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Project Time Scheduling Analysis Using the Critical Path Method and Program Evaluation and Review Techniques on the Sapphire Shophouse Project – Cimanggis Golf Estate

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Abstract: The construction project of Ruko Sapphire – Cimanggis Golf Estate experienced several delays, resulting in discrepancies between the planned schedule outlined in the S-Curve and the actual conditions in the field. These delays were caused by technical issues with the reinforcement fabrication machine, inconsistencies between structural and architectural stair drawings, rescheduling of concrete casting due to weather and the availability of a concrete pump truck. This study aims to analyze the project scheduling using two methods: the Critical Path Method (CPM), to identify the critical path and determine the minimum project duration, and the Program Evaluation and Review Technique (PERT), to estimate optimistic, most likely, and pessimistic time durations as well as the probability of completing the project on schedule. The research was conducted using a descriptive quantitative approach with primary data (observations and interviews) and secondary data (S-Curve). The results show that both CPM and PERT provide consistent, realistic, and accurate duration estimates, helping contractors identify critical activities, reduce the risk of delays, and provide a more reliable basis for project time planning.

Keywords: Project Scheduling, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Construction Project Management, Time Scheduling Analysis, Shophouse Construction Project, Cimanggis Golf Estate

INTRODUCTION

Background

The Sapphire Shophouse project is a commercial shophouse development that requires careful time management. It is designed as a strategic business district and will accommodate surrounding trade and shopping activities. Observations indicate that several construction phases have been delayed from the planned schedule. These delays indicate time management issues, requiring further analysis. Therefore, this research was conducted to analyze the time management of the Sapphire Shophouse project, with the aim of providing good planning recommendations in project scheduling, and the results of the discussion in this research can be a lesson for contractors in optimizing time management so that future project implementation can run more efficiently, effectively, and realistically.

Problem Formulation

1. What are the scheduling results for the Sapphire Shophouse project using the Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT)?
2. What is the completion time for the Sapphire Shophouse project using the Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT)?

Research Objectives

1. Identify which tasks are on the critical path and determine the minimum project duration using the Critical Path Method (CPM). Calculate the project completion time using optimistic, probable, and pessimistic time frames, and calculate the probabilities using the Program Evaluation and Review Technique (PERT).
2. Compare the project completion time between the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT).

Scope Of Problem

To ensure this research remains systematic and does not deviate from its initial objectives, the study focuses on project scheduling. This limitation was implemented to ensure an in-depth analysis and ensure the research results are useful. The limitations of the problem are:

1. This study discusses the scope of time scheduling in the construction of the Sapphire Shophouse project; there is no detailed discussion of cost, quality, or safety aspects.
2. The data used includes an s-curve, which serves as the basis for the Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT) analyses.
3. The analysis using the Critical Path Method (CPM) focuses solely on determining the critical path and minimum project completion duration.
4. The analysis using the Program Evaluation and Review Technique (PERT) is limited to estimating optimistic, pessimistic, and most likely time estimates, as well as calculating project probabilities.
5. Weather conditions, labor costs, and material delays are not considered in this study.

LITERATURE REVIEW

Construction Project Management

Management is a series of activities carried out to achieve a goal, carried out by a group of people. Therefore, before involving several people in the activity, it is necessary to determine the direction of the shared goal. Another definition of management is the process of planning, organizing, directing, and supervising group members in carrying out tasks to achieve predetermined goals. The nature of management is to organize the entire organization. Management is a vehicle for the process of implementation (management is the process of implementing goals). In project management, a key consideration in resolving problems is identifying and addressing the various issues that arise during the project's implementation.

Project Scheduling

Project scheduling is a key aspect of project management, encompassing the overall stages of work implementation, resource allocation, and estimated completion time. According to Ervinto (2005), the objectives of project scheduling are to logically determine work stages, calculate duration and resource requirements, identify critical tasks for project completion, and serve as a communication tool between the owner, consultant, and contractor. This scheduling can minimize the potential for delays and cost overruns.

Critical Path Method

Also known as critical path analysis, the Critical Path Method is a scheduling method used to identify tasks on the critical path in a construction project. The critical path itself is a

group of activities or tasks that require the shortest time to complete. This path is the longest and has minimal slack and float. Slack and float are temporary delays or waiting times (allowance or rest periods) that do not count towards the project's completion time.

