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Analysis in Machine Design Project Scheduling NCB 8 Using Critical Path Method (CPM) Load and Method of Manufacturing Oriented Control (LOMC) in Pt. XXX

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Abstract:- Accuracy in order fulfillment time of receipt of the promised company and product quality are in line with expectations, as well as the fee charged is considered reasonable is unsur-satisfaction elements that must be met by the company to the consumer. PT. XXX is a manufacturing company engaged in the manufacture of products such as car parts car roof, engine hood and fenders. Based on data from the company, according to the company in 2018 many mismatches or delayed against the schedule or the machine that has been made. This study aims to determine the time of receipt of the order to the Load method Oriented Manufacturing Control (LOMC) where the timing of the receipt of the order is based on a calculation that considers the manufacturing lead time order delivery time to customers, and also determine the critical path on the activities to be undertaken by the NCB engine 8. Using the Load method Oriented Manufacturing Control with due regard to the available capacity, delivery time and the priority order is obtained within project acceptance and also make critical path analysis of the project to be undertaken by the NCB 8 engines like PL, BJN, BJ, BN, bY. and K2.

Keywors:- *Critical Path, Project, Reachive Date.*

I. PRELIMINARY

1.1 Background

In the manufacturing industry, the manufacturing plays an important role in transforming raw materials into finished products. This is the challenge for the manufacturing industry, namely. XXX engaged in the manufacture of automobiles. To support the passage of the production process at the company there are important activities inside that.The important ativitas which goes to production planning production schedule for each project to meet the demand of consumers to achieve effective and efficient cycle. Then in carrying out production activities are impacts that will occur in the running production process that is shifting the production schedule. Production plans project that can not be produced today because it does not correspond to the existing project schedule so that there is a delay in implementing the next project.

The project is aimed as an activity that takes place within a certain time with a certain end result. Projects generally have jobs that once happened and never repeats exactly the same (Dimyati&Nurjannah, 2014). So that the project has a certain time limit that is intended as a benchmark or indicator of the level of accuracy or delay of the project itself. Strategy scheduling (Scheduling) is the key factor in running a project, the right strategy to make the project succeed before or right at a predetermined time.

Load oriented manufacturing control a manufacturing system that is important in reducing lead times and inventories of semi-finished level. Therefore, it has developed a new concept in the control of the manufacturing system is the concept of workload. One of the concepts developed workload is load-oriented manufacturing control LOMC), the function is toflow control time factory floor by controlling the actual input versus output planned work.

1.2 Problem Formulation

Based on the description of the background underlying this report, the formulation of the issues to be raised in this paper is as follows:

1. How implementation of the project on Critical path method (CPM) and the Load method of manufacturing oriented control (LOMC)?
2. how the scheduling design projects to be undertaken by the NCB 8 engine?

1.3 Limitations

Limitation of problems that are used are:

This research data collection taken through section Production Die DEPT. Machining Section. And analysis used only the machining NCB 8. With the method, we choose the critical path method (CPM) and load-oriented manufacturing control (LOMC) on the data obtained in the period August - September 2018.

II. RESULTS AND DISCUSSION

2.1Method *Critical Path Method* (CPM)

2.1.1 Networking

The results of the analyzed data to support the processing variables on the critical path data that is analyzed can be seen in Table 2.1 below:

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Table 2.1 Sequence Activities and Events Accompanied Previously Estimated Period of Time

No.	Type of work	Duration (Hours)	Previous activities
1	PL	245	
2	BJN	150	A
3	BJ	695	B
4	BN	10090	C
5	BY	370	D
6	K2	7215	D, E
7	PL	440	F
8	BJN	1130	G
9	BJ	280	H
10	BN	2220	H, I
11	BY	1880	J
12	K2	12650	K

1.1.2 Forward calculation

Table 2.2 Calculation of Forward CPM

No.	Type of work	Event Codes	Duration (Hours)	Previous activities	ES	EF (ES + Duration)
1	PL	A	245		0	245
2	BJN	B	150	A	245	395
3	BJ	C	695	B	395	1090
4	BN	D	10090	C	1090	11180
5	BY	E	370	D	11180	11550
6	K2	F	7215	D, E	11550	21640
VTV						
7	PL	G	440	F	21640	22080
8	BJN	H	1130	G	22080	23210
9	BJ	I	280	H	23210	23490
10	BN	J	2220	H, I	23490	25710
11	BY	K	1880	J	25710	27590
12	K2	L	12650	K	27590	40240
BZC						

On advanced computation, calculation of the initial event moves toward the terminal event is to calculate the fastest time of the event and the fastest time of the start and completed its activities (TE, ES and EF).

