DETERMINATION OF CRITICAL PATTERN OF 60 METER SHIP CONSTRUCTION PROJECT USING PRECEDENCE DIAGRAM METHOD (PDM)

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ABSTRACT: *PT. XYZ in Surabaya is engaged in the production of commercial ships, providing ship repair and maintenance services as well as general engineering with specifications based on orders. Along with the development of the technology industry, ship production requires every shipyard to evaluate the system used. The time delay is the problem of building a 60 meter commercial ship. The Precedence Diagram Method (PDM) is a method for scheduling project time and showing critical trajectories of project activities. The results showed that in the project scheduling, there are 13 activities that have a zero value or critical activity which are activities 1, 2, 3, 4, 5, 7, 9, 15, 16, 20, 22, 23, 26, 27, 28 So that it needs more strict control and supervision from the contractor in carrying out the activities of the 60 meter commercial ship building project activities for each activity/activity so that it does not experience delays and the project can be completed on time.*

Keywords: *Controlling, Planning, Critical trajectories, PDM.*

1. INTRODUCTION

PT. XYZ in Surabaya is engaged in the production of commercial vessels, providing ship repair and maintenance services as well as general engineering with specifications based on orders (Silvianita, 2018).

Along with the development of the technology industry, ship production requires every shipyard to evaluate the system used. The new ship building project is required to work fast according to the schedule. Poor performance, low quality, and cost overruns often occur in a project (Arica Dwi Susanto, 2018).

The literature used in this paper were obtained to support the research. These literature includes paper titled A fuzzy pert approach to evaluate plant construction project scheduling risk under uncertain resources capacity (R.Lin, 2009).

Earned Value Management Systems: Challenges and Future Direction (Wilson, 2013). CPM, PERT and Project Management With Fuzzy Logic Technique and Implementation On A Business (Mazlum, 2015). Integration of Building Information Modeling and Critical Path Method Schedules to Simulate the Impact of Temperature and Humidity at the Project Level (Shan, 2014). Comparative Study of Management Operation System Techniques (MOST) and CPM in Construction Scheduling (Shailla, 2014). Extension of Time Determination in Construction Projects in Nigeria: The Critical Path Method (Andawei, 2014). Critical path analysis for the management of fractured neckof femur (Balla, 1995). The Critical Path Method In Estimating Project Duration (Nafkha, 2016). Critical Path Analysis for New Product Planning (Wong, 1964). Measuring the Actual Energy Cost Performance of Green Buildings: A Test of the Earned Value Management Approach (Dwaikat, 2016). Cost Control and Performance Review of Software Projects by Using the Earned Value Management (Alecu, 2014). Critical Path Method in Designing Feasible Solutions (Agarwal, 2013). Traditional Critical Path Method versus Critical Chain Project Management: A Comparative View (M, 2015). Project Planning And Control With Pert And Cpm (K.K.Khandelwal, 2002). Project Planning And Scheduling Using PERT And CPM Techniques With Linear Programming: Case Study (Agyei, 2015). Fast Missile Boat Project Planning using CPM and What If Analysis Method (Silvianita, 2018). CPM Schedule Summarizing Function of the Beeline Diagram Method (Kim, 2012). Earned value method as a tool for project control (Czarnigowska, 2008). The Factors Affecting The Methods of Construction Projects Scheduling: An State of The Art and Overview (Fatemeh Nouban, 2017). Contruction Project Scheduling with Time, Cost and Material Restrictions Using Fuzzy Mathematical Models and Critical Path Method (Daniel Castro-Lacouture, 2009). Planning and Monitoring of industrial punch development processes (Y. Arslan, 2017)

PDM is a network that is generally in the form of a rectangle, while the arrow is only as a guide to the relations of the activities in question. The activity relationship shows the relationship between activities with one line from the previous node to the next node.

This Paper is organized as follows. Section 2 review about the basic ship theory. Section 3 gives result and section 4 discussion of research. Finally, in section 5 present conclusion this paper.