Program Evaluation And Review Technique

The Program Evaluation and Review Technique (PERT) is a scheduling method developed to address the problem of time uncertainty during project implementation. This method emerged because, in reality, not all activities can have their duration predicted with certainty. Many factors can hinder the construction process. Therefore, this analysis is designed to help calculate how long it will take to complete the project, taking into account all the factors and uncertainties that will arise during implementation.

$$Te = \frac{to+4tm+tp}{6}$$

The probability of project completion is based on a normal distribution. With the standard deviation and variance for each activity, the likelihood of the project being completed on time can be calculated. The advantage of the Program Evaluation and Review Technique is that it is more realistic. The probability of project completion is based on a normal distribution. With the standard deviation and variance for each activity, the likelihood of the project being completed on time can be calculated. The advantage of the Program Evaluation and Review Technique is that it is more realistic.

Thinking Framework

In general, the research flow is as follows:

1. Problem: The Sapphire Shophouse project experienced a discrepancy between the planned S-Curve schedule and the actual results on the ground.
2. Solution: Applying the CPM and PERT analysis methods.
3. Objective: To determine the critical path, minimum project duration, and project completion probability.
4. Result: A more realistic project schedule was developed for use in future projects.

Research Hypotesis

A hypothesis is an assumption that requires evidence, therefore, it requires scientific data analysis and testing. Hypotheses are formulated based on theoretical foundations and a literature review of project scheduling methods. Research hypotheses are tentative assumptions that will be proven through analysis and calculations. Based on the aforementioned theory, the hypotheses in this study are:

1. By using the Critical Path Method, the critical path and minimum duration of the Sapphire Shophouse project can be determined.
2. By using the Program Evaluation and Review Technique, the optimistic, probable, and pessimistic time estimates, as well as the project's probability, can be determined.
3. Combining these two methods provides more accurate and realistic scheduling analysis results than using either method alone.

RESEARCH METHODOLOGY

Types Of Research

The results of this study used quantitative methods because the data used in this study are in the form of numbers and the analysis process uses statistics. In terms of data collection, this study used quantitative methods in the form of observation and structured interviews, so the researcher interacted directly with the person providing the data. Quantitative data collection usually involves direct interaction with the source without any intervention from other participants. In this interaction, the researcher and the source have similar

backgrounds, perspectives, beliefs, values, and different interests. The purpose of quantitative research is to describe the relationship between variables, test or verify theories, and seek valuable generalizations.

Location And Research Object

This research location is in the Sapphire Ruko project located on Jl. Cimanggis Boulevard, Tapos District, Depok City, West Java Province, 16457. Administratively, this project location is included in the East Depok area which borders Cibinong District, Bogor Regency and has relatively easy access to the city of Jakarta via the Cimanggis Toll Road and the Bogor highway. The object of this research is data and documents related to the implementation of the Sapphire Ruko development project which focuses on the project scheduling aspect. The objects used for the analysis include:

1. Project Scheduling Data, in the form of a sequence of activities, as well as the duration of each work activity.
2. S-curve, which is a graphical representation of the cumulative project progress against the implementation time.
3. Working Drawings, drawings used as a reference in carrying out the development.

Data Collection Technique

1. Field observations are conducted directly at the project site to obtain a realistic picture of the construction project implementation process.
2. Interviews are conducted with anyone involved in the ongoing work phase.
3. Documentation serves as a memorization technique or record that can be accessed at any time, even after the work is completed, to still be able to view the workmanship.

Software Tools

1. Microsoft Excel is used as the primary tool for processing quantitative data obtained from S-curves and interviews. Other key functions include compiling complete task lists with durations and calculating network diagram results.
2. AutoCAD is used to display technical visualizations of network diagrams in the form of forward and reverse calculations.

Data Analysis Techniques

CPM Analysis:

1. Identify the critical path.
2. Calculate the minimum project completion time.

PERT Analysis:

1. Calculate optimistic (to), pessimistic (tp), and probable (tm) time estimates.
2. Use the expected time (te) formula:

$$Te = \frac{to+4tm+tp}{6}$$

3. Calculate the probability of project completion.

Results:

1. Compare the original project schedule with the results of the CPM and PERT analyses.
2. Provide more realistic and implementable scheduling recommendations for the contractor.

