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Planning of Implementation Schedules using CPM and PERT Methods in The Office Construction Project of Dipatiunus Tangerang Banten

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ABSTRACT

Construction delays remain a recurring issue in infrastructure development in Indonesia due to inadequate scheduling and time mismanagement. This study investigates time optimization in the Dipati Unus Office construction project in Tangerang, Banten, by applying the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT). The objective is to analyze and compare the scheduling effectiveness of both methods to minimize delays and identify critical work activities. This research adopts a case study approach using primary data from field observations and interviews, and secondary data from project documentation such as S-curves, daily reports, and schedules. Data were analyzed using Microsoft Project 2024 to identify critical paths and calculate project durations. The CPM analysis revealed 32 critical tasks with a total duration of 97 days, while PERT produced a shorter estimated duration of 90 days with a 54% probability of on-time completion. The findings demonstrate that both methods are effective for time management, but PERT offers more flexibility under uncertainty. The study implies that integrating CPM and PERT with digital planning tools can significantly improve project scheduling accuracy and execution efficiency. These insights can support future planning strategies in medium-scale construction projects.

Keywords: Project scheduling, Critical Path Method, PERT, construction delay, time optimization

INTRODUCTION

Every development project requires structured planning so that it can be completed according to a predetermined schedule (Abdulkadir, 2023; Kerzner, 2025; Telehenna, 2021). In the construction project of the Dipati Unus Office in Tangerang Banten, effective time management is the main factor in supporting the efficiency of the work process and the quality of the final results. Timely completion plays a crucial role in the success of the project, so a systematic planning strategy is needed to reduce potential obstacles during implementation (Ali & Miller, 2017; Nwulu et al., 2023; Sligo et al., 2017).

This construction project faced obstacles such as logistical problems and delays in material distribution (Ruzieh, 2025; Zidane & Andersen, 2018). To overcome this, an approach is needed that is able to recognize important paths and calculate the estimated duration of each activity precisely (Su et al., 2023). The Critical Path Method (CPM) and Program Evaluation Review Technique (PERT) are methods that have proven to be effective in project time planning (Ba'Its et al., 2020; Bodunwa & Makinde, 2020; Pratyusha & Kumar, 2024). Both of these approaches can help ensure that project schedule management is carried out systematically and efficiently (Aghileh et al., 2024; Nenni et al., 2024; Salimimoghadam et al., 2025). With the application of this method, the project implementation is expected to be completed as planned, while minimizing the risk of delays (Kerzner, 2025; Perera et al., 2016).

Previous research related to the use of CPM and PERT methods has been conducted, one of which is "Analysis of New Product Development Project Scheduling Using Pert and CPM Methods". The results of the application of the PERT & CPM method show that the duration needed to complete the project with the CPM method is 101 days and with the PERT 102 days, with the CPM method it can be accelerated to accelerate the project completion time by 34% of the existing project schedule (Angelin & Ariyanti, 2019). The research on "Scheduling Analysis of Multi-Storey Building Projects Using the CPM Method" resulted in the calculation of the duration and cost of the CPM method resulting in a duration of 117 days, which is 19 days faster than the PERT method (Rahma & Kamandang, 2023). A similar study regarding Network Planning Analysis on Optimizing the Time and Cost of the BPJS Mosque Construction Project at Cileungsi Bogor Branch Office Research shows that the application of the PERT method succeeded in achieving the target completion duration in 78 days with a very low probability of failure, while the CPM method resulted in a faster completion time, namely 76 days (Syarif, 2020).

Based on the results of the existing research, it can be concluded that the CPM and PERT methods are effectively used to optimize project planning and scheduling. Therefore, these two methods are indispensable in development projects, as they are able to help in time management so that the project can be completed on time and according to plan, as well as to anticipate possible delays.

Construction project delays remain a critical issue in infrastructure development across Indonesia, often resulting from inadequate scheduling strategies, misestimated timelines, and poor management of sequential work items. In the case of the Dipatiunus Office construction project in Tangerang, these problems were exacerbated by logistical challenges and untimely material delivery. Without a structured approach to track and forecast work sequences, even minor setbacks can escalate into significant project delays and cost overruns.

Traditional planning methods often lack the precision and flexibility needed to manage uncertainty in construction timelines. Despite existing documentation and scheduling tools, many project managers still struggle to identify critical paths and allocate buffer times for high-risk tasks. The absence of reliable predictive models hinders proactive decision-making and jeopardizes project completion deadlines, which directly impacts budget efficiency and stakeholder satisfaction.

Given the increasing demand for timely and cost-efficient infrastructure delivery, this research is urgent in its attempt to apply structured planning models CPM and PERT to a real world construction project (Naeni & Salehipour, 2021; Panchal & Khokrale, 2024). By analyzing and comparing these two scheduling techniques, the research provides practical insights into improving execution strategies and reducing the risk of delays in future development projects.

Angelin and Ariyanti (2019) applied CPM and PERT to a new product development project and found that both methods improved time predictability, with CPM enabling a 34% acceleration of the baseline schedule. Their research underscored the advantage of deterministic modeling for structured environments, while highlighting PERT's utility in addressing uncertainty.

Rahma and Kamandang (2023) analyzed a multi-storey building project and concluded that CPM resulted in a project duration of 117 days 19 days faster than PERT. Their findings emphasize CPM's strength in critical path identification and its ability to compress timelines with clear sequencing.

Syarif (2020) evaluated time-cost optimization in mosque construction using both PERT and CPM. The study revealed that PERT provided a higher probability of timely project completion, while CPM produced a shorter duration. This trade-off between risk mitigation (PERT) and speed optimization (CPM) aligns with the challenges faced in real-world projects, indicating the need for tailored approaches.

While numerous studies have demonstrated the value of CPM and PERT in construction project scheduling, few have conducted direct, side-by-side implementation analyses within mid-scale public infrastructure projects in Indonesia. This research addresses that gap by applying both models to the same project context and evaluating their comparative effectiveness using real execution data from the Dipatiunus Office development.

The novelty of this study lies in its dual-model application of both CPM and PERT on the same construction site, along with detailed statistical probability analysis of project completion timelines. Furthermore, the research uses TE calculations and variance-based probabilistic forecasting, supported by Microsoft Project 2024 simulations, to derive actionable insights that bridge theory and practice in project management.

The objective of this research is to evaluate and compare the effectiveness of Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT) in scheduling the Dipatiunus Office construction project, with the goal of identifying optimal strategies for managing time, anticipating delays, and increasing project completion certainty.

