



## Optimization of Cluster House Construction Using Critical Path Method (CPM) and Evaluation and Review Technique (PERT) Program at PT.XYZ

Tubagus Hedi Saepudin<sup>1</sup>, Andi Turseno<sup>2</sup>, Andreas Tri Panudju<sup>3</sup> Reni Masrida<sup>4</sup> Riyan Ramadhan<sup>5</sup>

<sup>1</sup>Bhayangkara Jakarta Raya university, Indonesia, email: [tubagus.hedi@dsn.ubharajaya.ac.id](mailto:tubagus.hedi@dsn.ubharajaya.ac.id)

<sup>2</sup>Bhayangkara Jakarta Raya university, Indonesia, email: [andi.turseno@dsn.ubharajaya.ac.id](mailto:andi.turseno@dsn.ubharajaya.ac.id)

<sup>3</sup>Bhayangkara Jakarta Raya university, Indonesia, email: [ahmad.andreas@dsn.ubharajaya.ac.id](mailto:ahmad.andreas@dsn.ubharajaya.ac.id)

<sup>4</sup>Bhayangkara Jakarta Raya university, Indonesia, email: [reni.masrida@dsn.ubharajaya.ac.id](mailto:reni.masrida@dsn.ubharajaya.ac.id)

<sup>5</sup>Bhayangkara Jakarta Raya university, Indonesia, email: [riyan.ramadhan18@mhs.ubharajaya.ac.id](mailto:riyan.ramadhan18@mhs.ubharajaya.ac.id)

Corresponding Author: [tubagus.hedi@dsn.ubharajaya.ac.id](mailto:tubagus.hedi@dsn.ubharajaya.ac.id)<sup>1</sup>

**Abstract:** PT.XYZ So research was carried out so that we could find the critical path for a house construction project using the CPM method, the duration of the critical path for building a house, and how much budget was spent on building a house using the CPM method. CPM is a project management concept which is interpreted in a network image that marks project activities from start to finish with the aim of determining the critical path and PERT is a network model that is able to determine the completion time of activities. The aim is to assess and review development projects and requires three calculations. optimistic, pessimistic and realistic. The results of this research show that house construction project work using the CPM method has a work duration of 182 days, a decrease of 118 days from the actual duration and the costs incurred in this work are IDR 1,956,043,000. can reduce the budget by IDR 771,914,000/35% of the actual budget. The house construction project produces a Te value of 182.48 and a standard deviation value of 8.09 and has a probability of 53.59% if the project is completed within 182 days. However, if you use the assumption that the project can be completed within 190 days, the probability is 83.89%.

**Keyword:** Project Management CPM-PERT Method, Interview

### INTRODUCTION

Currently, one of the cities that is rapidly advancing its property development prospects is housing in the rapidly growing Bekasi City area. Areas that were previously rice fields have turned into residential neighbourhoods with various social facilities that support housing. So that this area is one of the destinations where developers to carry out a property development project in the country of Indonesia.

Property growth is very influential in population growth where Bekasi city in the 2018-2020 census results survey conducted by the Central Bureau of Statistics, Bekasi City has a population of 2,943,859 people. The high population in Bekasi City is caused by the movement of residents to Bekasi City, therefore the result of the development of the population which affects the sale of property in the area.

For the smooth running of a project, a management is needed that directs the project from start to finish, namely project management. Project management continues to grow and develop because modern industry needs to coordinate to control various activities. Project management has a special character, where management working hours are limited by a certain schedule.

To manage a project the success rate of a project is often due to insufficient planning of project activities and ineffective control, project activities become unfavourable, leading to delays and a decrease in the quality of work. Delay in completing a project is a very undesirable condition. Because it can be detrimental to both parties. Therefore, the company must be able to maximise the efficient use of time in each activity so that the project implementation can be carried out in accordance with the predetermined time.

The project plan can help in showing a relationship of each activity with other activities throughout the project and to identify relationships that need to be completed between other activities first. In addition to displaying the appropriate time estimates for each activity. Therefore, planning methods that are often used are Critical Path Method (CPM) and Programme Evaluation Review Technique (PERT).

## METHOD

In this study using quantitative and qualitative research methods which analyse the duration of activities with project work, in the project development activity schedule, structural project cost budget activities. Solving problems in this project, researchers use material from project management using the critical path method (CPM) and Program Evaluation and Technique (PERT).

## RESULTS AND DISCUSSION

Tabel 1. Project Work Identity

Identity of Development Work (February - November 2022)	
Company	PT.XYZ
Job Name	Cluster Housing Development Project
Job Type	House Type 40/72
Size	Cluster
Development	28 Houses
Workers	24 People
Type of Work	Job Order
Work Location	North Tambun Kec., Bekasi Regency
A (Plan)	266 Days
M (Actual)	300 Days
Land Area	4.079m <sup>2</sup>

Based on the company data above, it can be concluded that there is a delay in workmanship from the plans that have been made. Of course this will be a problem for the

company. The cause of the delay in the construction of Cluster housing is the late delivery of materials and supervision of workers.