2. MATERIALS AND METHODS

2.1. Technical Concept

In determining the exact duration factors:

1. Volume of work
2. The condition in project fields
3. Weather conditions
4. Resources conditions (labor, materials, equipment)
5. Experiences on previous project (similar project)

2.2. Project Time Management

There are three stages to be performed in project management:

1. Planning Process

Planning process includes the setting of goals, defining projects and forming team organizations. Regarding the capability in working on several projects at once (mostly in large companies), an effective way to assign labors and physical resources is through the project organization. The project organization is led by a project manager who coordinates project activities with other departments and reports to top management.

2. Scheduling

Scheduling is the link between labor, money, and materials used in a project. Project scheduling involves specifying the duration of project activities to be completed, raw materials, labor and time required for each activity. The popular approach used is the Gantt Chart or the Bar Chart Method. Other project scheduling methods are PERT (Project Evaluation and Review Technique) and CPM (Critical Path Method).

3. Controlling

Project controls include control over resources, cost, quality and budget. Project control is also used to revise the project plan and allow to change/shift resources to a needed places (rearranging) so that the time and cost can be appropriate. Project control involves strict supervision of resources, cost, quality and budget. Control also means the use of feedback loops to revise the project plan and resource arrangements where needed.

2.3. Network Component

There are two approaches to describe the project network: activity on node - AON and activity on arrow (AOA). At the AON convention, the point indicates the activity, whereas at the AOA, the arrow indicates the activity.

2.4. Precedence Diagram Method (PDM)

Precedence Diagram Method is a networking method that is included in the classification of AON (Activity On Node). In this method, the activity is written in a node that is generally rectangular, while the arrows as a pointer relationship between the activities concerned. Thus the dummy which is an important sign to indicate the dependence relationship, is not required in PDM.

The precedence method diagram can be described as four relations of activity/logic, Each node has two ends, namely the beginning or beginning = (S) and the end or end = (F) that is (Tan, 1998):

In the precedence diagram method, the existence of four relations of activity/logic can be described. Each node has two ends namely the beginning/starting tip = (S) and end/ finish tip = (F) (Tan, 1998):

1. Activity relation of *Start-to-start* (SS): When A starts, B can be started.

2. Activity Relation of *Start-to-finish* (SF): When A starts, B can be finished.

3. Activity Relation *Finish-to-Start* (FS): When A finish, B can be started.

4. Activity Relation *Finish-to-finish* (FF): When A finish, B can be finished.

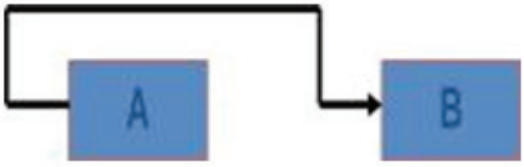

Fig. 1 Activity Relation of *Start-to-Start* (SS)

Fig. 2 Activity Relation of *Start-to-Finish* (SF)

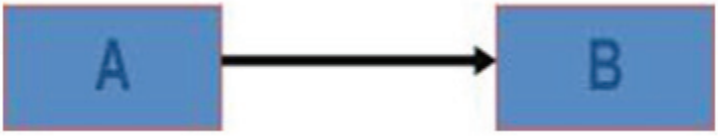

Fig. 3 Activity Relation of *Finish-to-Start* (FS)

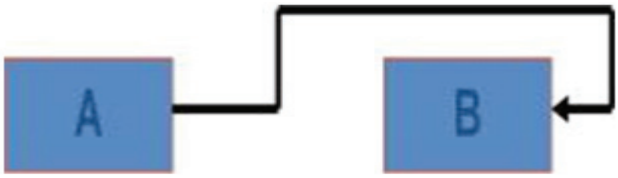

Fig. 4 Activity Relation of *Finish-to-Finish* (FF)

2.5. Method of Research

Analysis of this research data are as follows:

Calculations was performed using excel software whose results can handle planning an activity, organizing and controlling time and costs that convert input data into an output data according to purpose, then the overall time of building a 60 meter commercial ship can b e known.