1.1.3 Backward calculations

Table 2.3 Calculation of Backward CPM

No.	Type of work	Event Codes	Duration (Hours)	Previous activities	ES	EF (ES + Duration)	LS	LF
1	PL	A	245		0	245	11660	11905
2	BJN	B	150	A	245	395	11905	12055
3	BJ	C	695	B	395	1090	12055	12750
4	BN	D	10090	C	1090	11180	12750	22840
5	BY	E	370	D	11180	11550	22840	23210
6	K2	F	7215	D, E	11550	21640	23210	23580
VTV								
7	PL	G	440	F	21640	22080	23580	24020
8	BJN	H	1130	G	22080	23210	24020	25150
9	BJ	I	280	H	23210	23490	25150	25430
10	BN	J	2220	H, I	23490	25710	25430	25710
11	BY	K	1880	J	25710	27590	25710	27590
12	K2	L	12650	K	27590	40240	27590	40240
BZC								

In the countdown, move the calculation of the terminal event leading to the initial event. The goal is to calculate the time of the latest occurrence of the event and when the slowest commencement and completed activities (TL, LS, and LF) or is intended to know the time and date of the end of the project in order to begin and end each activity without delay period of project completion overall.

1.1.4 Calculation of the CPM network diagram

Having obtained the results of advanced calculation and countdown CPM, next is calculate free float and total float to be found of the pathways is critical path. Which is the critical path is the path that consists of a series of activities within the scope of the project, which if if delayed will result in delays in the overall project. Calculation of free float and total float is as follows:

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Table 2.4 Calculation of network diagram CPM

No.	Type of work	Event Codes	Duration (Hours)	Previous activities	ES	EF (ES + Duration)	LS	LF	FF	TF
1	**PL**	A	245		0	245	11660	11905	0	11660
2	**BJN**	B	150	A	245	395	11905	12055	0	11660
3	BJ	C	695	B	395	1090	12055	12750	0	11660
4	BN	D	10090	C	1090	11180	12750	22840	0	11660
5	BY	E	370	D	11180	11550	22840	23210	0	11660
6	K2	F	7215	D, E	11550	21640	23210	23 580	2875	4815
VTV										
7	PL	G	440	F	21640	22 080	23 580	24020	0	1940
8	BJN	H	1130	G	22 080	23210	24020	25150	0	1940
9	BJ	I	280	H	23210	23 490	25150	25 430	2000	1940
10	BN	J	2220	H, I	23 490	25 710	25 430	25 710	0	0
11	BY	K	1880	J	25 710	27 590	25 710	27 590	0	0
12	K2	L	12650	K	27 590	40 240	27 590	40 240	0	0
BZC										

From the table, as a sign that the project is a critical path activity, then the activity red letters is the critical path that will be described in the critical path network, is as follows:

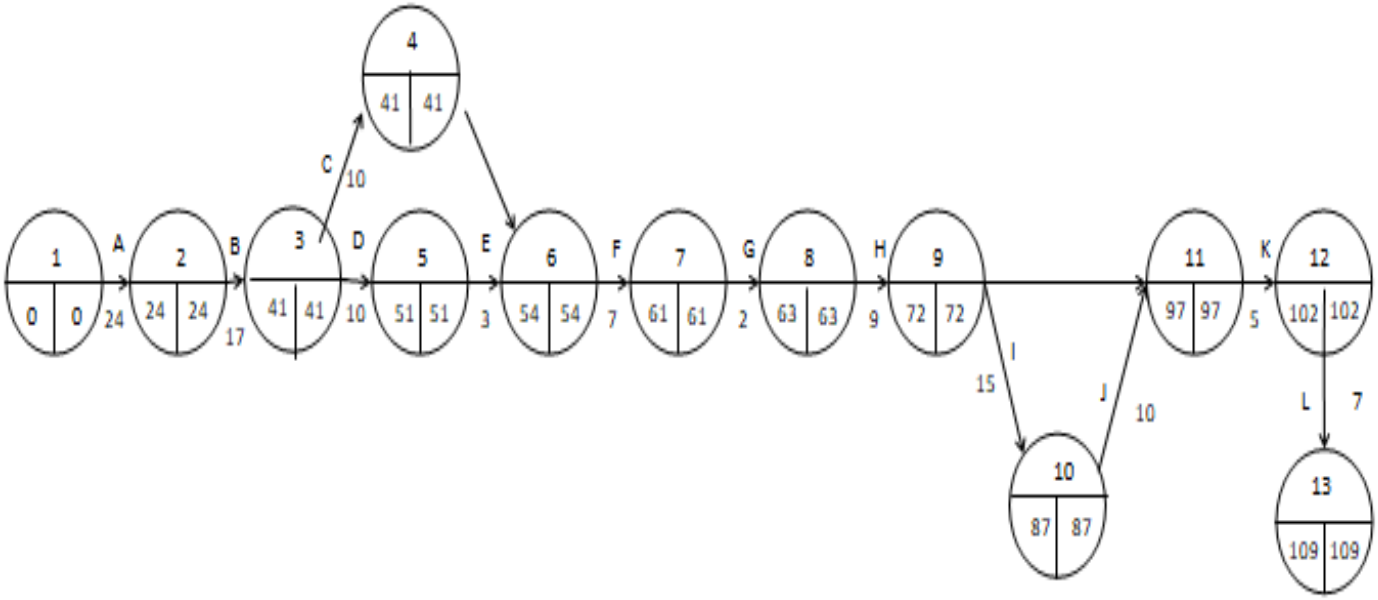

Figure 2.1 Network diagram the critical path CPM

1.2 LOMC method (Load-Oriented Manufacturing Control)

2.2.1 Standard time

Product demand data collected in this study were drawn from the data product orders dies in Agusus - September 2018.

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Table 2.5.Calculation of Normal Time and Standard Time

type Project	Process	Cycle Time (Minutes)	Load Time (Minutes)	*rating Factor*	Normal Time (Minutes)	*Allowance*	Standard Time (Minutes)
VTV	PL	122.5	36.7	0:13	163 971	29%	211.52
	BJN	75	22.5	0:12	100.2	28%	128.25
	BJ	347.5	104.2	0:09	461 078	35%	622.45
	BN	5045	1513.5	0:12	6740.12	28%	8627.35
	BY	185	0	0:12	185	37%	253.45
	K2	3607.5	1082.2	0:09	4787.098	29%	6175.35
BZC	PL	220	66	0:13	294.58	29%	380.01
	BJN	565	169.5	0:12	754.84	28%	966.19
	BJ	140	42	0:09	185.78	35%	250.8
	BN	1110	333	0:12	1482.96	28%	1898.19
	BY	940	0	0:12	940	37%	1287.8
	K2	6325	1897.5	0:09	8393.275	29%	10827.32

1.2.2 Calculation of Available Capacity

The production capacity is available every type of process is calculated based on the number of operators, the number of machines, working hours per day, the amount of shift work, efficiency and utilization factor. The number of operators working days 1 week is 6 days and the number of working hours 1 day is 8 hours, and the number of work shifts 1 day is 2 shift working hours. The capacity available in the PL (milling process to cast parts dies) is calculated as follows:

Capacity of hours provided the PL = Jlh machine / operator x hours / day x Number Shift x Efficiency x Utilization
= 1 x 8 hours / day x 2 x 0.85 x 0.90
= 12:24 hours / day

The same calculation is done to calculate the available capacity on the BJN process until the process on K2. The total capacity available on each of the dies can be seen in Table 2.6.

Table 2.6. hour capacity available each process

Process	Total Engineering / Operator	Hours / Shift	Total Shift	Utilities (%)	Efficient (%)	Total Capacity Available (Hours / Day)
PL	1	8	2	85%	90%	12:24
BJN	2	8	2	85%	90%	24.48
BJ	1	8	2	85%	90%	12:24
BN	2	8	2	85%	90%	24.48
BY	2	8	2	85%	90%	24.48
K2	2	8	2	85%	90%	24.48

2.2.3 *Loading Sequence*

The order of loading sequence is determined by the rules of priority FCFS (First Come First Serve). Direlease Project is the first project to arrive. This rule is used as the arrival time project did not come together. By using the priority rules FCFS (First Come First Serve) and the arrival time of the project to see the data in Table 4.1. then the loading sequence of the first sequence is VTV 03, followed by Project VTV 04, BZC BZC 02 and 04. In Table 2.7. can see the order of the first charged.

Table 2.7. loading sequence data

type Project	PL	BJN	BJ	BN	BY	K2
	TO (Hours)	TO (Hours)	TO (Hours)	TO (Hours)	TO (Hours)	TO (Hours)
VTV 03	0	0	0	428.3	61.7	612.5
VTV 04	40.8	25	115.8	1253.3	0	590
BZC 02	0	0	0	370	45	2015.8
BZC 04	73.3	188.3	46.7	0	268.3	92.5

2.2.4 conversion Expenses

Load conversion is done to see the magnitude of the load to be received by each process on the dies. Before converting the load, first known percentage loading (LPG).

$$LPG = X\ 100\% \frac{Load\ Limit\ (hours)}{Planned\ Output\ (hours)}$$

From the data capacity and the load limit of the company can be obtained that LPG amounted to 131%. For example in PL capacity available at 12:24 hours, while the load limit (hours / day x number of machines) is 16 hours / day x 1 = 16 hours, then its LPG by 16 / 12:24 x 100% = 131%. The percentage value of loading (LPG) will be used to convert the load.