This study provides practical benefits for project managers, contractors, and policymakers by offering a comparative framework for selecting scheduling methods based on project complexity and risk levels. The findings support the use of quantitative forecasting and variance analysis to enhance timeline reliability, resource allocation, and contingency planning in future infrastructure projects.

METHOD

Based on the methodology section of the research, the study uses a qualitative case study method with mixed data sources (qualitative and quantitative). The research is conducted on a specific infrastructure development project the Dipatiunus Office construction in Tangerang, Banten which qualifies it as a single-site case study. The case study approach is appropriate for this context because it allows for a detailed, contextualized exploration of the time management challenges and scheduling practices used in real-world construction environments. This method is particularly suitable when the boundaries between the phenomenon (scheduling effectiveness) and the context (construction project execution) are not clearly defined.

The study collects both primary data (field observations, interviews with project managers and workers) and secondary data (project schedules, S-curve plans, and daily progress reports). These data types are then processed through data reduction, data presentation (via tables, graphs, and network diagrams), and conclusion verification. The analytical tools employed include the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT), both of which are project scheduling techniques grounded in quantitative logic but applied here within a broader qualitative framework. The goal is not only to measure durations and critical paths but also to understand the contextual challenges affecting those timelines, aligning this research with a descriptive-analytical case study methodology.

In conclusion, the research is best characterized as a descriptive and analytical case study that incorporates both qualitative inquiry (via interviews and contextual analysis) and quantitative scheduling analysis (via CPM and PERT techniques). This hybrid approach ensures a comprehensive understanding of time management issues within the specific project setting.

RESULTS AND DISCUSSION

A. CPM METHOD ANALYSIS

CPM analysis is a method used to control and plan project work time by knowing the activities that are on a critical trajectory.

1. Calculating the Duration of the Job

Work duration is an explanation of the duration (time span) of activities in the work network method, which is the length of time needed to complete the activity from start to finish. Here are some of the work items and their duration.

Table 1. Duration of Work

Yes	Job Items	Duration
1	**Unloading Work**	
2	Dismantling old buildings for access	14 days
3	Dismantle the Zingalume wall for 2nd floor entrance	13 days
4	Existing Beam Beam	14 days
5	Dismantling existing Ceilings	13 days
6	Dismantling the existing walls	21 days
7	Dismantling/Polishing Concrete Floors for Sites	21 days
8	Dismantling/Polishing Concrete Floors for Sloof	28 days
9	Dispose of Debris	34 days
10	**Kali Stone Foundation Work & Quarries**	
11	Site Excavation	28 days
12	Foundation Excavation	28 days
13	Kali Stone Foundation	28 days
14	Land Reform Returns	21 days
15	**Concrete Work**	
16	**Concrete Footprint**	
17	- K 300 NFA concrete	7 days
18	- Iron D13mm, D10mm	28 days
19	- Formwork plywood 9mm	21 days
20	**Concrete Sloof**	
21	- K 300 NFA concrete	7 days
22	- Fattening D16mm, D13mm, Fattening 8mm	20 days
23	- Formwork plywood 9mm	14 days
24	**Concrete Pedestral Columns**	
25	- K 300 NFA concrete	14 days
26	- Fattening D16mm, D13mm, Fattening 8mm	21 days

Yes	Job Items	Duration
27	- Formwork plywood 9mm	21 days
28	**Steel Frame Work**	
29	Anchor 60x16mm	14 days
30	H Beam 200x200x8x12 (12 Btg)	49 days
31	WF 350x1175x7x11 (9 Btg)	49 days
32	WF 300x150x6.5x9 (1 Btg)	49 days
33	WF 250x125x6x9 (8 Btg)	49 days
34	WF 200x100x5.5x8 (10 Btg)	49 days
35	Flat 16mm (2 Lmbr)	29 days
36	Flat 12mm (1 Lmbr)	29 days
37	Flat 8mm (2 Lmbr)	29 days
38	Flat 6mm (1 Lmbr)	29 days
39	HTB 60x19mm Builds	28 days
40	HTB 50x16mm Builds	28 days
41	HTB Builds 40x13mm	28 days
42	Bondek T: 0.75mm	28 days
43	Concoctors (Iron D10mm Spacing 80cm/65cm)	28 days
44	Zinc Cromate Kansai	29 days
45	Grouting	14 days
46	Mobilization of the Workshop	7 days
47	**Concrete Plate Second Floor**	
48	- Edge Formwork	14 days
49	-Story	14 days
50	- Wiremesh M8 (1 layer)	14 days
51	- 10mm Iron Wrap	14 days
52	- Concrete Thickness 15cm K 300	21 days
53	- Pump Mobilization	7 days
54	**Other Jobs**	
55	Emergency ladders for workers	84 days
56	Emergency Exit	90 days
57	Stager	90 days
58	Hygiene	90 days

Source: ***Microsoft project*** **2024**

2. Slack Calculation Es Ef

The following is the calculation of Early Start (ES), Early Finist (EF), free Slack, and Total Slack for each work item in the project using Microsoft Project 2024.

3. Calculation of Slack Ls Lf

The following is the calculation of Latest Stars (LS), Latest Finish (LF), free Slack and Total Slack per work item on the project using Microsoft Project 2024.