RESULTS AND DISCUSSION

S Curve

An S-curve is a table containing a bar chart graph designed to show activities with a defined timeframe for progress during project implementation. Another definition of an S-curve is a graph consisting of a vertical axis representing cumulative cost and a horizontal axis representing time. The S-curve shows project capacity based on activities, time, and the weight of a project, expressed as a cumulative percentage of all project activities. This visualization provides information regarding project progress by comparing it to the planned schedule. Another definition of an S-curve is that it is an important tool in the planning and control process of a construction project. In general, the S-curve displays the relationship between time and work progress in an S-shaped graph. This graph typically describes slow progress in the early stages of the project because activities are still in the preparatory phase. Entering the middle stage, the pace of implementation increases as most of the major tasks in the project begin to be executed simultaneously. Then, towards the end of the project, the volume of work decreases and the project enters the finishing stage.

Activity Identification

The first step in developing a project schedule is to first identify all activities to be carried out during construction. This step ensures that each project's scope is clearly defined, including its sequence, duration, and dependencies on other tasks. Identifying activities can help ensure construction progresses on schedule and avoid setbacks or delays due to lack of coordination or inadequate planning.

NAMA PEKERJAAN
Pekerjaan Pendahuluan
Pekerjaan Tanah dan Urugan
Pekerjaan Sub Struktur Pondasi (Tanpa Tiang Pancang)
Pekerjaan Sub Struktur Pile Cap/ PC
Pekerjaan *Upper* Struktur Lantai Satu
Pekerjaan *Upper* Struktur Lantai Dua
Pekerjaan *Upper* Struktur Lantai Tiga dan Lantai Atap Dak
Pekerjaan *Upper* Struktur Lantai Dak
Pekerjaan Dinding dan Pasangan
Pekerjaan Beton Struktural dan Non Srtuktural
Pekerjaan Ksen, Pintu dan Jendela
Pekerjaan Penutup Lantai dan Dinding Lantai
Pekerjaan Plafond
Pekerjaan Sanitair
Pekerjaan Penutup Atap
Pekerjaan *Finishing*
Pekerjaan *Railing, Façade,* dll
Pekerjaan Mekanikal, Elektrikal dan Plumbing

Duration Of Activity

Once work activities are identified, the next step is to determine the duration of each task, namely, estimating the time required to complete each task. Determining duration is crucial because it impacts the project schedule and forms the basis of critical path analysis. The following are activity durations based on a previous S-Curve or one created by the contractor.

NAMA PEKERJAAN	DURASI (MINGGU)
Pekerjaan Pendahuluan	2

Pekerjaan Tanah dan Urugan	8
Pekerjaan Sub Struktur Pondasi (Tanpa Tiang Pancang)	4
Pekerjaan Sub Struktur Pile Cap/ PC	7
Pekerjaan *Upper* Struktur Lantai Satu	18
Pekerjaan *Upper* Struktur Lantai Dua	14
Pekerjaan *Upper* Struktur Lantai Tiga dan Lantai Atap Dak	11
Pekerjaan *Upper* Struktur Lantai Dak	8
Pekerjaan Dinding dan Pasangan	18
Pekerjaan Beton Struktural dan Non Srtuktural	14
Pekerjaan Ksen, Pintu dan Jendela	12
Pekerjaan Penutup Lantai dan Dinding Lantai	14
Pekerjaan Plafond	17
Pekerjaan Sanitair	8
Pekerjaan Penutup Atap	11
Pekerjaan *Finishing*	14
Pekerjaan *Railing, Façade*, dll	16
Pekerjaan Mekanikal, Elektrikal dan Plumbing	25

