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Production capacity planning using RCCP method with CPOF approach: a case study in an automotive Industry

Production capacity planning using RCCP method with CPOF approach: a case study in an automotive Industry

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Abstract: The consumer motorcycle soaring demand cause automotive manufacturing has an obstacle in fulfilling them. The motorcycle manufacturing realizes that the soaring demand has a constraint in terms of production load or meet. The aim of this study was to conduct an RCCP analysis with the CPOF approach in the XYZ Company assembling line. The problem that occurred in the assembling line consists of 3 working groups, namely sub assy, mainline RH, and mainline LH. The solution to the problem in the assembling line is done by the Rough Cut Capacity Planning-RCCP method of Capacity Planning Using Overall Factor Approach-CPOF. Based on the result using the CPOF approach, the production load of each workgroup was calculated as follows: sub assy of 115,690 minutes, mainline RH of 186,000 minutes and mainline LH of 218,701 minutes. This result showed an overload capacity in the assembly line and led to a production loss of 868 units in January, 836 units in February, and 867 units in March. It is possible to solve this underload problem through overtime and work weekends.

1. Introduction

The XYZ is an automotive manufacturing company that produces a motorcycle. In an effort to meet the needs of consumers properly and quickly, the company has an obstacle in terms of meeting a load of production in accordance with existing capacity. The imbalance between the capacity and load was due to many work elements of an operator. The problem of imbalanced production capacity occurred in the assembly line consisted of 3 workgroups, namely sub assy, mainline RH, and mainline. To fulfilling the production load or consumer demand for the capacity by the XYZ Company is very influential on the production schedule and can cause losses in terms of time and production. The problem in this assembling line can be solved by the Rough Cut Capacity Planning (RCCP) method with the Capacity Planning Using Overall Factor Approach (CPOF) approach. RCCP is a plan to determine the capacity to meet the Master Production Schedule. Good support from vendors in supplying automotive parts or components largely determines the assembling. One important in automotive manufacture is the supply of spare parts for customers, where customers must quickly get it [1]. The application of the CPOF approach required the input of the Master Production Schedule (MPS), the total production time, and the proportion of resource use. The Capacity calculation using this method is expected to provide improvement propose to the XYZ Company that the planning production schedule can run well.

Rough Cut Capacity Planning (RCCP) is a plan to determine the capacity to meet the Master Production Schedule (MPS). The RCCP validates the MPS; it is useful to determine specific sources that are expected to become a potential obstacle [2, 3].

Capacity Planning with Overall Factors (CPOF) approach are required three inputs, namely: MPS, the total time to produce a product, and the proportion time source are used. The step CPOF multiplied the total time of each family to the number of MPS to obtain the total time needed for the factory to search MPS. This total time is then divided into the usage time of each source by multiplying the total time by the proportion of resource use [2-4].

The normal time is obtained by multiplying the cycle time and the rating factors. The calculation rating factor is taken if the operator working at an unnatural speed, thus the results of the time calculation should be normalized first. The formula is Wn = Cycle Time x (1 + Rating Factor) [5]. Standard time is the time that needed naturally by a normal worker to complete a task carried out in a good work system. The formula is WS = Normal Time x (1 + Allowance) [5, 6].

2. Research Method

In this study, using *the Rough Cut Capacity Planning* (RCCP) method and *Capacity Planning with Overall Factors* (CPOF) approach purposed to figure out production capacity planning. To achieve the objectives of the research, the steps taken are as follows:

2.1. Data collection

The data required is data on the number of workdays in 3 months (January 20 days, February 19 days and March 19 days), actual working hours (Monday - Thursday is 485 minutes, and Friday is 445 minutes), production process, total production time (53.63 minutes), total demand for three months (January = 3,500 units, February = 3,000 units, and March = 3,200 units) and the production process efficiency set by the company (January = 75%, February = 72% and March = 73%)

2.2. Data Processing

- Calculate normal time: Wn = Wc x (1- Rating Factor) [5]
- Calculate standard time: Ws = Wn x (1 + Allowance) [5, 6]
- Calculate the working hours available [7]:
- Calculating Utilities [8]: (Number of actual requests: total hours worked) x 100%
- Calculate Available Capacity [8]: Available working hours x efficiency x utility

The operating system needs control and integration from the manufacturer, supplier, and logistics partner [9].

2.3. Analysis

The capacity analysis is carried out using the CPOF approach, and proposed capacity building is carried out using the CPOF approach.

3. Result and Analysis

3.1. Calculation of Available Work

*3.1.1. Time***.** Measurement of available work hours was performed to obtain information about the work hour of the operator in the assembly line of PT XYZ. The calculation was done for January, February, and March using the following formula:

Work Hours on Day = Actual Work Hours x Number of Work Day

Calculation example for January:

Work Hour Monday – Thursday=
Actual Work Hours x Number of Work Day = 485 minutes x 16 days = 7,760 minutes
Work Hour on Friday = 445 minutes x 4 days = 1,780 minutes
Total Work Hour = 7,760 + 1,780 = 9,540 minutes

Table 1. Recapitulation of calculation of work hour/month.