Table 2. Calculation of *slack ls lf*

No	Job Items	Duration	*Latest Start*	*Latest Finish*	*Free Slack*	*Total Slack*
1	**Unloading Work**					
2	Dismantling old buildings for access	14 *days*	Mon 24/06/24	Sat 13/07/24	0	63
3	Dismantle the Zingalume wall for 2nd floor entrance	13 *days*	Wed 01/07/24	Sat 13/07/24	0	63
4	Existing Beam Beam	14 *days*	Sun 07/07/24	Sat 20/07/24	0	63
5	Dismantling existing Ceilings	13 *days*	Mon 24/06/24	Sat 06/07/24	0	63
6	Dismantling the existing walls	21 *days*	Sun 30/06/24	Sat 20/07/24	0	63
7	Dismantling/Polishing Concrete Floors for Sites	21 *days*	Sun 30/06/24	Sat 20/07/24	0	63
8	Dismantling/Polishing Concrete Floors for Sloof	28 *days*	Sun 30/06/24	Sat 27/07/24	63	63
9	Dispose of Debris	34 *days*	Mon 24/06/24	Sat 27/07/24	63	63
10	**Kali Stone Foundation Work & Quarries**					
11	Site Excavation	28 *days*	Sun 28/04/24	Sat 25/05/24	0	0
12	Foundation Excavation	28 *days*	Sun 28/04/24	Sat 25/05/24	0	0
13	Kali Stone Foundation	28 *days*	Sun 05/05/24	Sat 01/06/24	0	0
14	Land Reform Returns	21 *days*	Sun 12/05/24	Sat 01/06/24	0	0
15	**Concrete Work**					
16	**Concrete Footprint**					
17	- K 300 NFA concrete	7 *days*	Sun 26/05/24	Sat 01/06/24	0	0
18	- Iron D13mm, D10mm	28 *days*	Sun 05/05/24	Sat 01/06/24	0	0
19	- Formwork plywood 9mm	21 *days*	Sun 12/05/24	Sat 01/06/24	0	0
20	**Concrete Sloof**					
21	- K 300 NFA concrete	7 *days*	Sun 26/05/24	Sat 01/06/24	0	0
22	- D16mm, D13mm, 8mm Iron	20 *days*	Wed 13/05/24	Sat 01/06/24	0	0
23	- Formwork plywood 9mm	14 *days*	Sun 19/05/24	Sat 01/06/24	0	0
24	**Concrete Pedestral Columns**					
25	- K 300 NFA concrete	14 *days*	Sun 14/07/24	Sat 27/07/24	0	0
26	- D16mm, D13mm, 8mm Iron	21 *days*	Sun 19/05/24	Sat 08/06/24	0	0
27	- Formwork plywood 9mm	21 *days*	Sun 26/05/24	Sat 15/06/24	0	0
28	**Steel Frame Work**					
29	Anchor 60x16mm	14 *days*	Sun 02/06/24	Sat 15/06/24	0	0
30	H Beam 200x200x8x12 (12 Btg)	49 *days*	Sun 02/06/24	Sat 20/07/24	0	0
31	WF 350x1175x7x11 (9 Btg)	49 *days*	Sun 02/06/24	Sat 20/07/24	0	0
32	WF 300x150x6.5x9 (1 Btg)	49 *days*	Sun 02/06/24	Sat 20/07/24	0	0
33	WF 250x125x6x9 (8 Btg)	49 *days*	Sun 02/06/24	Sat 20/07/24	0	0
34	WF 200x100x5.5x8 (10 Btg)	49 *days*	Sun 02/06/24	Sat 20/07/24	0	0
35	Flat 16mm (2 Lmbr)	29 *days*	Sun 02/06/24	Sun 30/06/24	0	0
36	Flat 12mm (1 Lmbr)	29 *days*	Sun 02/06/24	Sun 30/06/24	0	0
37	Flat 8mm (2 Lmbr)	29 *days*	Sun 02/06/24	Sun 30/06/24	0	0
38	Flat 6mm (1 Lmbr)	29 *days*	Sun 02/06/24	Sun 30/06/24	0	0
39	HTB Bolt 60x19mm	28 *days*	Sun 16/06/24	Sat 13/07/24	0	0

No	Job Items	Duration	*Latest Start*	*Latest Finish*	*Free Slack*	*Total Slack*
40	HTB Bolt 50x16mm	28 *days*	Sun 16/06/24	Sat 13/07/24	0	0
41	HTB Bolt 40x13mm	28 *days*	Sun 16/06/24	Sat 13/07/24	0	0
42	Bondek T: 0.75mm	28 *days*	Sun 30/06/24	Sat 27/07/24	0	0
43	Concoctors (Iron D10mm Spacing 80cm/65cm)	28 *days*	Sun 30/06/24	Sat 27/07/24	0	0
44	Zinc Cromate Kansai	29 *days*	Sun 09/06/24	Sat 27/07/24	0	7
45	Grouting	14 *days*	Sun 14/07/24	Sat 27/07/24	0	21
46	Mobilization of the Workshop	7 *days*	Sun 14/07/24	Sat 20/07/24	0	28
47	**Concrete Plate Second Floor**					
48	- Edge Formwork	14 *days*	Sun 14/07/24	Sat 27/07/24	0	0
49	- Relat	14 *days*	Sun 14/07/24	Sat 27/07/24	0	0
50	- Wiremesh M8 (1 layer)	14 *days*	Sun 07/07/24	Sat 20/07/24	0	0
51	- Iron Wrap 10mm	14 *days*	Sun 07/07/24	Sat 27/07/24	0	0
52	- Concrete Thickness 15cm K 300	21 *days*	Sun 14/07/24	Sat 27/07/24	0	0
53	- Pump Mobilization	7 *days*	Sun 21/07/24	Sat 27/07/24	28	28
54	**Other Jobs**					
55	Emergency ladders for workers	84 *days*	Mon 06/05/24	Sat 27/07/24	7	7
56	Emergency Exit	90 *days*	Wed 29/04/24	Sat 27/07/24	0	7
57	Stager	90 *days*	Wed 29/04/24	Sat 27/07/24	0	7
58	Hygiene	90 *days*	Wed 29/04/24	Sat 27/07/24	7	7

Source : Microsoft project 2024

4. Critical Path

A critical path is the path that determines the fastest total duration to complete all activities in a project. Activities on the critical path are important activities, which must be completed according to the scheduled time. If there is one activity whose implementation is late or delayed, it will result in a delay in the completion of the project as a whole.

Table 3. Critical path

No	Job Items	*Duration*	*Early Start*	*Early Finish*	*Latest Start*	*Latest Finish*	*Free Slack*	*Total Slack*
1	Site Excavation	28 *days*	Sun 28/04/24	Sat 25/05/24	Sun 28/04/24	Sat 25/05/24	0	0
2	Foundation Excavation	28 *days*	Sun 28/04/24	Sat 25/05/24	Sun 28/04/24	Sat 25/05/24	0	0
3	Kali Stone Foundation	28 *days*	Sun 05/05/24	Sat 01/06/24	Sun 05/05/24	Sat 01/06/24	0	0
4	Land Reform Returns	21 *days*	Sun 12/05/24	Sat 01/06/24	Sun 12/05/24	Sat 01/06/24	0	0
5	- K 300 NFA concrete	7 *days*	Sun 26/05/24	Sat 01/06/24	Sun 26/05/24	Sat 01/06/24	0	0
6	- Iron D13mm, D10mm	28 *days*	Sun 05/05/24	Sat 01/06/24	Sun 05/05/24	Sat 01/06/24	0	0
7	- Formwork plywood 9mm	21 *days*	Sun 12/05/24	Sat 01/06/24	Sun 12/05/24	Sat 01/06/24	0	0

