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ANALYSIS OF NETWORK PLANNING WITH THE CRITICAL PATH METHOD IN THE FRAMEWORK OF PROJECT TIME AND COST EFFICIENCY (Case Study of the Implementation of the Masnana Section Road Construction Project – Wali, Namrole District, South Buru Regency)

Marfien Hadi Waluyo[1], Jozef R. Pattiruhu[2], Stenly Ferdinandus[3]
[1,2,3] Management Study Program, Pattimura University, Ambon, Indonesia

ARTICLEINFO

ABSTRACT

CPM (Critical Path Method) is one of the time-oriented Network Planning Methods that leads to determining project scheduling and time estimates that are terministic/definite. The purpose of research with this method is to determine the time and cost of the project and find out what activities are included in the critical activities. The population in this study is the Masnana – Wali Section Road Development project in South Buru Regency, Namrole District which is handled by CV. Mighty Son. The sample used for the Masnana Section Road Construction project - Wali for the period October (17 October 2022) - December (08 December 2022). Data collection techniques in this study were interviews and observations. Data analysis techniques use the CPM (critical path method) method. Based on the results of the research and discussion, the form of the critical network for the Masnana - Wali Section Road Development project in South Buru Regency, Namrole District is ABCDEFGHMNNOPQRSTUVY with an efficient time duration of 123 days from the normal time of 124 days. This time duration is the most efficient time after being accelerated using the CPM method, the total cost of the Masnana - Wali Road Development project in South Buru Regency, Namrole District with an efficient time of Rp. 2,512,286,813 which of the initial cost of Rp. 2,497,872,247.68. This time duration is the most efficient time after being accelerated using the CPM method, the total cost of the Masnana - Wali Road Development project in South Buru Regency, Namrole District with an efficient time of Rp. 2,512,286,813 which of the initial cost of Rp. 2,497,872,247.68. This time duration is the most efficient time after being accelerated using the CPM method, the total cost of the Masnana - Wali Road Development project in South Buru Regency, Namrole District with an efficient time of Rp. 2,512,286,813 which of the initial cost of Rp. 2,497,872,247.68.The optimum duration and cost results obtained from this Crashing analysis can be considered for its application in project implementation. This is because the results of time and cost optimization show that a shorter implementation duration will require greater implementation costs compared to normal duration and cost conditions.

Keywords:
Project Management,
Network Planning,
CPM,
Time and Cost Efficiency

E-mail:
marfienwaluyo13@gmail.com

1. INTRODUCTION

In Indonesia, every company wants to make a profit. Company profits can build a good image in society. Companies exist not only about profits but also about how alert they are in dealing with problems. Every company finally feels compelled to further increase the potential of existing resources by balancing

the mastery of existing technology so that companies can survive in the competition. Companies that are unable to compete will experience a decline and even many companies in Indonesia will go bankrupt. This is due to, among other things, being unable to compete in time and production costs. In terms of time and production costs, the company must be as efficient as possible in the use of time in each activity so that costs can be minimized from the original plan.Therefore, in starting and completing a project it is necessary to plan, organize, direct, coordinate and supervise as well as possible. Good planning is needed in development, namely by considering time and cost efficiency as well as quality quality(Setiawan, 2021). [1] Good planning is seen from how the contractor company can maximize the function of the time and cost of each activity. Because the parameters used in construction project management are a function of time and cost. Time and cost management includes planning, compiling and controlling schedules. The method that has been developed for this problem is what we know as Network Planning. Network planning which uses the critical path method is one of the management techniques used to assist, plan and control projects handled by the company.

2. METHODS

2.1 Types of research

In the concept of quantitative research, measurement is the center of research. This is because the measurement results can help to see a relationship between empirical observations and the results of the data. Quantitative research also aims to help find relationships between variables in a population.

2.2 Population And Sample

The study used a population, namely the Masnana - Wali Section Road Development project in South Buru Regency, Namrole District which was handled by CV. Mighty Son.

Sample.