Tabel 2. Duration of Work Activities

Code	ACTIVITY DESCRIPTION	ACTIVITY DURATION	
		Plan (Day)	Actual (Day)
A	Preparation	12	12
B	Earthwork	48	54
C	Foundation Work	24	27
D	Sanitary Works	24	24
E	Wall Work	21	24
F	Roof Installation	23	25
G	Plaster & Aci Work	20	24
H	Electrical Installation	10	12
I	Ceiling Installation	19	20
J	Ceramic Installation	19	20
K	Window, Door, & Frame Installation	20	22
L	Painting	10	15
M	Drainage	5	7
N	Main Road Construction	5	7
O	Construction of Security Post	3	3
P	Garden Construction	3	4
TOTAL		266	300

Based on the table above are the stages of the Cluster housing construction work where the initial work is the preparation stage and ends with the finishing stage with a total planning duration of 266 days and an actual duration of 300 days.

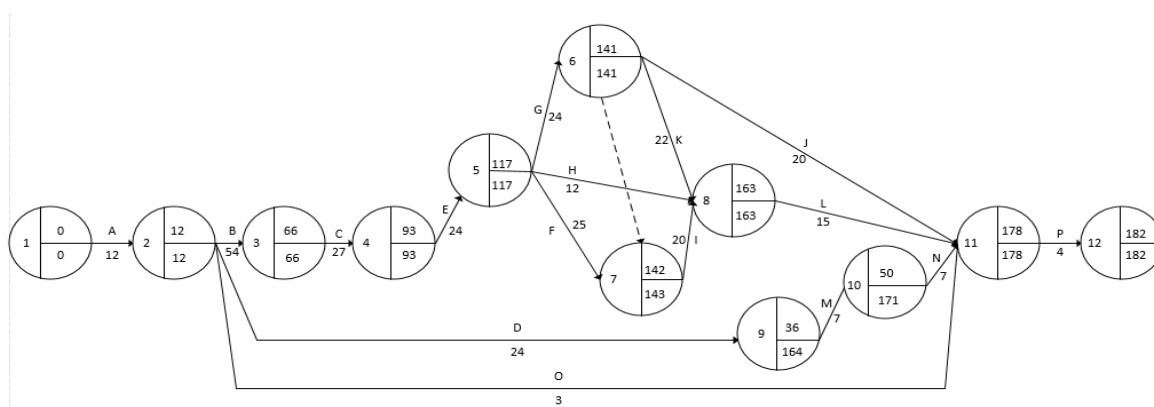


Figure 1. Critical Work Network

From the picture above, it explains that of the 16 work networks, there are 8 critical path activities, namely A-B-C-E-F-G-K-L-P. The results of the critical path will be made into a table, the table of the critical path is as follows:

Table 3. Results of Work Network Analysis

Code	Durasi Hari	Forward Calculation		Backward Calculation		Float		Remarks
		Start (LS)	Finish (LF)	Start (LS)	Finish (LF)	Total Float (TF)	Free Float (FF)	
A	12	0	12	0	12	0	0	Critical
B	54	12	66	12	66	0	0	Critical
C	27	66	93	66	93	0	0	Critical
E	24	93	117	93	117	0	0	Critical
G	24	117	141	117	141	0	0	Critical
K	22	141	163	141	163	0	0	Critical
L	15	163	178	163	178	0	0	Critical
P	4	178	182	178	182	0	0	Critical

In the table above, it can be seen that there are 8 networks that include critical paths, if calculated the critical path will result in a work duration of 182 days. The critical path at this stage is a path consisting of a series of project scope activities, if it is late it will result in a delay in the overall work. And will experience losses on the implementation that has been set. Activities that are on this path are called critical activities. From the float calculation above, the critical path can be determined where the critical path has a flat is ZERO.

