya Nusantara, located in Surakarta, Central Java. The research object was the company's project management system processes, with a specific case study of the Al Azhar Cairo Islamic School construction project in Kartasura. *Critical Path Method* (CPM) is the basis of a work planning and control system based on a network. CPM was first used in the UK in the mid-1950s on a power plant project, then developed by the Integrated Engineering Control Group of E.I. du Pont de Nemours and Company, initiated by Walker and Kelly Jr. in 1957, both from Renington 20 Rand, Univac Computer Division, which was called critical path scheduling (Critical Path Scheduling-CPS) (Syahputra et al., 2024). The components in the CPM method are :

1. Network diagram
2. Relationships between activity sequence symbols
3. *Critical path*
4. Activity deadlines
5. Activitity schedule limits

To determine and find the critical path, there are two calculations: forward and backward. Determining the critical path also takes into account float and free float calculations. The formulas for forward calculations, backward calculations, and float determination are as follows.Perhitungan maju

1. Forward calculation :
   EF = (ES + D) Maksimum
2. Backward calculation :
   LS = (LF + D) Minimum
3. Float Dertimination :
   TF = LF – D – EF

From the float calculation results, the critical path is stated if TF = 0
Symbol description :
EF = Earliest Finish
ES = Earliest Start

D = Duration
LS = Lastest Start
LF = Lastest Finish
TF = Total Float

RESULT AND DISCUSSION

Based on the results of primary and secondary data collection from CV Kharisma and interviews, it can be explained that the work items performed represent data for all tasks within the project. A description of the work items and their duration can be seen in Table 1. Each work item is given a symbol to facilitate diagram creation.

Table 1. Activity Description

Code	Job Items	Activities that precede	Duration (Days)
A	Preparatory work	-	50
B	Lower Structure Level 1	A	25
C	Lower Structure Level 2	B	21
D	Lower Structure Level 3	B	23
E	Ground Floor Work	C,D	16
F	Upper Structure Level 1	E	17
G	Upper Structure Level 2	E	20
H	1st Floor Structure	G	74
I	2nd Floor Structure	H	123
J	3rd Floor Structure	I	17
K	Walls and Partitions of the 1st floor	J	75
L	2nd Floor Walls and Partitions	J	85
M	1st Floor Finishing	K,L	138
N	Final Work	N	17
	Sum		701

Table 1. is the determination of work items before creating a work network model as in Figure 1. is a work network model between project activities by considering the activities that precede each existing work item.

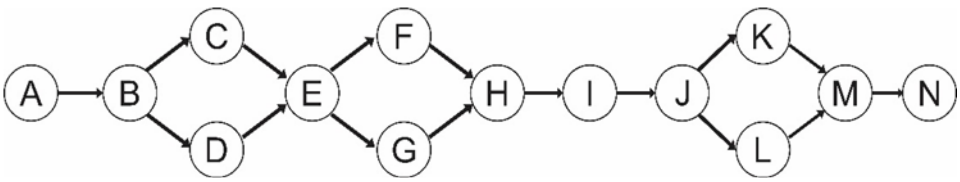

Figure 1. Work Network Model

The CPM calculation has two calculation steps: forward calculation and backward calculation. In the forward calculation, there are the earliest start and earliest finish values, while in the backward calculation, there are the last start and last finish values. The results of the forward and backward calculations can be seen in Table 2 below.

Table 2. Calculation CPM

Code	Activities that precede	Duration (Days)	Fordward		Backward	
			ES	EF	LS	LF
A	-	50	0	50	0	50
B	A	25	50	75	50	75
C	B	25	75	96	77	98
D	B	25	75	98	75	98
E	C,D	16	98	114	98	114
F	E	19	114	131	117	134
G	E	19	114	134	114	134
H	G	74	134	208	134	208
I	H	123	208	331	208	331
J	I	17	331	348	331	348
K	J	75	348	423	358	433
L	J	85	348	433	348	433
M	K,L	138	433	571	433	571
N	N	17	571	588	571	588

In Table 2, the total work completed was shown with a required duration of 588 days. Then, the total float was calculated to determine the critical path for the work item. The calculation results can be seen in Table 3 below.