No	**Job Items**	***Duration***	***Early Start***	***Early Finish***	***Latest Start***	***Latest Finish***	***Free Slack***	***Total Slack***
8	- K 300 NFA concrete	7 *days*	Sun 26/05/24	Sat 01/06/24	Sun 26/05/24	Sat 01/06/24	0	0
9	- D16mm, D13mm, 8mm Iron	20 *days*	Wed 13/05/24	Sat 01/06/24	Wed 13/05/24	Sat 01/06/24	0	0
10	- Formwork plywood 9mm	14 *days*	Sun 19/05/24	Sat 01/06/24	Sun 19/05/24	Sat 01/06/24	0	0
11	- D16mm, D13mm, 8mm Iron	21 *days*	Sun 19/05/24	Sat 08/06/24	Sun 19/05/24	Sat 08/06/24	0	0
12	- Formwork plywood 9mm	21 *days*	Sun 26/05/24	Sat 15/06/24	Sun 26/05/24	Sat 15/06/24	0	0
13	Anchor 60x16mm	14 *days*	Sun 02/06/24	Sat 15/06/24	Sun 02/06/24	Sat 15/06/24	0	0
14	H Beam 200x200x8x12 (12 Btg)	49 *days*	Sun 02/06/24	Sat 20/07/24	Sun 02/06/24	Sat 20/07/24	0	0
15	WF 350x1175x7x11 (9 Btg)	49 *days*	Sun 02/06/24	Sat 20/07/24	Sun 02/06/24	Sat 20/07/24	0	0
16	WF 300x150x6.5x9 (1 Btg)	49 *days*	Sun 02/06/24	Sat 20/07/24	Sun 02/06/24	Sat 20/07/24	0	0
17	WF 250x125x6x9 (8 Btg)	49 *days*	Sun 02/06/24	Sat 20/07/24	Sun 02/06/24	Sat 20/07/24	0	0
18	WF 200x100x5.5x8 (10 Btg)	49 days	Sun 02/06/24	Sat 20/07/24	Sun 02/06/24	Sat 20/07/24	0	0
19	Flat 16mm (2 Lmbr)	29 *days*	Sun 02/06/24	Sun 30/06/24	Sun 02/06/24	Sun 30/06/24	0	0
20	Flat 12mm (1 Lmbr)	29 *days*	Sun 02/06/24	Sun 30/06/24	Sun 02/06/24	Sun 30/06/24	0	0
21	Flat 8mm (2 Lmbr)	29 *days*	Sun 02/06/24	Sun 30/06/24	Sun 02/06/24	Sun 30/06/24	0	0
22	Flat 6mm (1 Lmbr)	29 *days*	Sun 02/06/24	Sun 30/06/24	Sun 02/06/24	Sun 30/06/24	0	0
23	HTB Bolt 60x19mm	28 *days*	Sun 16/06/24	Sat 13/07/24	Sun 16/06/24	Sat 13/07/24	0	0
24	HTB Bolt 50x16mm	28 *days*	Sun 16/06/24	Sat 13/07/24	Sun 16/06/24	Sat 13/07/24	0	0
25	HTB Bolt 40x13mm	28 days	Sun 16/06/24	Sat 13/07/24	Sun 16/06/24	Sat 13/07/24	0	0
26	Bondek T: 0.75mm	28 *days*	Sun 30/06/24	Sat 27/07/24	Sun 30/06/24	Sat 27/07/24	0	0
27	Concoctors (Iron D10mm Spacing 80cm/65cm)	28 *days*	Sun 30/06/24	Sat 27/07/24	Sun 30/06/24	Sat 27/07/24	0	0
28	- Edge Formwork	14 *days*	Sun 14/07/24	Sat 27/07/24	Sun 14/07/24	Sat 27/07/24	0	0
29	Relat	14 *days*	Sun 14/07/24	Sat 27/07/24	Sun 14/07/24	Sat 27/07/24	0	0

No	Job Items	*Duration*	*Early Start*	*Early Finish*	*Latest Start*	*Latest Finish*	*Free Slack*	*Total Slack*
30	- Wiremesh M8 (1 layer)	14 *days*	Sun 07/07/24	Sat 20/07/24	Sun 07/07/24	Sat 20/07/24	0	0
31	- Iron Wrap 10mm	21 *days*	Sun 07/07/24	Sat 27/07/24	Sun 07/07/24	Sat 27/07/24	0	0
32	- Concrete Thickness 15cm K 300	14 *days*	Sun 14/07/24	Sat 27/07/24	Sun 14/07/24	Sat 27/07/24	0	0

Source : Microsoft project 2024

There are 32 critical works with a duration of 97 days that are not allowed to be postponed or late.

5. Gant Chart

Gant charts are one of the tools used in project management that can help improve the efficiency of individuals or teams. Management ethics can use this tool to increase work productivity, especially ethics in compiling schedules, monitoring the success of the project being worked.

B. PERT METHOD ANALYSIS

PERT analysis is a method that identifies relationships between activities within a project to optimize schedules and manage time uncertainty.

1. Calculating the Duration

Analysis with the PERT method is used to calculate the probability that the project can be completed on time. If the CPM uses a definite time, the PERT method uses three time estimates for each work activity, namely, optimistic time (a), most likely time (m) and pessimistic time (b). The following are the results of the analysis of optimistic time, most likely time and pessimistic time in the office construction project of Dipati Unus in Tangerang - Banten.

Table Error! No text of specified style in document.. **Calculating the duration**

No	Job Items	A	M	B
1	**Unloading Work**			
2	Dismantling old buildings for access	7 days	20 *days*	25 *days*
3	Dismantle the Zingalume wall for 2nd floor entrance	6 *days*	13 *days*	17 days
4	Existing Beam Beam	9 *days*	14 *days*	18 *days*
5	Dismantling existing Ceilings	10 *days*	13 *days*	18 *days*
6	Dismantling the existing walls	12 days	21 *days*	35 *days*
7	Dismantling/Polishing Concrete Floors for Sites	8 *days*	21 *days*	32 *days*
8	Dismantling/Polishing Concrete Floors for Sloof	8 *days*	28 *days*	32 *days*
9	Dispose of Debris	18 *days*	34 *days*	42 *days*
10	**Kali Stone Foundation Work & Quarries**			
11	Site Excavation	10 *days*	27 *days*	30 *days*
12	Foundation Excavation	28 *days*	28 *days*	25.33 *days*
13	Kali Stone Foundation	12 *days*	28 *days*	30 *days*
14	Land Reform Returns	14 *days*	21 *days*	30 *days*
15	**Concrete Work**			