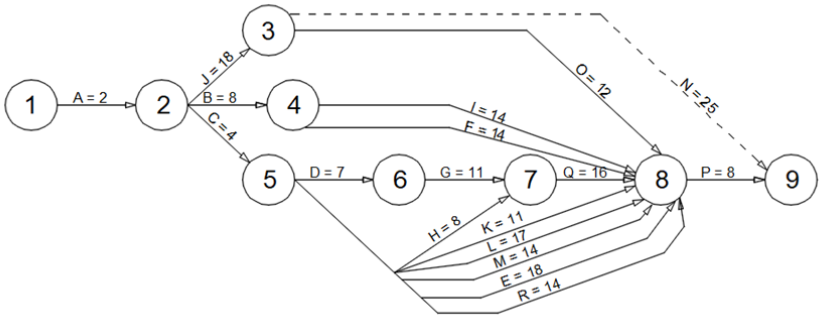
Of the 18 projects, there were delays in the Upper Structure of the First, Second, and Third Floors. These delays included:
1. Delays in Reinforcement Production
2. Incorrect Staircase Drawings
3. Rescheduling of the Casting Schedule

NAMA PEKERJAAN	KODE	AKTIFITAS YANG MENDAHULUI	DURASI (MINGGU)
Pekerjaan Pendahuluan	A	(-)	2
Pekerjaan Tanah dan Urugan	B	A	8
Pekerjaan Sub Struktur Pondasi	C	A	4
Pekerjaan Sub Struktur Pile Cap/ PC	D	C	7
Pekerjaan Upper Struktur Lantai Satu	E	C	18
Pekerjaan Upper Struktur Lantai Dua	F	B	14
Pekerjaan Upper Struktur Lantai Tiga dan Dak	G	D	11
Pekerjaan Upper Struktur Lantai Dak	H	C	8
Pekerjaan Beton Struktural dan Non Srtuktural	I	B	14
Pekerjaan Dinding dan Pasangan	J	A	18
Pekerjaan Penutup Atap	K	C	11
Pekerjaan Plafond	L	C	17
Pekerjaan Penutup Lantai dan Dinding Lantai	M	C	14
Pekerjaan Mekanikal, Elektrikal dan Plumbing	N	J	25
Pekerjaan Kusen, Pintu dan Jendela	O	J	12
Pekerjaan Sanitair	P	O, I, F, Q, K, L, M, E, R	8
Pekerjaan Railing, Façade, dll	Q	G, H	16
Pekerjaan Finishing	R	C	14

Activity On Arrow Diagram

An Activity on Arrow (AOA) diagram is a type of network diagram used in project management to plan and schedule activities. An Activity on Arrow (AOA) diagram depicts activities as arrows and events or occurrences (or nodes) as nodes. The direction of the arrows indicates the order in which tasks are executed.

The main component of an AOA is the arrow, representing an activity or task. Each arrow is typically labeled (e.g., A, B, C) and has a time duration. To support the Critical Path Table, researchers will create a complete AOA diagram.



1. Path 1: 1 + 2 + 3 + 9 = 45 weeks
2. Path 2: 1 + 2 + 3 + 8 + 9 = 40 weeks
3. Path 3: 1 + 2 + 4 + 8 + 9 = 32 weeks
4. Path 4: 1 + 2 + 4 + 8 + 9 = 32 weeks
5. Path 5: 1 + 2 + 5 + 6 + 7 + 8 + 9 = 48 weeks
6. Path 6: 1 + 2 + 5 + 7 + 8 + 9 = 38 weeks
7. Path 7: 1 + 2 + 5 + 8 + 9 = 32 weeks

This means the critical path is path 5, with a total project time of 48 weeks.

The forward pass is a network used to determine the earliest start and finish times for each activity, assuming no delays. The result is the Early Start Time (ES) and Early Finish Time (EF) for each activity.

The formula is:

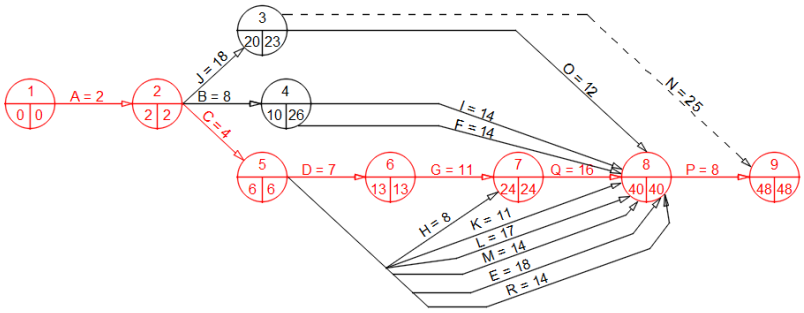
$$= ES + Duration$$

ES = Usually starts with 0, since it is the first activity.