Month	Work Hour (minute)
January	9.540
February	9.055
March	9.055

3.2. Calculation of Rough Capacity CPOF Technique
Data input in the CPOF technique is standard time, production quantity per month, and proportion. Calculation steps in CPOF technique as below:

Example task calculation bracket upper in January:
Total capacity requirements = total monthly production x total production time Total capacity requirements = 3.500 units x 53,63 minutes = 187.705 minutes

The proportion of resource use = the operating time of an activity / the total standard time The proportion of resource use = 1,53 minutes / 53,63 minutes = 0,02853

Time required by a task = total capacity needs x proportion of resource use The time required by a task = 187.705 x 0,02853 = 5.355

Table 2. Calculation of rough capacity.

Task	Proportion	Periode			Total Time (minute)
		Jan (minute)	Feb (minute)	Mar (minute)	
Sub Assy					
Bracket Upper	0.02853	5.355	4.590	4.896	14.841
Main Line RH					
Assembling of Swing Arm, Prop Stand	0.03431	6.440	5.520	5.888	17.848
Main Line RH					
Numbering Frame	0.04456	8.365	7.170	7.648	23.183

After the data obtained from the rough capacity calculation, then the analysis is carried out with the CPOF approach to determine the capacity to meet the load or work. As for the analysis of the CPOF approach can be seen in table 3:

Table 3. Analysis of the CPOF approach.

Description	Jan	Feb	Mar	Total
Bracket Upper				
Available time (minute)	9.540	9.055	9.055	27.650
Available capacity (minute)	4.007	3.325	3.569	10.901
Rough Capacity (minute)	5.355	4.590	4.896	14.841
Underload (minute)	-1.348	-1.265	-1.327	-3.940
Loss (multiplied by task)	881	827	867	2.575

Assembling of *Swing Arm, Prop stand*				
Available time (minute)	9.540	9.055	9.055	27.650
Available capacity (minute)	4.865	3.977	4.297	13.139
Rough Capacity (minute)	6.440	5.520	5.888	17.848
Underload (minute)	-1.575	-1.543	-1.591	-4.709
Loss (multiplied by task)	856	839	865	2.559
Numbering Frame				
Available time (minute)	9.540	9.055	9.055	27.650
Available capacity (minute)	6.296	5.150	5.553	16.999
Rough Capacity (minute)	8.365	7.170	7.648	23.183
Underload (minute)	-2.069	-2.020	-2.095	-6.184
Loss (multiplied by task)	866	845	877	2.587

Loss (multiplied by task) was obtained through the calculation of capacity under load (minute) divided by standard time. All tasks listed above represented the workgroup of sub assy, mainline RH and mainline LH that experienced capacity under load, thus improvement is required to meet the production schedule.

3.3. Capacity Improvement Proposal using the CPOF Approach

The existence of capacity underload insists the company balances production load with available capacity. One effort to increase the capacity is to schedule overtime or work weekends. Example: The work hours that cannot meet the company's production load target, thus the company should be doing work weekends on Saturday for 4 (four) weeks, with the actual work hour of 7 hours, or about 420 minutes. So it has 1,680 minute work weekends and added overtime for 2 hours or 120 minutes after actual work hours for 13 days on January, 2 hours or 120 minutes after actual work hours for 16 days on February, and 2 hours or 120 minutes after actual work hours for 15 days on March.

Table 4. Improvement proposal.

Description	Jan	Feb	Mar	Total
Bracket Upper				
Available time (minute)	12.780	12.655	12.535	37.970
Efficiency (%)	0.75	0.72	0.73	-
Utilization (%)	0.56	0.51	0.54	-
Available Capacity (minute)	5.368	4.647	4.941	14.956
Rough Capacity (minute)	5.355	4.590	4.896	14.841
Underload (minute)	+13	+57	+45	+115
Assembling of *Swing Arm, Prop stand*				
Available time (minute)	12.780	12.655	12.535	37.970
Efficiency (%)	0.75	0.72	0.73	-
Utilization (%)	0.68	0,61	0,65	-
Available Capacity (minute)	6.518	5.558	5.948	18.024
Rough Capacity (minute)	6.440	5.520	5.888	17.848
Underload (minute)	+78	+38	+60	+176
Numbering Frame				
Available time (minute)	12.780	12.655	12.535	37.970
Efficiency (%)	0.75	0.72	0.73	-
Utilization (%)	0.88	0.79	0.84	-
Available Capacity (minute)	8.435	7.198	7.686	23.319
Rough Capacity (minute)	8.365	7.170	7.648	23.183
Underload (minute)	+70	+28	+38	+136

4. Conclusion

Based on the result of data analysis performed, the conclusion drawn is as follows:

1. Results of analysis using the CRP method CPOF approach for a workgroup of sub assy, mainline RH, and mainline LH showed that all tasks conducted by the three workgroups in the assembly line had available production capacity that was lower than the production load. This problem led to a lack of quantity produced in January, February, and March of 868 units, 863 units, and 867 units, respectively.
2. Improvement proposed to balance the capacity and load is to schedule overtime and work weekends. In January, there should be work weekends on Saturday for four weeks with previous actual work time from 420 minutes to 1,680 minutes and overtime of 2 hours for 13 days. In February, there should be work weekends on Saturday for four weeks with previous actual work time from 420 minutes to 1.680 minutes and overtime of 2 hours for 16 days. In March, there should be work weekends on Saturday for four weeks with a previous actual work time of 420 minutes to 1.680 minutes and overtime of 2 hours for 15 days.

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