If the known value of LPG was 131%, then the workload of project VTV 03 for the period 1 operations 1 is as follows.

$$BKijk = TOij\ j\text{-}1\left(\frac{100}{LPG}\right)$$

$$BKijk = 0 \text{ x } 1\text{-}1\left(\frac{100}{131}\right)$$

$$= 0$$

Later in the same manner respectively project workload types VTV 03 in the period 1 to the operation of the 2nd = 0 hours, operating 3rd = 0 hours because the process is no pengeraan. Then, the operation of all 4 = 191 hours, operating all 5 = 21 hours and operation of all 6 = 159 hours ,. In the same way do the calculation of load conversion for the type of project VTV 04, BZC BZC 03 and 04 in period 1. The conversion result expense in the period 1 can be seen in Table 4:18. Before conversion expense in the period 2, first seen in the period sequencing results 1. From the sequencing results for the period 03 3 Project VTV operations 1 through 6 operation has been completed (*), whereas 04 projects operating VTV 1 to 6 have not been completed , resulting in a change in the workload for the operation of 1 to 6.

Table 2.8. load conversion period of 3

type Project	Operation No. 1 PL	Operation No. 2 BJN	Operation No. 3 BJ	Operation No. 4 BN	Operation No. 5 BY	Operation No. 6 K2	Project Status (Release / No release)
	TO (Hours)	TO (Hours)	TO (Hours)	TO (Hours)	TO (Hours)	TO (Hours)	
VTV 03	0	0	0	85	5	24	R
VTV 04	40.8	25	115.8	1,253.3	0	590	X
BZC 02	0	0	0	370	45	2,015.8	X
BZC 04	73.3	188.3	46.7	0	268.3	92.5	X

Table 2.9. load conversion period of 4

type Project	Operation No. 1 OT	Operation No. 2 BJN	Operation No. 3 BJ	Operation No. 4 BN	Operation No. 5 BY	Operation No. 6 K2	Project Status (Release / No release)
	TO (Hours)	TO (Hours)	TO (Hours)	TO (Hours)	TO (Hours)	TO (Hours)	
VTV 03	*	*	*	*	*	*	R
VTV 04	18	15	88	957	-	344	X
BZC 02	0	0	0	370	45	2,015.8	X
BZC 04	73.3	188.3	46.7	0	268.3	92.5	X

2.2.5 *Loading*

This loading process is based on the conversion of the load. The loading process is done to determine the project that will be released over a period based on the load limit of every type of process against the dies.

From Table 2.8. it can be seen that in the period of 3 Project type VTV 03 is charged to the OT (operation 1) to process BJ(Work machining at a specific tilt angle on the dies) at 0 hours because it has no progress in the process, while the operations of the four charged 85 hours, the operation of all five charged 5 hours, the operation of all six charged 24 hours. Because all job types VTV 03 Project is under the load limit on the period of 3, then Project type VTV 03 can be released and marked R. Likewise with Project-type job VTV 04, 02 da BZC BZC 04 had crossed the line load, so it can notreleased and marked X, and will wait for their turn to be released in the next period. For loading the fourth period, the first visible results of the sequencing of the third period.

2.2.6 *sequencing*

Sequencing operation aims to determine the order of Project into the process at any period in accordance with the capacity of each process and evaluate the Project that has been done on any kind of process for the planning period. Ordering should be based on the operation schedule data, which will produce the best performance of the due date to avoid delays in the completion of the Project.

The process of sequencing is based on the process of loading in each period. Based on the calculation of the production capacity available, the K2 (the construction of the surface side) is a critical process, since it has the smallest capacity of 0.1 units / day, so that the allocation of the workload in the process of sequencing for all of customizable process, this activity is done to balance the load on each process, thus avoiding bottlenecks.

2.2. 7 Calculation of Received Date

The timing of receipt of order (received date) was obtained after calculating the due date. From the diagram sequencing in the period 1 to period 12. The sequencing can be seen from the due date of each project dies. Due date dies each type of project can be seen in Table 2.10

No. *project*	Column Type	Number (Trunk)	Arrival *order*(SPK)	Start Date done	*Due Date LOMC*	*Due Date*
1	VTV 03	8	01/08/2018	08/02/2018	3 days	14 days
2	VTV 04	9	16/08/2018	08/18/2018	6 days	12 days
3	BZC 02	8	09/01/2018	03/09/2018	4 days	17 days
4	BZC 04	8	09/20/2018	09/21/2018	2 days	9 days

Table 2.10. Due Date Calculation Results Each Order

III. CONCLUSION

1. Based on the CPM method known length of the project as much as 40 240 minutes with critical path activities BN, BY and K2
2. Calculations in LOMC method showed that the calculation is more accurate determination of the date received, considering the capacity available on each different process, a process in a different process and production flow on the production floor. So as to know when the due date of 4 jobs the project, and all the different jobs that projects can be completed in accordance with the provisions of the agreement, which previously has been delayed.

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