The sample of this research datanamely projectConstruction of Jalan Masnana Section - Wali for the period October (17 October 2022) - December (08 December 2022).

Compilation of Network Diagrams

The steps that must be taken when compiling a network diagram using CPM are:

1) Identify the jobs that must be carried out to complete the work as a whole based on Activity Oriented.
2) Determine the sequence of work to be carried out, what work must be completed before a job begins and what work must be done after a job is finished.
3) Determine the DurationActivity using the Mean (average).
4) Create an image network (network diagram) in accordance with the list of existing activities.
5) If there are imperfections in the network image, it is necessary to add a dummy activity.
6) Determine the critical path, namely the longest path or path with jobs that have the same EFT and LST.
7) Determine the time difference between the actual time/time needed and the time it should be.
8) Determine the ratio of savings that occur in each activity.

3. RELUST AND DISCUSSION

Table 1. List of Construction Activities for the Masnana-Wali Road Section, Namrole District

No	Work	Cost (IDR)	Duration(Days)
I	DIVISION 1. GENERAL	**51,560,000.00**	
1.2	Preparation, mobilization & demobilization	30,440,000.00	15
	Implementation of a construction safety management system	-	
	- Preparation of SMKK or RKK conceptual designs, quality programs	6,500,000.00	10
	- Making procedures and work instructions	-	-
	- Preparation of SMKK implementation reports	-	-
	- Construction Safety Induction (Safety Induction)	1,000,000.00	1
	- Construction Safety Briefing (Safety Briefing)	1,000,000.00	1
	- Insurance	1,500,000.00	1
	- K3 officer	750,000.00	5
	- K3 banners/banners	1,000,000.00	1

	- Protective Hat (Safety Helmet)	1,000,000.00	1
	- Respiratory and Mouth Protection (Mask)	20,000.00	1
	- Gloves (Safety Gloves)	200,000.00	1
	- Safety Vest (Safety Vest)	500,000.00	1
	- Lars Shoes	2,000,000.00	1
	- First aid kit (K3 box, stretcher, general medication, bandages)	1,000,000.00	1
	- Fire extinguishers	800,000.00	1
	- Restricted area	1,600,000.00	1
	- Hint Signs	750,000.00	1
	- Prohibition Sign	750,000.00	1
	- Warning sign	750,000.00	1
III	DIVISION 3. EARTH WORK	**1,275,866,786.26**	
	Ordinary Dig	76.115.850.84	8
	Excavation of the structure with a depth of 0-2 meters	3.836.192.69	2
	Stockpiles selected from excavated sources	1.145.463.757.73	61
	Road preparation	50,450,985.00	7
VII	DIVISION 7. STRUCTURE	**1,170,445,461.42**	
	Medium quality concrete fc'20 MPa	16.947.094.03	5
	Medium quality concrete fc'20 MPa (negotiable)	*18,795,867.93*	-
	U32 threaded reinforcing steel	61.854.232.00	11
	Medium quality concrete fc'20 MPa (negotiable)	*47,369,970.87*	-
	Stone Couple	58.828.047.17	8
	Stone Pair (negotiable)	966.650.249.42	
	Total	2,497,872,247.68	150

Source: CV. Mighty Son, 2022

3.1 Project Implementation Planning

Table 2. Sequence of Work for the Masnana-Wali Road Construction Project, Namrole District

Activity	Work	Predecessor	Duration (Days)
	DIVISION 1. GENERAL		
A	Preparation, mobilization & demobilization	-	15
	Implementation of a construction safety management system	-	-
B	- Preparation of SMKK or RKK conceptual designs, quality programs	A	10
	- Making procedures and work instructions	-	-
	- Preparation of SMKK implementation reports	-	-
C	- Construction Safety Induction (Safety Induction)	B	1
D	- Construction Safety Briefing (Safety Briefing)	C	1
E	- Insurance	D	1
F	- K3 officer	E	5
G	- K3 banners/banners	F	1
H	- Protective Hat (Safety Helmet)	G	1
I	- Respiratory and Mouth Protection (Mask)	G	1
J	- Gloves (Safety Gloves)	G	1
K	- Safety Vest (Safety Vest)	G	1
L	- Lars Shoes	G	1
M	- First aid kit (K3 box, stretcher, general medication, bandages)	H,I,J,K,L	1
N	- Fire extinguishers	M	1
O	- Restricted area	N	1
P	- Hint Signs	N	1
Q	- Prohibition Sign	N	1
R	- Warning sign	N	1
	DIVISION 3. EARTH WORK		
S	Ordinary Dig	O, P, Q, R	8
Q	Excavation of the structure with a depth of 0-2 meters	S	2
u	Stockpiles selected from excavated sources	Q	61
V	Road preparation	u	7