No	Job Items	A	M	B
16	**Concrete Footprint**			
17	- K 300 NFA concrete	3 *days*	7 *days*	14 days
18	- Iron D13mm, D10mm	14 *days*	28 *days*	36 *days*
19	- Formwork plywood 9mm	14 *days*	21 *days*	28 *days*
20	**Concrete Sloof**			
21	- K 300 NFA concrete	3 *days*	7 *days*	14 *days*
22	- D16mm, D13mm, 8mm Iron	10 *days*	20 *days*	30 *days*
23	- Formwork plywood 9mm	4 *days*	14 *days*	24 *days*
24	**Concrete Pedestral Columns**			
25	- K 300 NFA concrete	4 *days*	14 *days*	24 *days*
26	- D16mm, D13mm, 8mm Iron	10 *days*	21 *days*	32 *days*
27	- Formwork plywood 9mm	10 *days*	21 *days*	32 *days*
28	**Steel Frame Work**			
29	Anchor 60x16mm	6 *days*	14 *days*	20 *days*
30	H Beam 200x200x8x12 (12 Btg)	28 *days*	49 days	76 *days*
31	WF 350x1175x7x11 (9 Btg)	28 *days*	49 *days*	73 *days*
32	WF 300x150x6.5x9 (1 Btg)	22 *days*	49 *days*	60 *days*
33	WF 250x125x6x9 (8 Btg)	28 *days*	49 *days*	71 *days*
34	WF 200x100x5.5x8 (10 Btg)	30 *days*	49 *days*	74 *days*
35	Flat 16mm (2 Lmbr)	16 *days*	29 *days*	35 *days*
36	Flat 12mm (1 Lmbr)	14 *days*	29 *days*	38 *days*
37	Flat 8mm (2 Lmbr)	14 *days*	29 *days*	37 *days*
38	Flat 6mm (1 Lmbr)	12 *days*	29 *days*	35 *days*
39	HTB Bolt 60x19mm	20 *days*	28 *days*	38 *days*
40	HTB Bolt 50x16mm	18 *days*	28 *days*	34 *days*
41	HTB Bolt 40x13mm	16 *days*	28 *days*	34 *days*
42	Bondek T: 0.75mm	16 *days*	28 *days*	38 *days*
43	Concoctors (Iron D10mm Spacing 80cm/65cm)	18 *days*	28 *days*	36 *days*
44	Zinc Cromate Kansai	20 *days*	29 *days*	38 *days*
45	Grouting	8 *days*	14 *days*	20 *days*
46	Mobilization of the Workshop	4 *days*	7 *days*	16 *days*
47	**Concrete Plate Second Floor**			
48	- Edge Formwork	8 *days*	14 *days*	22 *days*
49	- Relat	7 *days*	14 *days*	27 *days*
50	- Wiremesh M8 (1 layer)	8 *days*	14 *days*	27 *days*
51	- Iron Wrap 10mm	15 *days*	21 *days*	33 *days*
52	- Concrete Thickness 15cm K 300	7 *days*	14 *days*	24 days
53	- Pump Mobilization	5 *days*	7 *days*	12 *days*
54	**Other Jobs**			
55	Emergency ladders for workers	45 *days*	84 *days*	92 *days*
56	Emergency Exit	46 *days*	90 *days*	120 *days*
57	Stager	55 *days*	90 *days*	110 *days*
58	Hygiene	50 *days*	90 *days*	130 *days*

Source : Microsoft project 2024

2. Determining the Te Value

The TE value is the average value if an activity is performed in large quantities. In the calculation of TE, the pessimistic and optimistic times each have a weight of 1, while the most likely time is given a weight of 4, so the TE value is obtained by the following formula:

$$te = \frac{a + 4(m) + b}{6}$$

information:
te = expected time
a = optimistic time
b = pessimistic time
m = most likely time

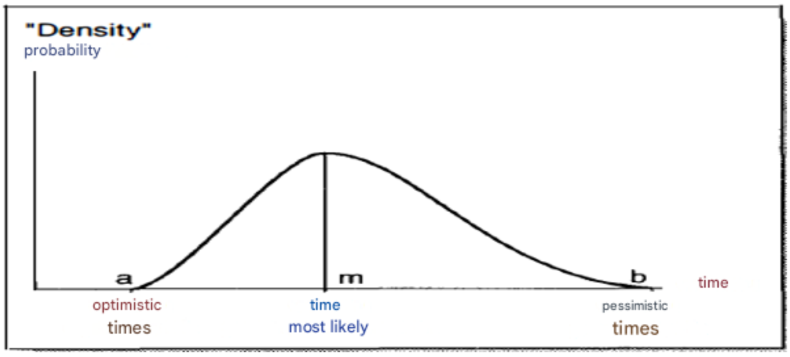

Figure 1. Asymmetric Distribution (Beta)
Source : Google

TE value for each type of activity in the office construction project at Unus Tangerang – Banten

Table 5. Calculation of the value of Te

No	Job Items	A	M	B	TE
1	**Unloading Work**				
2	Dismantling old buildings for access	7 *days*	20 *days*	25 *days*	18.67 *days*
3	Dismantle the Zingalume wall for 2nd floor entrance	6 *days*	13 *days*	17 *days*	12.5 *days*
4	Existing Beam Beam	9 *days*	14 *days*	18 *days*	13.83 *days*
5	Dismantling existing Ceilings	10 *days*	13 *days*	18 *days*	13,33 *days*
6	Dismantling the existing walls	12 *days*	21 *days*	35 *days*	21.83 *days*
7	Dismantling/Polishing Concrete Floors for Sites	8 *days*	21 *days*	32 *days*	20.67 *days*
8	Dismantling/Polishing Concrete Floors for Sloof	8 *days*	28 *days*	32 *days*	25.33 *days*
9	Dispose of Debris	18 *days*	34 *days*	42 *days*	32.67 *days*
10	**Kali Stone Foundation Work & Quarries**				
11	Site Excavation	10 *days*	27 *days*	30 *days*	24,67 *days*
12	Foundation Excavation	28 *days*	28 *days*	25.33 *days*	25.33 *days*
13	Kali Stone Foundation	12 *days*	28 *days*	30 *days*	25.67 *days*
14	Land Reform Returns	14 *days*	21 *days*	30 *days*	21.33 *days*
15	**Concrete Work**				
16	**Concrete Footprint**				