Meanwhile, Backward Calculation is the next step after Forward Calculation. Its purpose is to determine the late start and finish times for an activity without delaying the entire project. The results of this calculation are the Late Start Time (LS) and Late Finish Time (LF) for each activity. The formula is:

$$= LF – Duration$$

LF = Typically the longest project completion time.



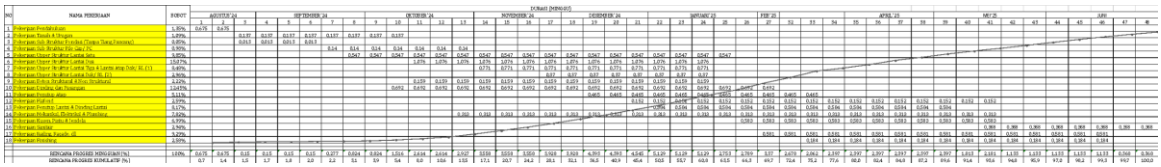
Calculate the Total Float, Free Float, and Critical Path for each activity:
Total Float = Late Finish – Early Start – Duration
Free Float = Early Finish – Early Start – Duration
The critical path is the path through which an activity must pass through where Total Float = Free Float = 0, meaning each activity has no delay or slack.

KODE	NODE		DURASI	EARLY		LATE		TOTAL	FREE	JALUR
				START	FINISH	START	FINISH	FLOAT	FLOAT	KRITIS
A	1	2	2	0	2	0	2	0	0	*
B	2	4	8	2	10	2	26	16	0	
C	2	5	4	2	6	2	6	0	0	*
D	5	6	7	6	13	6	13	0	0	*
E	5	8	18	6	40	6	40	16	16	
F	4	8	14	10	40	26	40	16	16	
G	6	7	11	13	24	13	24	0	0	*
H	5	7	8	6	24	6	24	10	10	
I	4	8	14	10	40	26	40	16	16	
J	2	3	18	2	20	2	23	3	0	
K	5	8	11	6	40	6	40	23	23	
L	5	8	17	6	40	6	40	17	17	
M	5	8	14	6	40	6	40	20	20	
N	3	9	25	20	48	23	48	3	3	
O	3	8	12	20	40	23	40	8	8	
P	8	9	8	40	48	40	48	0	0	*
Q	7	8	16	24	40	24	40	0	0	*
R	5	8	14	6	40	6	40	20	20	

Critical Path = A – C – D – G – Q – P with a project life of 48 weeks

Minimum Duration Of The Project

The minimum project duration is the fastest time flow required to complete the work. Then, from the results of determining the activity identification, activity duration, activity on arrow diagram, and critical path, the final result is a minimum project duration of 48 weeks. If entered into the latest S-curve, the shape will be like the picture.



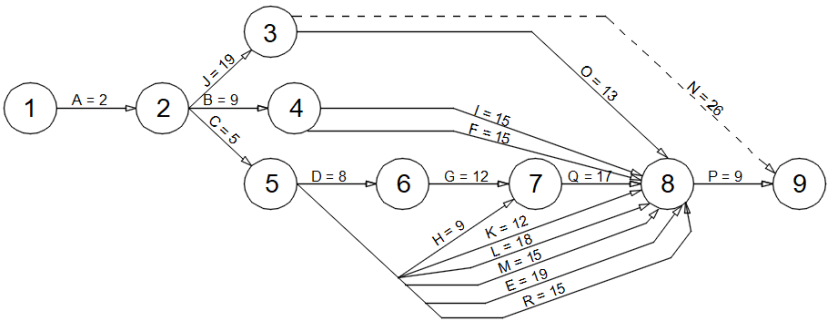
Optimistic, Possible And Pessimistic Time