	DIVISION 7. STRUCTURE		
W	Medium quality concrete fc'20 MPa	V	5
	Medium quality concrete fc'20 MPa (negotiable)	-	-
X	U32 threaded reinforcing steel	W	11
	Medium quality concrete fc'20 MPa (negotiable)		-
Y	Stone Couple	X	8
	Stone Pair (negotiable)		-

Source: CV Putra Perkasa, 2022

3.2 Calculating Critical Path Through Network Diagram

Table 3. Table of network information for the Masnana-Wali Road Development Project in Namrole District

No	Code	Time	Calculation				slack	Path Properties
			Proceed		Back off			
			(ICE)	(EF)	(LS)	(LF)		
1	A	15	0	15	0	15	0	Critical
2	B	10	15	25	15	25	0	Critical
3	C	1	25	26	25	26	0	Critical
4	D	1	26	27	26	27	0	Critical
5	E	1	27	28	27	28	0	Critical
6	F	5	28	33	28	33	0	Critical
7	G	1	34	35	34	35	0	Critical
8	H	1	35	36	35	36	0	Critical
9	I	1	35	36	34	35	1	-
10	J	1	35	36	34	35	1	-
11	K	1	35	36	34	35	1	-
12	L	1	34	35	35	36	1	-
13	M	1	35	36	35	36	0	Critical
14	N	1	36	37	36	37	0	Critical
15	O	1	37	38	37	38	0	Critical
16	P	1	37	38	37	38	0	Critical
17	Q	1	37	38	37	38	0	Critical
18	R	1	37	38	37	38	0	Critical
19	S	8	38	46	38	46	0	Critical
20	Q	2	46	48	46	48	0	Critical
21	u	61	48	109	48	109	0	Critical
22	V	7	109	116	109	116	0	Critical
23	W	5	46	51	100	105	5	-
24	X	11	51	62	105	116	11	-
25	Y	8	116	124	116	124	0	Critical

3.3 Cost Analysis of Project Completion Time

In determining the slope of the cost, it must first know the shortened time and the amount of costs incurred to shorten this time. In the Masnana Wali road construction project, there will only be a number of shortened activities, such as Ordinary Excavation Work, Selected Stockpiling work from excavated sources, Road body preparation work, and Stone Pairing work.

The cost slope for each activity can be calculated in the following table:

Cost Slope formula:

$$\text{Slopes} = \frac{biaya\ di\ percepat - biaya\ normal}{duruassi\ normal - durasi\ dipercepat}$$

Table 4. Accelerated time and costs

activity	Duration (days)		Cost (IDR)		Cost Slope (Rp)
	Normal	**accelerated**	**Normal**	**accelerated**	
A	15	15	30,440,000.00	-	-
B	10	10	6,500,000.00	-	-
C	1	1	1,000,000.00	-	-
D	1	1	1,000,000.00	-	-