Tabel 4. Actual Analysis Result

Code	Activity Description	Activity Duration	Price Building	Total Manpower	Cost Labors	Total
A	Preparation	12	Rp42,806,000	24	Rp2,700,000	Rp45,506,000
B	Earthwork	54	Rp15,120,000	24	Rp2,700,000	Rp17,820,000
C	Foundation Work	27	Rp266,420,000	24	Rp2,700,000	Rp269,120,000
D	Sanitary Works		Rp182,756,000	24		Rp182,756,000
E	Wall Work	24	Rp166,754,000	24	Rp2,700,000	Rp169,454,000
F	Roof Installation		Rp203,199,000	24		Rp203,199,000
G	Plaster & Aci Work	24	Rp3,416,000	24	Rp2,700,000	Rp6,116,000
H	Electrical Installation		Rp80,049,000	24		Rp80,049,000
I	Ceiling Installation		Rp140,420,000	24		Rp140,420,000
J	Ceramic Installation		Rp89,054,000	24		Rp89,054,000
K	Window, Door, & Frame Installation	22	Rp387,240,000	24	Rp2,700,000	Rp389,940,000
L	Painting	15	Rp253,428,000	24	Rp2,700,000	Rp256,128,000
M	Drainage		Rp49,790,000	8		Rp49,790,000
N	Main Road Construction		Rp36,035,000	10		Rp36,035,000
O	Construction of Security Post		Rp8,500,000	4		Rp8,500,000
P	Garden Construction	4	Rp11,506,000	6	Rp650,000	Rp12,156,000
	Total	182				Rp1,956,043,000

In the table above, it describes that there is a change in the duration and budget issued by the project, this states that the construction of Cluster housing is 182 days with a budget of Rp. 1,956,043,000 if there is no delay in activities where the activity duration is reduced by 84 days and the budget is reduced by Rp. 771,914,000 from actual.

Tabel 5. Jalur Kritis PERT

Code	Activity Description	EETi(ES)	Druasi (TE)	EETj(EF) Start	EETi(LS) Finish	Durasi (TE)	EETj(LF) Finish	Remarks
A	Preparation	0	12,33	12,33	0	12,33	12,33	Critical
B	Earthwork	12,33	53,33	65,66	12,33	53,33	65,66	Critical
C	Foundation Work	65,66	27	92,66	65,66	27	92,66	Critical
D	Sanitary Works	92,66	24,5	117,16	92,66	24,5	117,16	Not Critical
E	Wall Work	117,16	24,16	141,32	117,16	24,16	141,32	Critical
F	Roof Installation	141,32	25,16	166,48	141,32	25,16	166,48	Not Critical
G	Plaster & Aci Work	166,48	24	190,48	166,48	24	190,48	Critical
H	Electrical Installation	190,48	12,16	202,64	190,48	12,16	202,64	Not Critical
I	Ceiling Installation	202,64	20,33	222,97	202,64	20,33	222,97	Not Critical
J	Ceramic Installation	222,97	20,33	243,3	222,97	20,33	243,3	Not Critical
K	Window, Door, & Frame Installation	243,3	22,33	265,63	243,3	22,33	265,63	Critical
L	Painting	265,63	14,66	280,29	265,63	14,66	280,29	Critical
M	Drainage	280,29	7,1	287,39	280,29	7,1	287,39	Not Critical
N	Main Road Construction	287,39	7,5	294,89	287,39	7,5	294,89	Not Critical
O	Construction of Security Post	294,89	3,33	298,22	294,89	3,33	298,22	Not Critical
P	Garden Construction	298,22	4,33	302,55	298,22	4,33	302,55	Critical

Based on the table above obtained from the results of forward and backward calculations and can be known critical path of the PERT method, namely: A-B-C-E-G-K-L-P.