3. RESULT

In this part, the authors would like to discuss about critical path with PDM, so that the expected time can be in accordance with the planning of the 60 meters commercial ship construction

The time and cost plan data of a 60 meter commercial ship construction project was for 314 days. The data on the schedule and duration of the 60 meter commercial ship building planning project along with the time duration are presented in table 1 and the cost budget design data are listed in table 2.

Table 1. Schedule and Duration of the 60 Meter Commercial Ship Construction Project

No	Activity	Duration (hari)	Start	Finish
	Hull Construction		10/10/2016	06/06/2017
1	Hull Fabrication	70	10/10/2016	15/01/2017
2	Hull Sub Assembly	104	18/10/2016	11/03/2017
3	Hull Assembly	137	26/10/2016	06/05/2017
4	Hull Erection	137	25/11/2016	06/06/2017
	Painting anode Catodic Protection		01/10/2016	22/05/2017
5	Blasting and Painting Raw Material	48	10/10/2016	15/12/2016
6	Block Blasting and Painting	137	15/11/2016	31/05/2017
7	Finishing Hull	27	06/06/2017	12/07/2017
8	Painting Outfitting	79	06/06/2017	22/09/2017
9	Anode	19	14/03/2017	07/04/2017
	Hull Outfitting		10/10/2016	05/10/2017
10	Seat and Foundation	86	10/10/2016	07/02/2017
11	Deck Machinery and Equipment	86	07/02/2017	07/06/2017
12	Interior	171	07/02/2017	05/10/2017
	Machinery Outfitting		10/10/2016	05/10/2017
13	Piping System Including Ducting	181	10/10/2016	20/06/2017
14	Shafting	51	20/06/2017	30/08/2017

No	Activity	Duration (hari)	Start	Finish
15	Machinery Outfitting	25	31/08/2017	05/10/2017
	Electric, Electronic Outfitting		10/10/2016	05/10/2017
16	Cabling	172	10/10/2016	07/06/2017
17	Power Supply	172	02/11/2016	01/07/2017
18	Illuminiation	172	26/11/2016	26/07/2017
19	Communication and Instrumentation	178	21/12/2016	18/08/2017
20	Computing and Information	172	13/01/2017	12/09/2017
21	Nautical and Radio	172	07/02/2017	05/10/2017
	Function and Commisioning		05/10/2017	30/10/2017
22	Machinery Commisioning	9	05/10/2017	18/10/2017
23	Equipment Commisioning	8	10/10/2017	21/10/2017
24	Lighting Commisioning	4	18/10/2017	24/10/2017
25	System Control Commisioning	4	24/10/2017	30/10/2017
	HAT and SAT		02/11/2017	18/12/2017
26	Harbour Acceptance Test	31	02/11/2017	16/12/2017
27	Yard Trial	14	27/11/2017	18/12/2017
	Delivery		20/12/2017	20/12/2017
28	Delivery to Customer	0	20/12/2017	20/12/2017

Table. 2 Budget Plan

No.	Job Description (Thousands Rupiah)		Cost	
A	**Hull Construction**			
	1	Hull Fabrication	Rp	46.176.942
	2	Hull Sub Assembly	Rp	6.244.996
	3	Hull Assembly	Rp	8.286.629
	4	Hull Erection	Rp	8.286.629
B	**Painting anode Catodic Protection**			
	5	Blasting and Painting Raw Material	Rp	3.242.594
	6	Block Blasting and Painting	Rp	2.522.018
	7	Finishing Hull	Rp	1.621.297