E	1	1	1,500,000.00	-	-
F	5	5	750,000.00	-	-
G	1	1	1,000,000.00	-	-
H	1	1	1,000,000.00	-	-
I	1	1	20,000.00	-	-
J	1	1	200,000.00	-	-
K	1	1	500,000.00	-	-
L	1	1	2,000,000.00	-	-
M	1	1	1,000,000.00	-	-
N	1	1	800,000.00	-	-
O	1	1	1,600,000.00	-	-
P	1	1	750,000.00	-	-
Q	1	1	750,000.00	-	-
R	1	1	750,000.00	-	-
S	8	6	76,115,850.00	95,144,812.00	65,723,343
Q	2	2	3,836,192.00	-	
u	61	54	1,145,463,985.00	1,276,910,671.00	18,778,098
V	7	5	50,450,985.00	64,865,552.00	7,207,283
W	5	4	16,947,094.00	-	-
X	11	8	61,854,232.00	-	-
Y	8	6	58,828,047.00	73,535,058.00	7,353,505
Total			1,465,056,385		

Source: processed research data

Based on the results of the previous analysis, it is known that the duration of the completion of the Masnana-wali road construction project in the Namrole sub-district is in a normal position, namely 124 days with a total cost of Rp.1,465,056,385,-

Expedited activities start from activities:

1. Activity Y accelerated by 2 days
   A+B+C+D+E+F+G+H+M+N+O+P+Q+R+S+T+U+V+Y
   15+10+1+1+1+5+1+1+1+1+1+1+1+1+1+8+2+61+7+6 = 125

   Cost = total normal cost + (2 x slope of activity Y)
   =1,465,056,385+(2x7,353,505)
   =1,479,763,395
2. Activity V accelerated by 2 days
   A+B+C+D+E+F+G+H+M+N+O+P+Q+R+S+T+U+V+Y
   15+10+1+1+1+5+1+1+1+1+1+1+1+1+1+8+2+61+5+6 = 123

   Cost = total normal cost + (2 x slope of activity V)
   =1,465,056,385+(2x7,207,283)
   =1,479,470,861

3. U activities accelerated by 7 days
   A+B+C+D+E+F+G+H+M+N+O+P+Q+R+S+T+U+V+Y
   15+10+1+1+1+5+1+1+1+1+1+1+1+1+1+8+2+54+5+6 = 116

   Cost = total normal cost + (7 x slope of activity U)
   =1,465,056,385+(7x18,778,098)
   =1,596,503,071

4. Activity S accelerated by 2 days
   A+B+C+D+E+F+G+H+M+N+O+P+Q+R+S+T+U+V+Y
   15+10+1+1+1+5+1+1+1+1+1+1+1+1+1+6+2+54+5+6 = 114

Cost = total normal cost + (2 x activity slope S)
=1,465,056,385. +(2x65,723,343)
1,596,503,071

To find the optimal time and cost of the project can be seen in the table below

Table 5. Alternative Project Acceleration

Activities to be planned will be accelerated	Project duration (days)	Project cost (Rp)
Normal	124	1,465,056,385
Activity Y accelerated by 2 days	125	1,479,763,395
Activity V accelerated by 2 days	123	1,479,470,861
U activities accelerated by 7 days	116	1,596,503,071
Activity S accelerated by 2 days	114	1,596,503,071

Source: processed research data

4. CONLUSION

The conclusions from the above research are described as follows, Based on the results of data processing and the discussion described above, it can be concluded that the form of the Masnana-Wali Road Development Project network, Namrole District, South Buru Regency, namely: Preparation, mobilization & demobilization - Preparation of SMKK or RKK conceptual designs, quality program - Safety induction Construction (Safety Induction) - Construction Safety Briefing (Safety Briefing) – Insurance – K3 officers – K3 Banners/Banners - Safety Helmets – Gloves (Safety Gloves) – Safety Vests – Restricted Areas) – Prohibition Signs – Warning Signs – Ordinary Excavation - Excavation of the structure with a depth of 0-2 meters - Selected embankment from excavated sources - Preparation of the road body - Masonry (Critical Path) and when accelerating the critical path does not change. The efficient time duration is 123 days from the normal time of 124 days. This time duration is the most efficient time after being accelerated using the CPM method, the total cost of the Masnana - Wali Road Development project in South Buru Regency, Namrole District with an efficient time of Rp. 2,512,286,813 which of the initial cost of Rp. 2,497,872,247.68.

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