Optimistic Time (to) is the fastest possible time that can be achieved if all work can run smoothly and there are no obstacles, Possible Time (tm) is the most realistic time among the other times. This time is obtained based on experience and normal project implementation conditions. Pessimistic Time (tp) is the longest time to complete the project if many obstacles arise, such as material delays, weather, and technical problems. Add the optimistic, pessimistic, and possible times from the previous table data while determining the expected or hoped-for time with the formula:

$$Te = \frac{to+4tm+tp}{6}$$

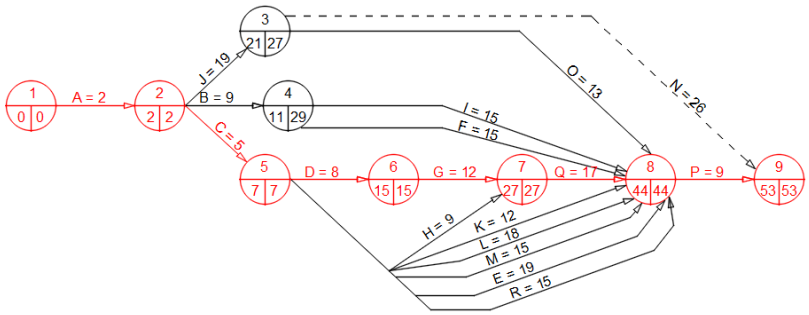
DATA PEKERJAAN							
NAMA PEKERJAAN	KODE KEGIATAN	AKTIFITAS YANG MENDAHULUI	DURASI (MINGGU)			WAKTU EKSPEKTASI	VARIANS
			To	Tm	Tp	To+(4*Tm)+Tp/6	(Tp- To/6)²
1. Pekerjaan Pendahuluan	A	(-)	2	2	2	2	0
2. Pekerjaan Tanah & Urugan	B	A	8	8	10	9	0,111
3. Pekerjaan Sub Struktur Pondasi (Tanpa Tiang Pancang)	C	A	4	4	6	5	0,111
4. Pekerjaan Sub Struktur Pile Cap/ PC	D	C	7	7	9	8	0,111
5. Pekerjaan Upper Struktur Lantai Satu	E	C	18	19	20	19	0,111
6. Pekerjaan Upper Struktur Lantai Dua	F	B	14	15	16	15	0,111
7. Pekerjaan Upper Struktur Lantai Tiga & Lantai Atap Dak/ RL (	G	D	11	12	13	12	0,111
8. Pekerjaan Upper Struktur Lantai Dak/ RL (2)	H	C	8	9	10	9	0,111
10. Pekerjaan Beton Struktural & Non Struktural	I	B	14	14	16	15	0,111
9. Pekerjaan Dinding dan Pasangan	J	A	18	18	20	19	0,111
15. Pekerjaan Penutup Atap	K	C	11	11	13	12	0,111
13. Pekerjaan Plafond	L	C	17	17	19	18	0,111
12. Pekerjaan Penutup Lantai & Dinding Lantai	M	C	14	14	16	15	0,111
18. Pekerjaan Mekanikal, Elektrikal & Plumbing	N	J	25	25	27	26	0,111
11. Pekerjaan Kusen, Pintu & Jendela	O	J	12	12	14	13	0,111
14. Pekerjaan Sanitair	P	O, I, F, Q, K, L, M, E, R	8	8	10	9	0,111
17. Pekerjaan Railing, Façade, dll	Q	G, H	16	16	18	17	0,111
16. Pekerjaan Finishing	R	C	14	14	16	15	0,111
TOTAL PEKERJAAN SELESAI			221	225	255	238	

After determining the expected time and variance, the results obtained differed from the CPM method's time duration. Therefore, it was necessary to recreate the forward and backward calculation network diagrams using the latest duration (expected time).



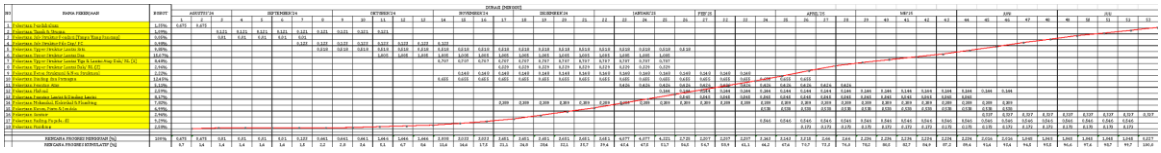
1. Path 1: 1 + 2 + 3 + 9 = 47 weeks
2. Path 2: 1 + 2 + 3 + 8 + 9 = 43 weeks
3. Path 3: 1 + 2 + 4 + 8 + 9 = 35 weeks
4. Path 4: 1 + 2 + 4 + 8 + 9 = 35 weeks
5. Path 5: 1 + 2 + 5 + 6 + 7 + 8 + 9 = 53 weeks
6. Path 6: 1 + 2 + 5 + 7 + 8 + 9 = 42 weeks
7. Path 7: 1 + 2 + 5 + 8 + 9 = 35 weeks