No.	Job Description (Thousands Rupiah)		Cost
	8	Painting Outfitting	Rp 4.743.795
	9	Anode	Rp 1.140.913
C	**Hull Outfitting**		
	10	Seat and Foundation	Rp 5.224.179
	11	Deck Machinery and Equipment	Rp 5.224.179
	12	Interior	Rp 10.388.311
D	**Machinery Outfitting**		
	13	Piping System Including Ducting	Rp 10.928.743
	14	Shafting	Rp 3.122.498
	15	Machinery Outfitting	Rp 1.561.249
E	**Electric, Electronic Outfitting**		
	16	Cabling	Rp 4.203.363
	17	Power Supply	Rp 4.563.651
	18	Illuminiation	Rp 4.383.507
	19	Communication and Instrumentation	Rp 4.743.795
	20	Computing and Information	Rp 4.803.843
	21	Nautical and Radio	Rp 3.963.171
E	**Function and Commisioning**		
	22	Machinery Commisioning	Rp 600.480
	23	Equipment Commisioning	Rp 540.432
	24	Lighting Commisioning	Rp 120.096
	25	System Control Commisioning	Rp 420.336
F	**HAT and SAT**		
	26	Harbour Acceptance Test	Rp 1.921.537
	27	Yard Trial	Rp 900.721
G	**Delivery**		
	28	Delivery to Customer	Rp 120.096
	TOTAL		Rp 150.000.000

3.1. Gantt Chart Planning Data for 60 Meter Commercial Ship Construction Project

Making a planning schedule for a 60 meter commercial ship construction project used the Gantt Chart to determine when the activities / activities were started, postponed and completed.

The plan schedule of a 60 meter commercial ship construction project can be seen in the following figure below:

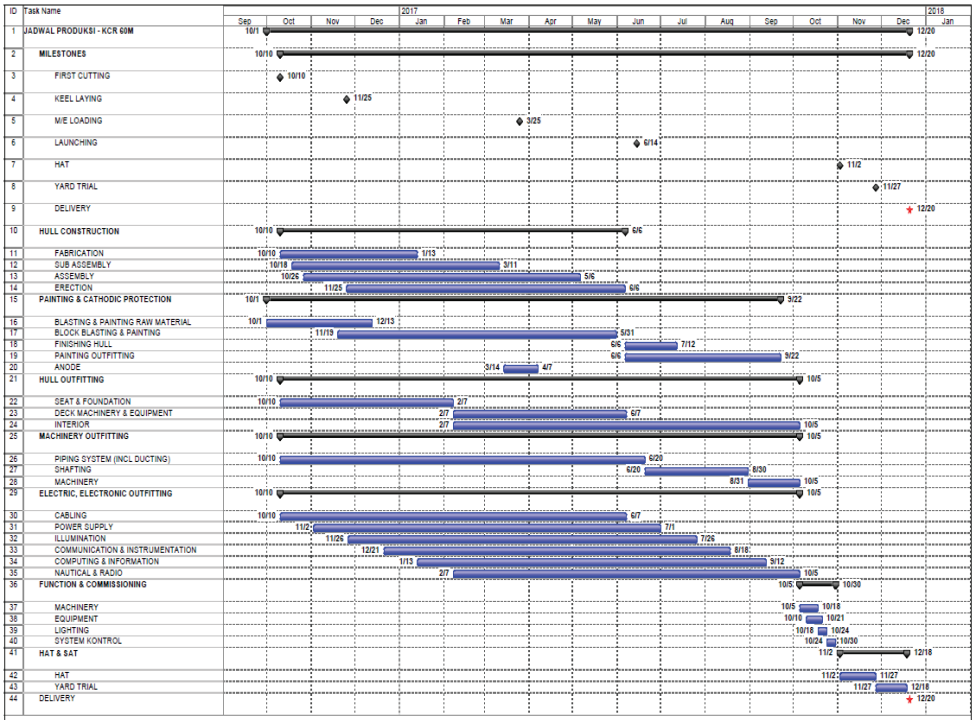

Fig. 5 Gantt Chart Planning Data for 60 Meter Commercial Ship Construction Project

4. DISCUSSION

In this study, the PDM method used one determinant number and four constraints. The four constraints in the Precedence Diagram Method (PDM) are important components in the formation of its network. In addition, the four constraints give different forms by placing activity information in the display of precedent diagrams as nodes.