No	Job Items	A	M	B	TE
17	- K 300 NFA concrete	3 *days*	7 *days*	14 *days*	7.5 *days*
18	- Iron D13mm, D10mm	14 *days*	28 *days*	36 *days*	27 *days*
19	- Formwork plywood 9mm	14 *days*	21 *days*	28 *days*	21 *days*
20	**Concrete Sloof**				
21	- K 300 NFA concrete	3 *days*	7 *days*	14 *days*	7.5 *days*
22	- D16mm, D13mm, 8mm Iron	10 *days*	20 *days*	30 *days*	20 *days*
23	- Formwork plywood 9mm	4 *days*	14 *days*	24 *days*	14 *days*
24	**Concrete Pedestral Columns**				
25	- K 300 NFA concrete	4 *days*	14 *days*	24 *days*	14 *days*
26	- D16mm, D13mm, 8mm Iron	10 *days*	21 *days*	32 *days*	21 *days*
27	- Formwork plywood 9mm	10 *days*	21 *days*	32 *days*	21 *days*
28	**Steel Frame Work**				
29	Anchor 60x16mm	6 *days*	14 *days*	20 *days*	13.67 *days*
30	H Beam 200x200x8x12 (12 Btg)	28 *days*	49 *days*	76 *days*	50 *days*
31	WF 350x1175x7x11 (9 Btg)	28 *days*	49 *days*	73 *days*	49.5 days
32	WF 300x150x6.5x9 (1 Btg)	22 *days*	49 *days*	60 *days*	46.33 *days*
33	WF 250x125x6x9 (8 Btg)	28 *days*	49 *days*	71 *days*	49.17 *days*
34	WF 200x100x5.5x8 (10 Btg)	30 *days*	49 *days*	74 *days*	50 *days*
35	Flat 16mm (2 Lmbr)	16 *days*	29 *days*	35 *days*	27.83 *days*
36	Flat 12mm (1 Lmbr)	14 *days*	29 *days*	38 *days*	28 *days*
37	Flat 8mm (2 Lmbr)	14 *days*	29 *days*	37 *days*	27.83 *days*
38	Flat 6mm (1 Lmbr)	12 *days*	29 *days*	35 *days*	27.17 *days*
39	HTB Bolt 60x19mm	20 *days*	28 *days*	38 *days*	28.33 *days*
40	HTB Bolt 50x16mm	18 days	28 *days*	34 *days*	27,33 *days*
41	HTB Bolt 40x13mm	16 *days*	28 *days*	34 *days*	27 *days*
42	Bondek T: 0.75mm	16 *days*	28 *days*	38 *days*	27.67 *days*
43	Concoctors (Iron D10mm Spacing 80cm/65cm)	18 *days*	28 days	36 *days*	27.67 *days*
44	Zinc Cromate Kansai	20 *days*	29 *days*	38 *days*	29 *days*
45	Grouting	8 *days*	14 *days*	20 *days*	14 *days*
46	Mobilization of the Workshop	4 *days*	7 days	16 *days*	8 *days*
47	**Concrete Plate Second Floor**				
48	- Edge Formwork	8 *days*	14 *days*	22 *days*	14.33 *days*
49	- Relat	7 *days*	14 *days*	27 *days*	13.83 *days*
50	- Wiremesh M8 (1 layer)	8 *days*	14 *days*	27 *days*	15,17 *days*
51	- Iron Wrap 10mm	15 *days*	21 *days*	33 *days*	22 *days*
52	- Concrete Thickness 15cm K 300	7 *days*	14 *days*	24 *days*	14.5 *days*
53	- Pump Mobilization	5 *days*	7 *days*	12 *days*	7.5 *days*
54	**Other Jobs**				
55	Emergency ladders for workers	45 *days*	84 *days*	92 *days*	78.83 *days*
56	Emergency Exit	46 *days*	90 *days*	120 *days*	87.67 *days*
57	Stager	55 *days*	90 *days*	110 *days*	87.5 *days*
58	Hygiene	50 *days*	90 *days*	130 *days*	90 *days*

Source : *Microsoft project* 2024

3. Critical Path

A critical path is the path that determines the fastest total duration to complete all activities in a project. Activities on the critical path are important activities, which must be completed according to the scheduled time. If there is one activity whose implementation is late or delayed, it will result in a delay in the completion of the project as a whole.

Table 6. Critical Path

No	Job Items	A	M	B	TE
1	Site Excavation	*10 days*	27 *days*	30 *days*	24,67 *days*
2	Foundation Excavation	28 *days*	28 days	25.33 *days*	25.33 *days*
3	Kali Stone Foundation	12 *days*	28 *days*	30 *days*	25.67 *days*
4	Land Reform Returns	14 *days*	21 *days*	30 *days*	21.33 *days*
5	- K 300 NFA concrete	3 *days*	7 *days*	14 *days*	7.5 *days*
6	- Iron D13mm, D10mm	14 *days*	28 *days*	36 *days*	27 *days*
7	- Formwork plywood 9mm	14 *days*	21 *days*	28 *days*	21 *days*
8	- K 300 NFA concrete	3 *days*	7 *days*	14 *days*	7.5 *days*
9	- D16mm, D13mm, 8mm Iron	10 *days*	20 *days*	30 *days*	20 *days*
10	- Formwork plywood 9mm	4 *days*	14 *days*	24 *days*	14 *days*
11	- D16mm, D13mm, 8mm Iron	10 *days*	21 *days*	32 *days*	21 *days*
12	- Formwork plywood 9mm	10 *days*	21 *days*	32 *days*	21 *days*
13	Anchor 60x16mm	6 *days*	14 *days*	20 *days*	13.67 *days*
14	H Beam 200x200x8x12 (12 Btg)	28 *days*	49 *days*	76 *days*	50 *days*
15	WF 350x1175x7x11 (9 Btg)	28 *days*	49 *days*	73 *days*	49.5 *days*
16	WF 300x150x6.5x9 (1 Btg)	22 *days*	49 *days*	60 *days*	46.33 *days*
17	WF 250x125x6x9 (8 Btg)	28 *days*	49 *days*	71 *days*	49.17 *days*
18	WF 200x100x5.5x8 (10 Btg)	30 *days*	49 *days*	74 *days*	50 *days*
19	Flat 16mm (2 Lmbr)	16 *days*	29 *days*	35 *days*	27.83 *days*
20	Flat 12mm (1 Lmbr)	14 *days*	29 *days*	38 *days*	28 *days*
21	Flat 8mm (2 Lmbr)	14 *days*	29 *days*	37 *days*	27.83 *days*
22	Flat 6mm (1 Lmbr)	12 *days*	29 *days*	35 *days*	27.17 *days*
23	HTB Bolt 60x19mm	20 *days*	28 *days*	38 *days*	28.33 *days*
24	HTB Bolt 50x16mm	18 *days*	28 *days*	34 *days*	27,33 *days*
25	HTB Bolt 40x13mm	16 *days*	28 *days*	34 *days*	27 *days*
26	Bondek T: 0.75mm	16 *days*	28 *days*	38 *days*	27.67 *days*
27	Concoctors (Iron D10mm Spacing 80cm/65cm)	18 *days*	28 *days*	36 *days*	27.67 *days*

Source : Microsoft project 2024

There are 27 critical works with a duration of 90 days that are not allowed to be postponed or late.