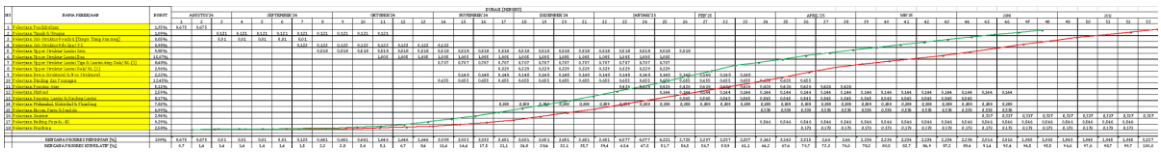
This means the critical path is on path 5, with a total project time of 53 weeks.



KODE	NODE		DURASI	EARLY		LATE		TOTAL	FREE	JALUR
				START	FINISH	START	FINISH			
A	1	2	2	0	2	0	2	0	0	*
B	2	4	9	2	11	2	29	18	0	
C	2	5	5	2	7	2	7	0	0	*
D	5	6	8	7	15	7	15	0	0	*
E	5	8	19	7	44	7	44	18	18	
F	4	8	15	11	44	29	44	18	18	
G	6	7	12	15	27	15	27	0	0	*
H	5	7	9	7	27	7	27	11	11	
I	4	8	15	11	44	29	44	18	18	
J	2	3	19	2	21	2	27	6	0	
K	5	8	12	7	44	7	44	25	25	
L	5	8	18	7	44	7	44	19	19	
M	5	8	15	7	44	7	44	22	22	
N	3	9	26	21	53	27	53	6	6	
O	3	8	13	21	44	27	44	10	10	
P	8	9	9	44	53	44	53	0	0	*
Q	7	8	17	27	44	27	44	0	0	*
R	5	8	15	7	44	7	44	22	22	

Critical Path = A – C – D – G – Q – P with a project life of 53 weeks





Project Probability

Project probability is the likelihood of completing the project within the planned timeframe. To test this probability, researchers will use three estimated timelines using the PERT method, as follows:

$$Z = \frac{T - Tetotal}{\sqrt{\sum \text{variansi}}}$$

If the Main Contractor gives a target project completion time of 54 weeks, and the Sub Contractor estimates the project completion time to be 53 weeks, then the probability is:

$$Z = \frac{54-53}{\sqrt{0{,}555}} = 1{,}34$$

The Distribution Table contains the probability of the Z value: 90.99%

0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817

Comparison Of Results

The results of the Critical Path Method analysis show that the time to complete the Ruko Sapphire project is 48 weeks, while the results of the Program Evaluation and Review Technique analysis show that the time to complete the Ruko Sapphire project is 53 weeks.

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Conclusion

1. The Critical Path Method analysis results show a critical path of A – C – D – G – Q – P, consisting of the preliminary work – foundation substructure work without piles – pile cap substructure work – third floor upper structure and roof slab work – sanitary works – finishing works, with a project completion time of 48 weeks.
2. The Program Evaluation and Review Technique analysis results show a critical path of A – C – D – G – Q – P, consisting of the preliminary work – foundation substructure work without piles – pile cap substructure work – third floor upper structure and roof slab work – sanitary works – finishing works, with a pessimistic project completion time of 53 weeks, with a project probability of 90.99%.
3. The Critical Path Method analysis results indicate a 48-week completion time for the Sapphire Shophouse construction project, while the Program Evaluation and Review Technique analysis results indicate a 53-week completion time for the Sapphire Shophouse project. This shows that with the Program Evaluation and Review Technique analysis, the time to complete the project is longer than the Critical Path Method analysis, but with a 90.99% probability the project can be completed.

Suggestions

1. Project control and supervision should focus on activities within the critical path, namely preliminary work, substructure, upper structure, sanitary works, and finishing.
2. The Program Evaluation and Review Technique is recommended as a reference for definitive time planning because it provides more realistic duration estimates than the Critical Path Method.

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