The results of the construction data determination on the 60 meter commercial ship construction project can be seen in the following table:

Table 3. Determination the Construction of the 60 Meter Commercial Ship Construction Project

No	Kegiatan	Konstrain
1	Hull Fabrication	-
2	Hull Sub Assembly	SS(1-2) = 6
3	Hull Assembly	SS(2-3) = 6
4	Hull Erection	SS(3-4) = 22
5	Blasting and Painting Raw Material	-
6	Block Blasting and Painting	SS(5-6) = 30
7	Finishing Hull	FS(9-7) = 42
		FS(3-7) = 22
		FS(4-7) = 0
		FS(6-7) = 4
8	Painting Outfitting	FS(4-8) = 0
		FS(6-8) = 4
9	Anode	FS(2-9) = 2
10	Seat and Foundation	-
11	Deck Machinery and Equipment	FS(10-11) = 0
12	Interior	FS(10-12) = 0
13	Piping System Including Ducting	-
14	Shafting	FS(11-14) = 9
		FS(13-14) = 0
15	Machinery Outfitting	FS(7-15) = 37
		SS(8-15) = 63
		FS(14-15) =1
16	Cabling	-
17	Power Supply	SS(16-17) = 17
18	Illuminiation	SS(16-18) = 35
19	Communication and Instrumentation	SS(16-19) = 52
20	Computing and Information	SS(16-20) = 70
21	Nautical and Radio	SS(16-21) = 86
22	Machinery Commisioning	FS(12-22) = 0
		FS(15-22) = 0
23	Equipment Commisioning	FS(16-23) =89
		FS(17-23) = 72

No	Kegiatan	Konstrain
		FS(18-23) = 54
		FS(19-23) = 31
		FS(20-23) = 20
		FS(21-23) = 4
24	Lighting Commisioning	SS(23-24) = 6
25	System Control Commisioning	FS(24-25) = 0
26	Harbour Acceptance Test	FS(22-26) = 11
		FS(23-26) = 9
		FS(25-26) = 3
27	Yard Trial	SS(26-27) = 18
28	Delivery to Customer	FS(27-28) = 2

Table. 4 Table of Activities for Construction of a 60 Meter Commercial Ship Constraction Project

No	Job Description	Activity Code	Initial Activity	Duration (hari)
	Hull Construction			
1	Hull Fabrication	1	-	70
2	Hull Sub Assembly	2	1	104
3	Hull Assembly	3	2	137
4	Hull Erection	4	3	137
	Painting anode Catodic Protection			
5	Blasting and Painting Raw Material	5	-	48
6	Block Blasting and Painting	6	5	137
7	Finishing Hull	7	3, 4, 6, 9	27
8	Painting Outfitting	8	4, 6	79
9	Anodizing	9	2	19
	Hull Outfitting			
10	Seat and Foundation	10	-	86
11	Deck Machinery and Equipment	11	10	86
12	Interior	12	10	171
	Machinery Outfitting			
13	Piping System Including Ducting	13	-	181
14	Shafting	14	11, 13	51

No	Job Description	Activity Code	Initial Activity	Duration (hari)
15	Machinery Outfitting	15	7. 8. 14	25
	Electric, Electronic Outfitting			
16	Cabling	16	-	172
17	Power Supply	17	16	172
18	Illuminiation	18	16	172
19	Communication and Instrumentation	19	16	178
20	Computing and Information	20	16	172
21	Nautical and Radio	21	16	172
	Function and Commisioning			
22	Machinery Commisioning	22	12, 15	9
23	Equipment Commisioning	23	16,17,18,19,20,21	8
24	Lighting Commisioning	24	23	4
25	System Control Commisioning	25	24	4
	HAT and SAT			
26	Harbour Acceptance Test	26	22, 23, 25	31
27	Yard Trial	27	26	14
	Delivery			
28	Delivery to Customer	28	27	0

Based on the series of project activities in the table above with the addition of constrains provisions in table 4, they were then described in the form of a networking planning diagram using activity signs in the activity on node (AON) model as shown below:

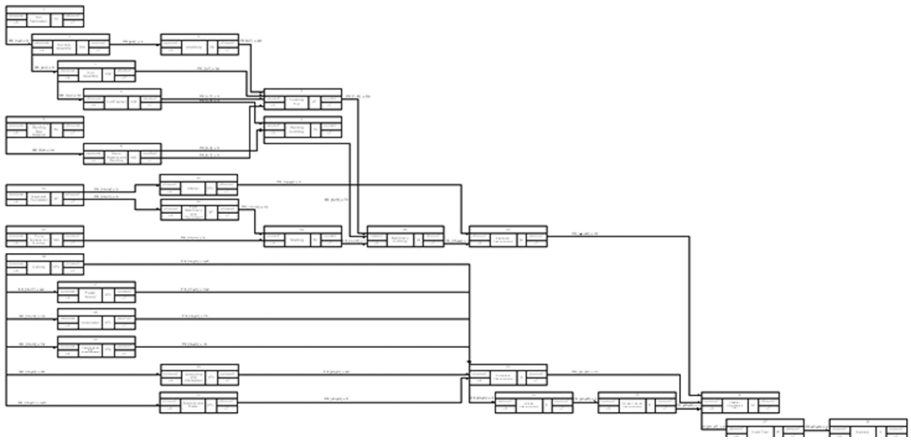

Fig. 6 Activity On Node of 60 Meter Commercial Ship Constraction Project

After the Time Schedule was known, the next step was the researcher to perform the PDM calculation to find out the project completion time.The PDM it consists of two stages, namely forward pass and backward pass.

1. *Forward Pass*

o Activity 1
ES (1) = 0
EF (1) = 0 + 70 = 70

o Activity 2
ES (2) = 0 + 6 = 6
EF (2) = 6 + 104 = 110

o Activity 3
ES (3) = 6 + 6 = 12
EF (3) = 12 + 137 = 149

o Activity 4
ES (4) = 12 + 22 = 34
EF (4) = 34 + 137= 171

o Activity 5
ES (5) = 0
EF (5) = 0 + 48 = 48

o Activity 6
ES = 0 + 30 = 30
EF = 30 + 137 = 167

o Activity 7
ES (7) = 130 + 42 = 172
= 149 + 22 = 171
= 171 + 0 = 171
= 167 + 4 = 171
EF (7)= 172 + 27 = 199

o Activity 8
ES (8) = 171+ 0 = 171
= 167 + 4 = 170
EF (8) = 171 + 79 = 250

o Activity 9
ES (9) = 110 + 2 = 112
EF (9) = 112 + 18 = 130

o Activity 10
ES (10)= 0
EF (10)= 0 + 86 = 86

o Activity 11
ES (11)= 87 + 0 = 86
EF (11)= 86 + 86 = 172

o Activity 12
ES (12) = 86 + 0 = 86
EF (12) = 86 + 171 = 257

o Activity 13
ES (13) = 0
EF (13) = 0 + 181 = 181

o Activity 14
ES (14) = 172 + 9 = 181
= 181 + 0 = 181
EF (14) = 181 + 51 = 232

o Activity 15
ES (15) = 199 + 36 = 235
= 171 +62 = 233
= 232 + 1 = 233
EF (15) = 235 + 25 = 260

o Activity 16
ES (16) = 0
EF (16) = 0 + 172 = 172

o Activity 17
ES (17) = 0 + 17 = 17
EF (17) = 17 + 172 = 189

o Activity 18
ES (18) = 0 + 35 = 35
EF (18) = 35 + 172 = 207

o Activity 19
ES (19) = 0 + 52 = 52
EF (19) = 52 + 178 = 230

o Activity 20
ES (20 = 0 + 70 = 70
EF (20) = 70 + 172 = 242

o Activity 21
ES (21) = 0 + 86 = 86
EF (21) = 86 + 172 = 258
o Kegiatan 22
ES (22) = 257 + 0 = 257
= 260 + 0 = 260
EF (22) = 260 + 9 = 269
o Activity 23
ES (23) = 172 + 89 = 261
= 189 + 72 = 261
= 207 + 54 =261
= 230 + 31 = 261
= 242 + 20 = 262
= 258 + 3 =261
EF (23) = 262 + 9 = 271
o Activity 24
ES (24) = 262 + 6 = 268
EF (24) = 268 + 4 = 272
o Activity 25
ES (25) = 272 + 0 = 272
EF (25) = 272 + 4 = 276
o Activity 26
ES (26) = 269 + 11 = 280
= 269 + 9 = 278
= 275 + 3 = 279
EF (26) = 280 + 31= 311
o Activity 27
ES (27) = 280 + 18 = 298
EF (27) = 298 + 14 = 312
o Activity 28
ES (28) = 312 + 2 = 314
EF (28) = 314 + 0 = 314