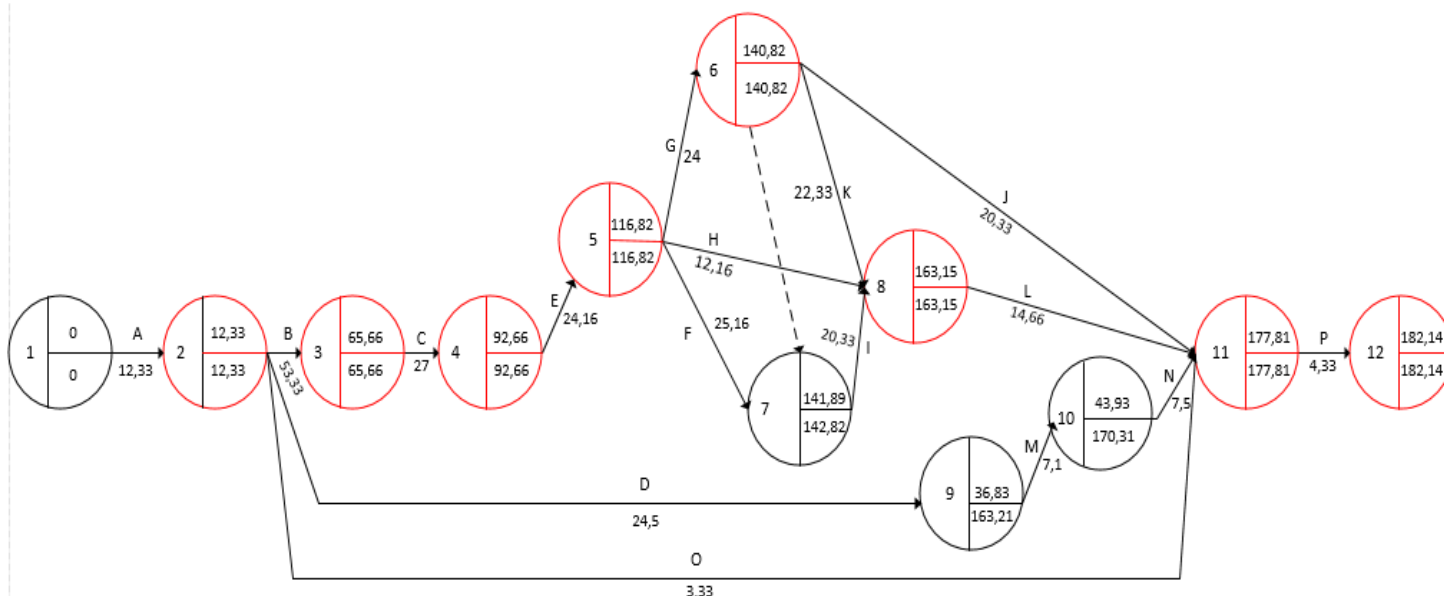


Figure 2. PERT Critical Path

This stage is the determination of the standard deviation value and the variance of this calculation obtained from the calculation of the critical path from CPM and PERT. There are 8 critical paths in the Cluster 40/72 housing construction project resulting in a count of te 302.55.

The standard deviation value is calculated using the formula  $s = \frac{1}{6}(b - a)$

And the calculation of activity variants with the formula  
 Activity variant =  $v(te) = s^2$

It is known that the PERT critical path has 8 critical paths, namely: A-B-C-E-G-K-L-P following display in tabular form.

Table 6. PERT Standard Deviation Value

Code	Activity Description	Optimistic Timing (a)	Realistic Time (m)	Pessimistic Time (b)	Duration (TE)	S
A	Preparation	12	12	14	12,33	0,33
B	Earthwork	48	54	56	53,33	1,33
C	Foundation Work	24	27	30	27	1
E	Wall Work	21	24	28	24,5	1,11
G	Plaster & Aci Work	20	24	28	24	1,33
K	Window, Door, & Frame Installation	20	22	26	22,33	1
L	Painting	10	15	18	14,66	1,33
P	Garden Construction	3	4	7	4,33	0,66
	Total	158	182	207	182,48	8,09

In the table above, the 8 critical paths have an optimal duration of 207 days, an expected time of 182.48 and a standard deviation value of 8.09.

Furthermore, from the calculation of variance, this calculation method is squared from the standard deviation results following the formula:

$$\text{Activity variants} = v(te) = s^2$$

Explanation:

V = Activity variant

Te = Expected time

S = Standard deviation

Furthermore, the calculation is processed into a table in the following form:

Table 7. PERT Variant Value

Code	Activity Description	Optimistic Timing (a)	Realistic Time (m)	Pessimistic Time (b)	Duration (TE)	S	V (TE)
A	Preparation	12	12	14	12,33	0,33	0,09
B	Earthwork	48	54	56	53,33	1,33	1,69
C	Foundation Work	24	27	30	27	1	1
E	Wall Work	21	24	28	24,5	1,11	1,36
G	Plaster & Aci Work	20	24	28	24	1,33	1,78
K	Window, Door, & Frame Installation	20	22	26	22,33	1	1
L	Painting	10	15	18	14,66	1,33	1,78
P	Garden Construction	3	4	7	4,33	0,66	0,44
Total		158	182	207	182,48	8,09	9,14

The table above explains that 8 critical path activities have a variant value of 9.14, it can be concluded that the standard deviation value and variant value have different results.

## CONCLUSION

Based on the results of data processing and data calculations, conclusions can be drawn from the evaluation of research work on the construction of cluster houses type 40/72 are:

- 1) From the calculation of the duration of time with the CPM (critical path method) critical path A-B-C-E-G-K-L-P.
- 2) Cost decreased by Rp.690,064,000 from the total budget plan with the CPM method (critical path method) while the actual cost of 771,914,000 using the CPM method (critical path method) decreased by 35%.
- 3) The application of the PERT (programme evaluation review technique) method to the construction of cluster housing produces a Te value of 182.48 and gets a standard deviation value of 8.09 besides that for the value of the cluster development variant is 9.14 and has a probability value of 53.59% if this project is done in 182 days. However, if you use the assumption that the project can be done in 190 days, the probability is 83.89%.
- 4) Delivery of materials and supervision of workers' performance greatly impact the implementation of the cluster construction project. The cause of the delay is the



difficulty of accessing vehicles and workers who are negligent towards their responsibilities.

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