Table 3. Calculation Float

Code	Total Float	Information
A	0	Critical
B	0	Critical
C	4	Uncritical
D	0	Critical
E	0	Critical
F	6	Uncritical
G	0	Critical
H	0	Critical
I	0	Critical
J	0	Critical
K	20	Uncritical
L	0	Critical
M	0	Critical
N	0	Critical

From the results of the total float calculation, it can be stated that TF (Total Float) = 0 is an activity that is stated in the Critical category and TF that still has remaining time is categorized as Not Critical (Kusnadi, Subagyo Ade Momon, 2021). Therefore, from the calculations in the table above, it can be seen that the critical path in the work item is found in activities with codes A-B-D-E-G-H-I-J-L-M-N, while activities that are not included in the critical path are activities C, F, and K.

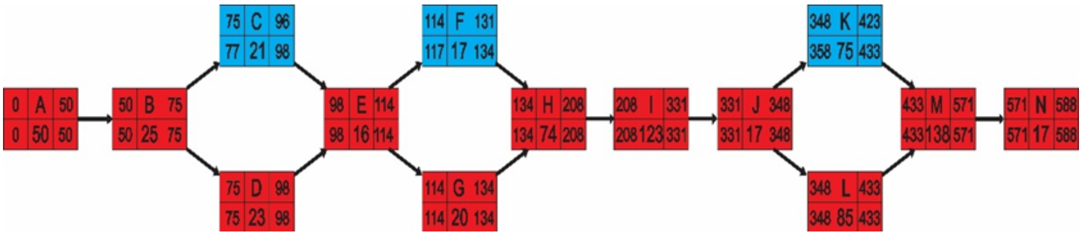

Figure 2. Critical Pathway

As can be seen from the diagram, the critical path is marked in red, while the non-critical path is marked in blue. The manual CPM calculation yields a duration of 588 days, with the critical path for work items A-B-D-E-G-H-I-J-L-M-N and the non-critical path for work items C-F-K.

CONCLUSION

The application of the Critical Path Method (CPM) in the project management process at CV. Kharisma Karya Nusantara has demonstrated a significant contribution to optimizing scheduling and enhancing overall project performance. By identifying sequential activities that determine project completion time, CPM enables project managers to clearly distinguish between critical and non-critical activities. The analysis conducted in this study revealed that the critical path consists of activities starting from preparatory work, lower structure levels 1 to 3, ground floor work, upper structure levels 1 and 2, first, second, and third floor structural works, walls and partitions of the second floor, first floor finishing, and final work. These activities have zero total float, which means that any delay in these tasks will directly extend the overall project duration. The manual CPM analysis calculated a total project duration of 588 days, representing a reduction from the initially estimated 701 days. This outcome confirms that the CPM technique provides a systematic and measurable approach to project scheduling, ensuring that time and resources are used more efficiently to achieve project objectives.

In addition to identifying critical activities, the integration of CPM results with digital project management tools, particularly Microsoft Project, further enhanced project efficiency. When the CPM model was simulated using Microsoft Project, the total project duration was reduced to 337 days, achieving a time saving of 251 days compared to the manual calculation. This result demonstrates that implementing an organized and technology-supported project management system allows for real-time coordination among various project components and improves control over the sequence of activities. The findings emphasize that digital integration helps to reduce delays, identify potential bottlenecks early, and support data-driven decision-making in project execution. Moreover, the adoption of CPM within a structured management framework contributes to cost reduction, better resource allocation, and improved project quality. Therefore, this study concludes that combining CPM analysis with modern digital scheduling tools significantly enhances project effectiveness and efficiency at CV. Kharisma Karya Nusantara. Future projects are encouraged to implement integrated and real-time monitoring systems to maintain consistent performance improvements and ensure sustainable operational excellence within the organization.

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