2. Backward Pass.

o Activity 28
LF (28) = 314
LS (28) = 314 – 0 = 314
o Activity 27
LF (27) = 314 – 2 = 312
LS (27) = 312 – 14 = 298
o Activity 26
LF (26) = 298 - 18 + 31 = 311
LS (26) = 311 - 31 = 280
o Activity 25
LF (25) = 280 – 3 = 277
LS (25) = 277 – 4 = 273
o Activity 24
LF (24) = 273 – 0 = 273
LS (24) = 273 – 4 = 269
o Activity 23
LF (23) = 269 – 6 + 8 = 271
= 280 – 9 = 271
LS (23) = 271 – 9 = 262
o Activity 22
LF (22) = 280 – 11 = 269
LS (22) = 269 – 9 = 260
o Activity 21
LF (21) = 262 – 3 = 259
LS (21) = 259 – 172 = 87
o Activity 20
LF (20) = 262 – 20 = 242
LS (20) = 242 – 172 = 70
o Activity 19
LF (19) = 262 – 31 = 231
LS (19) = 231 – 178 = 53
o Activity 18
LF (18) = 262 – 54 = 208
LS (18) = 208 – 173 = 36
o Activity 17
LF (17) = 262 – 72 = 190
LS (17) = 190 – 172 = 18
o Activity 16
LF (16) = 262 – 89 = 172
LS (16) = 173 – 172 = 1
= 18 – 17 = 1
= 36 – 35 = 1
= 53 – 52 = 1
= 70 – 70 = 0
= 87 – 86 = 1

- Activity 15
  LF (15) = 260 – 0 = 260
  LS (15) = 260 – 25 = 235
- Activity 14
  LF (14) = 235 – 1 = 234
  LS (14) = 234 – 51 = 183
- Activity 13
  LF (13) = 183 – 0 = 183
  LS (13) = 183 – 182 = 1
- Activity 12
  LF (12) = 260 – 0 = 260
  LS (12) = 260 – 171 = 89
- Activity 11
  LF (11) = 183 – 9 = 174
  LS (11) = 174 – 87 = 86
- Activity 10
  LF (10) = 87 – 0 = 87
  = 89 – 0 = 89
  LS (10) = 87 – 86 = 1
- Activity 9
  LF (9) = 172 - 42 = 130
  LS (9) = 130 - 18 = 112
- Activity 8
  LF (8) = 235 - 62 + 79 = 252
  LS (8) = 252 - 79 = 173
- Activity 7
  LF (7) = 235 - 36 = 199
  LS (7) = 199 - 27 = 172
- Activity 6
  LF (6) = 172 - 4 = 168
  = 173 - 4 = 169
  LS (6) = 168 - 137 = 31
- Activity 5
  LF (5) = 31 – 30 + 54 = 55
  LS (5) = 55 – 54 = 0
- Activity 4
  LF (4) = 173 - 0 = 173
  = 172 - 0 = 172
  LS (4) = 172 -138 = 34
- Activity 3
  LF (3) = 172 - 22 = 150
  = 34 – 22 + 137 = 149
  LS (3) = 149 – 137 = 12
- Activity 2
  LF (2) = 112 - 2 = 110
  = 12 – 6 + 104 = 110
  LS (2) = 110 - 104 = 6
- Activity 1
  LF (1) = 6 - 6 + 70 = 70
  LS (1) = 70 - 70 = 0

Table 5. Recapitulation of ES, EF, SL, LS and LF Value Calculation of the 60 Meter Commercial Ship Construction Project