4. Gant Chart

Gant charts are one of the tools used in project management that can help improve the efficiency of individuals or teams. Management ethics can use this tool to increase work productivity, especially ethics in compiling schedules, monitoring the success of the project being worked.

5. Calculation of standard values of deviations and variances

Determining a critical cross-standard deviation after calculating the te value, the standard deviation value can be calculated with the following formula:

$$Se = \frac{\mathrm{b} - \mathrm{a}}{6}$$

information:
se = standard deviation
ve = variant
a = optimistic time
b = pessimistic time

After calculating the standard deviation value, the value of Variance (V) can be found with the following formula:

$$Ve = \left(\frac{\mathrm{b} - \mathrm{a}}{6}\right)2$$

The following is the calculation of standard deviation and variance values on the critical path in the office construction project of Dipatiunus Tangerang – Banten

Table 7. Critical cross Ve value

No	Job Items LK	A	B	ONE	VE
1	Site Excavation	10 *days*	30 *days*	3.33 *days*	11,08
2	Foundation Excavation	28 *days*	25.33 *days*	2.67 days	7,12
3	Kali Stone Foundation	12 *days*	30 days	3 days	9
4	Land Reform Returns	14 *days*	30 *days*	2.67 *days*	7,12
5	- K 300 NFA concrete	3 *days*	14 *days*	1.83 *days*	3,34
6	- Iron D13mm, D10mm	14 *days*	36 *days*	3.67 *days*	13,46
7	- Formwork plywood 9mm	14 *days*	28 *days*	2.33 *days*	5,42
8	- K 300 NFA concrete	3 *days*	14 *days*	1.83 *days*	3,34
9	- D16mm, D13mm, 8mm Iron	10 *days*	30 *days*	3.33 *days*	11,08
10	- Formwork plywood 9mm	4 *days*	24 *days*	3.33 *days*	11,08
11	- D16mm, D13mm, 8mm Iron	10 *days*	32 *days*	3.67 *days*	13,46
12	- Formwork plywood 9mm	10 *days*	32 *days*	3.67 *days*	13,46
13	Anchor 60x16mm	6 *days*	20 *days*	2.33 *days*	5,42
14	H Beam 200x200x8x12 (12 Btg)	28 *days*	76 *days*	8 *days*	64
15	WF 350x1175x7x11 (9 Btg)	28 *days*	73 *days*	7.5 *days*	56,25
16	WF 300x150x6.5x9 (1 Btg)	22 *days*	60 days	6.33 *days*	40,06
17	WF 250x125x6x9 (8 Btg)	28 *days*	71 *days*	7.17 *days*	51,40
18	WF 200x100x5.5x8 (10 Btg)	30 *days*	74 *days*	7,33 *days*	53,72
19	Flat 16mm (2 Lmbr)	16 *days*	35 *days*	3.17 *days*	10,04
20	Flat 12mm (1 Lmbr)	14 *days*	38 *days*	4 *days*	16
21	Flat 8mm (2 Lmbr)	14 *days*	37 *days*	3.83 *days*	14,66
22	Flat 6mm (1 Lmbr)	12 *days*	35 days	3.83 *days*	14,66
23	HTB Bolt 60x19mm	20 *days*	38 *days*	3 *days*	9
24	HTB Bolt 50x16mm	18 *days*	34 *days*	2.67 *days*	7,12
25	HTB Bolt 40x13mm	16 *days*	34 *days*	3 *days*	9

No	Job Items LK	A	B	ONE	VE
26	Bondek T: 0.75mm	16 *days*	38 *days*	3.67 *days*	13,46
27	Concoctors (Iron D10mm Spacing 80cm/65cm)	18 *days*	36 *days*	3 *days*	9
	TOTAL VE LK		482,75		

Furthermore, the value of the standard deviation can be calculated using the Formula:

$$\text{Se LK} = \sqrt{Ve}\ LK$$

Information:

Where Se LK = Critical trajectory standard deviation

Ve LK = Number of variants of keritis activity

From table 7 above Ve LK = 482.75

$$\text{Then if LK} = \sqrt{Ve}\ LK$$

$$= \sqrt{482{,}25}$$

$$= 21{,}957$$

6. Calculate project probabilities

After obtaining the standard value of cross-critical deviation, it can be determined that the probability of the office construction project in Unus Tangerang – Banten can be completed on time, namely with the formula:

$$Z = \frac{\text{Td} - \text{Te}}{\text{Se LK}}$$

information:

Z = Value at normal distribution

Td = Target duration

Te = expected time

Se = Standard cross-critical deviation

$$Then\ Z = \frac{90 - 90}{21{,}957} = 0$$

With Z = 0, you can see the odds in the table 4.10 and you can see Td with the percentage of its duration on each chance.