Activity Code	Duration (Hari)	ES	EF	SL	LS	LF
1	70	0	70	0	0	70
2	104	6	120	0	6	120
3	137	12	149	0	12	149
4	137	34	173	0	34	173
5	48	0	48	0	0	48

Activity Code	Duration (Hari)	ES	EF	SL	LS	LF
6	137	30	167	1	31	168
7	**27**	**172**	**199**	**0**	**172**	**199**
8	79	171	250	2	173	252
9	**19**	**112**	**130**	**0**	**112**	**130**
10	86	0	86	1	1	87
11	86	86	172	1	87	173
12	171	86	257	1	87	258
13	181	0	181	1	1	183
14	51	181	232	2	183	234
15	**25**	**235**	**260**	**0**	**235**	**260**
16	**172**	**0**	**172**	**0**	**0**	**172**
17	172	17	189	1	18	190
18	172	35	207	1	36	208
19	178	52	230	1	53	231
20	**172**	**70**	**242**	**0**	**70**	**242**
21	172	86	258	1	87	259
22	**9**	**260**	**269**	**0**	**260**	**269**
23	**8**	**262**	**271**	**0**	**262**	**271**
24	4	268	272	1	269	273
25	4	272	276	1	273	277
26	**31**	**280**	**311**	**0**	**280**	**311**
27	**14**	**298**	**312**	**0**	**298**	**312**
28	**0**	**314**	**314**	**0**	**314**	**314**

Based on Table 5, the critical path from the PDM calculation was obtained. The critical path is the path through which critical work passes, namely the work that has the earliest start time equals with the last start time (ES = LS) and the earliest completion time equals with the latest finish time (EF = LF). The critical path on PDM can be seen in the following figure:

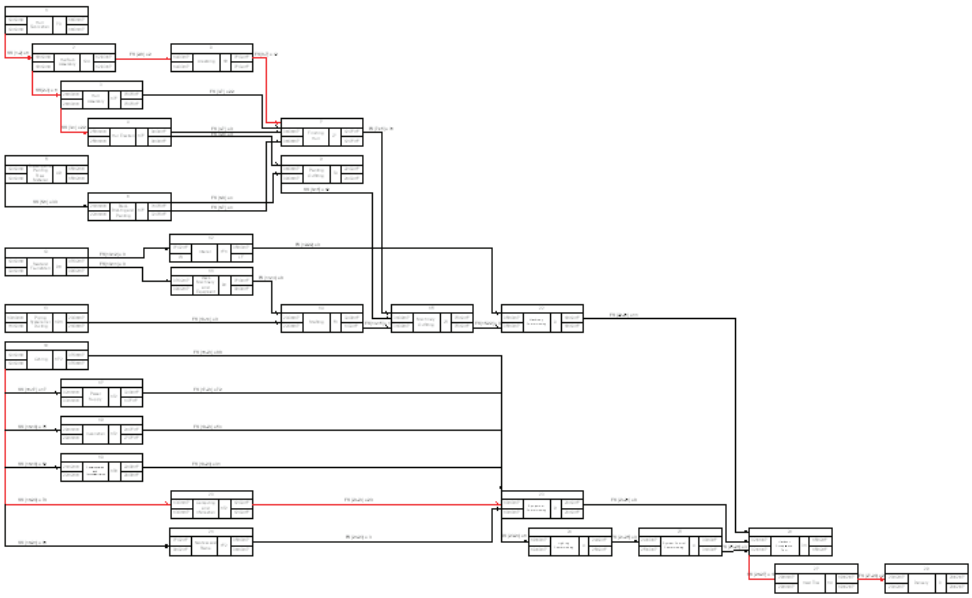

Fig. 7 PDM critical track on the 60 Meter Commercial Ship Construction Project

5. CONCLUSION

Based on the calculations obtained, activity 1, 2, 3, 4, 5, 7, 9, 15, 16, 20, 22, 23, 26, 27, 28 are critical paths. Thus, control and supervision is more stringent in carrying out the activities of the 60 meter commercial ship building project activitiesthan the contractor on each activity to avoid delays so that the project can be completed on time.

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