Td can be searched with the formula:

TD = (Z x Se LK) + Te

information:

Z = Value at normal distribution

Te = expected time

Se = Standard cross-critical deviation

TD score = (0 x 21,957) + 90 = 90

Table 8. Duration of probability

Odds (%)	Te	Or LK	Z	Td
0,13	90	21,957	0,0013	90
0,25	90	21,957	0,0256	91
15	90	21,957	0,1587	93

Odds (%)	Te	Or LK	Z	Td
54	90	21,957	0	90
84	90	21,957	0,8413	108
97	90	21,957	0,9772	111
99	90	21,957	0,9987	112

7. Create an event curve

It is known that the value of Te 90 and Se LK is worth 21.957, so the following results are obtained:

Positive calculations
90 + 21.957 = 111.95
90 + 43.914 = 133.91
90 + 65.871 = 155.87
Negative Calculation
90 – 21,957 = 68.4
90 – 43,914 = 46.91
90 – 65.871 = 24.12

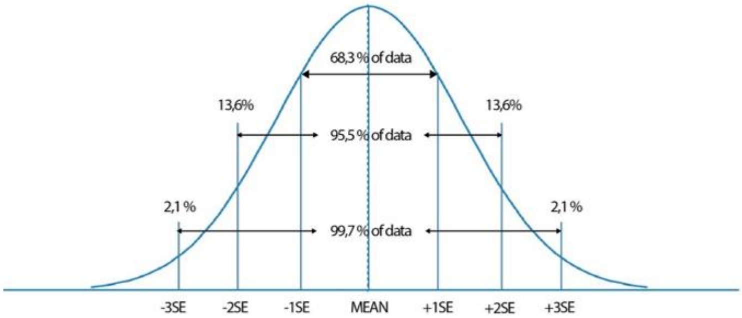

Figure 2. Event curve

From the distribution curve above, the average time life is obtained with a 54% chance of completion at the Te value.

CONCLUSION

Based on the research conducted on the Dipati Unus Office construction project in Tangerang–Banten, several conclusions were drawn. The duration of project implementation using the Critical Path Method (CPM) was 97 days, while the Program Evaluation and Review Technique (PERT) method estimated a shorter duration of 90 days. The PERT method, therefore, indicated a 77% higher time efficiency compared to the CPM method. Additionally, CPM analysis identified 32 critical work items that could not be delayed without impacting the overall project timeline. In the PERT analysis, the probability of completing the project within 90 days was calculated at 54%, indicating a moderate level of scheduling certainty. These findings demonstrate the effectiveness of both CPM and PERT in project time management, with PERT offering better flexibility under uncertainty. For future researchers, it is recommended to integrate digital simulation tools, risk probability modeling, and real-time project tracking systems to enhance forecasting accuracy and adaptivity in complex construction environments.

REFERENCES

Abdulkadir, M. (2023). *Project Management Schedule Planning for a Short-Distance Factory Relocation: A Case Study*.

Aghileh, M., Tereso, A., Alvelos, F., & Monteiro Lopes, M. O. (2024). Multi-project scheduling under uncertainty and resource flexibility: a systematic literature review. *Production & Manufacturing Research*, *12*(1), 2319574.

Ali, M., & Miller, L. (2017). ERP system implementation in large enterprises–a systematic literature review. *Journal of enterprise information management*, *30*(4), 666–692.

Angelin, A., & Ariyanti, S. (2019). New Product Development project scheduling analysis using the Pert and CPM methods. *Scientific Journal of Industrial Engineering*, *6*(1), 63–70.

Ba'Its, H. A., Puspita, I. A., & Bay, A. F. (2020). Combination of program evaluation and review technique (PERT) and critical path method (CPM) for project schedule development. *International Journal of Integrated Engineering*, *12*(3), 68–75.

Bodunwa, O. K., & Makinde, J. O. (2020). Application of Critical Path Method (CPM) and Project Evaluation Review Techniques (PERT) in Project Planning and Scheduling. *J. Math. Stat. Sci*, *6*, 1–8.

Kerzner, H. (2025). *Project management: a systems approach to planning, scheduling, and controlling*. John Wiley & Sons.

Naeni, L. M., & Salehipour, A. (2021). Optimization for project cost management. *Application of Mathematics and Optimization in Construction Project Management*, 79–118.

Nenni, M. E., De Felice, F., De Luca, C., & Forcina, A. (2024). How artificial intelligence will transform project management in the age of digitization: a systematic literature review. *Management Review Quarterly*, 1–48.

Nwulu, E. O., Elete, T. Y., Omomo, K. O., Akano, O. A., & Erhueh, O. V. (2023). The importance of interdisciplinary collaboration for successful engineering project completions: A strategic framework. *World Journal of Engineering and Technology Research*, *2*(3), 48–56.

Panchal, F., & Khokrale, S. (2024). *Effective Project Management with SAP Project System (PS): Balancing Scope, Time and Budget Constraints*.

Perera, N. A., Sutrisna, M., & Yiu, T. W. (2016). Decision-making model for selecting the optimum method of delay analysis in construction projects. *Journal of Management in Engineering*, *32*(5), 4016009.

Pratyusha, M. N., & Kumar, R. (2024). A comparative study on critical path method and project evaluation and review technique in construction under uncertain environment. In *Data-driven modelling with fuzzy sets* (pp. 150–164). CRC Press.

Rahma, K. A., & Kamandang, Z. R. (2023). Analysis of Scheduling of Multi-Storey Building Projects Using CPM (Critical Path Method) and PERT (Program Evaluation and Review Technique) Methods (Case Study: Phase 1 Development Project of Muhammadiyah Gresik Hospital). *Scientific Journal of Batanghari University of Jambi*, *23*(2), 1275–1279. https://doi.org/10.33087/jiubj.v23i2.4126

Ruzieh, A. S. (2025). Advancing Middle East Construction Sustainability: A Framework for Addressing Logistics Challenges Through Solutions and Critical Success Factors. *Sustainability*, *17*(2), 533.

Salimimoghadam, S., Ghanbaripour, A. N., Tumpa, R. J., Kamel Rahimi, A., Golmoradi, M., Rashidian, S., & Skitmore, M. (2025). The Rise of Artificial Intelligence in Project Management: A Systematic Literature Review of Current Opportunities, Enablers, and Barriers. *Buildings*, *15*(7), 1130.

Sligo, J., Gauld, R., Roberts, V., & Villa, L. (2017). A literature review for large-scale health information system project planning, implementation and evaluation. *International journal of medical informatics*, *97,* 86–97.

Su, J.-M., Chang, J.-H., Indrayani, N. L. D., & Wang, C.-J. (2023). Machine learning approach to determine the decision rules in ergonomic assessment of working posture in sewing machine operators. *Journal of Safety Research*, *87*, 15–26.

Syarif, R. (2020). *Network Planning Analysis on Optimizing the Time and Cost of the BPJS Mosque Construction Project Cileungsi Bogor Branch Office*.

Scott, N. (2021). *Assessment On The Planning And Implementation Of Project Schedule In The Construction Of Real Estate Projects, A Case Study On Grand View Addis Real Estate*. ST. MARY'S UNIVERSITY.

Zidane, Y. J.-T., & Andersen, B. (2018). The top 10 universal delay factors in construction projects. *International Journal of Managing Projects in Business, 11*(3), 650–672.