Production Capacity Requirements Planning Using The Capacity Method Requirement Planning

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Abstract

PT. ABC is a company engaged in the manufacture of Dolomite Fertilizer. The number of requests is greater than the amount of production. Due to fluctuations in the number of requests that tend to increase, this occurs due to a lack of capacity at the workstation. Therefore, it is necessary to calculate the capacity requirements planning analysis for each work station to know the company's capacity needs. The research aims to identify the shortage/excess production capacity and provide proposals for the balance of production capacity at PT. A B C. Production capacity research was conducted using the Capacity Requirement Planning (CRP) method. Results and Discussion, comparison of available capacity and required capacity (load) are as follows, work station jaw crusher available capacity 36.74 hours/week while required capacity (load) 36 hours/week, work station bucket elevator available capacity 36, 74 hours/week while the required capacity (load) is 14.4 hours/week, work station ball mill available capacity is 36.74 hours/week while the required capacity (load) is 45.6 hours/week, and work station silo flour the available capacity is 36.74 hours/week while the required capacity (load) is 51.59 hours/week. In conclusion, two stations experience excess capacity, namely the jaw crusher work station with an excess capacity of 0.74 hours/week and the bucket elevator work station with an excess capacity of 22.34 hours/week. The other two work stations experienced a lack of capacity, namely the ball mill work station with a capacity shortage of 22.34 hours/week and the silo flour work station with a capacity shortage of 14.85 hours/week. Efforts to balance capacity by scheduling overtime and adding equipment (machinery) to work centers that lack capacity, so that the company's production targets are achieved.

Keywords: *Capacity, Capacity Requirement Planning, Industry, Production, Workstation.*

1. Introduction

PT. ABC is one of several companies engaged in the fertilizer and dolomite mining industry which was established on August 16, 2016. PT. ABC is a newly established dolomite stone processing factory with a land area of ±1.39 Ha but already has a fairly rapid development. The demand from consumers in 2019 was 8,359.45 tons while the total production was only 4,175.5 tons. Based on the results of the interview, it is suspected that there is a lack of capacity at the work center. Therefore, it is necessary to calculate the capacity requirements planning analysis for each work center so that the company's capacity needs can be known. Production planning is an activity related to everything regarding production, both in terms of sources of raw materials and capacity [1] [2].

According to [3] with the title "Planning for production capacity requirements at SP Aluminum", it is a manufacturing company that specifically produces kitchen utensils, such as pans, pans, etc. The strategy to fulfill demand is carried out with a make to stock production strategy. The main raw material used to manufacture these products is aluminum. Marketing of aluminum products is carried out through various distributors in various regions by supplying pans ordered by distributors according to the distributor's estimate of the demand for frying pans in their respective regions [4]. The purpose of the research is that the company can plan production capacity requirements in accordance with the available production capacity on the production floor so that they are able to distribute frying pans to distributors in the right amount. The shortage of production capacity that occurs can be taken as the best policy to overcome the shortage of capacity. The results of the study showed that there was a lack of capacity at work stations for printing super pans of size 15 and 16, grinding, lathe, and polishing. The lack of capacity that occurs is resolved first by adding three hours of time. Then, the lack of capacity that still occurred at the Lathe work station in the eighth and thirty-first periods of 68.43 minutes and 943.44 minutes was resolved by subcontracting it to company partners [5] [6].

According to [7] with the title "Engineering the production capacity of warm clothing (sweater) style 120512 and style 193948 at PT. Aulia Pratama with the capacity requirement planning (CRP) method, is a company engaged in the manufacture of warm clothing. The company, which is located in Cimanggis, Depok, tries to provide the best   service by meeting customer demands. Given a large number of customer orders, the company makes an effort to satisfy customers, namely fulfilling customer orders on time so that customers do not switch to other similar companies [8]. carried out is planning for optimal capacity requirements (Capacity Requirement Planning) to fulfill   customer orders. The main purpose of planning capacity requirements (Capacity Requirement Planning) is to compare the load determined through customer orders with the capacity of each work center in a certain period. n The production capacity of sweater style 120512 and 193948 for each work center in August is as follows, work center 1 : 189,763,712 minutes/month, work center 2 : 16,579,648 minutes/month, work center 3 : 129,316,704 minutes /month, and work center 4: 33,349,696 minutes/month. Meanwhile, the available capacity in each work center is work center 1: 115,200 minutes/month, work center 2: 34,560 minutes/month, work center 3: 161,280 minutes/month, and work center 4: 69,120 minutes/month. Based on the comparison results of each work center above, it is known that there is a capacity imbalance where work center 1 lacks a capacity of 74,563.712 minutes/month, work center 2 has an excess capacity of 17,980,352 minutes/month, work center 3 has excess capacity of 31,963,296 minutes/month. month, work center 4 has an excess capacity of 35,770,304 minutes/month. Therefore it is necessary to make efforts to balance/approach the capacity balance. With a capacity comparison analysis, it is determined efforts to balance/approach the capacity balance by adding operators from work centers that are overloaded, adding extra shifts, and adding workers to work centers that lack capacity [9] [10].

The problems in the research are how to plan production capacity, how to calculate the shortage/excess production capacity at each work station, and how to make suggestions in balancing production capacity needs, The limitation of the problem in the research is the demand data used from 2017 to 2019, the calculation of costs is not carried out [11].

2. Literature Review

2.1. Capacity

Write According to [12] Capacity is the level of the optimum production capability of a facility usually expressed as the amount of output in a certain period. Capacity is also referred to as a measure of the productive capability of a facility per unit of operating time [13]. Operations managers pay attention to capacity because they want to have   sufficient capacity to meet consumer demand, capacity affects operating cost efficiency, and capacity is very useful for knowing output planning, capacity maintenance costs, and is very decisive in the analysis of investment needs [14].

Capacity is distinguished between three different levels, including. [15] :
1. Potential capacity is the distinguishable capacity within the decision horizon of senior executives.
2. Immediate capacity is the capacity that can be provided in the current budget period.
3. Effective capacity is the capacity used in the current budget period.

2.2. Forecasting

Forecasting is an important tool in effective and efficient planning, especially in the economic field. Forecasting is a method for estimating a future value using past data [16]. Forecasting is a data science task that is central to many activities within an organization. For instance, organizations across all sectors of industry must engage in capacity planning to efficiently allocate scarce resources and goal setting to measure performance relative to a baseline. Producing high-quality forecasts is not an easy problem for either machines or most analysts [17]. Effective capacity is the capacity used in the current budget period [18].

2.2. Master Production Schedule

Master Production Schedule is a statement about the final product, from the manufacturing industry that produces output in terms of quantity and time period. The Master Production Schedule deals with statements about production and not statements about the market demand. The Master Production Schedule is the final statement of how much-finished product should be produced and when it should be produced. Through the Master Production Schedule, a communication link is formed between the marketing department and the manufacturing department [19].

2.3. Material Requirement Planning (MRP)

Material Requirement Planning (MRP) is a typical plan in a manufacturing company, especially regarding scheduling the flow of goods to and through the process of making finished goods. The MRP technique is used for planning control of items that depend on items with higher levels. A master production program should be periodically adjusted according to demand, and as a consequence, a phenomenon known as nervousness generates instability in the production schedule. Nervousness is defined as a character in a Master Resource Planning (MRP) system when minor changes in higher-level records or the master production schedule cause significant timing or quantity changes in lower-level schedules and orders [20] [21].

MRP system must complete the following three main functions: parts demand calculation, inventory calculation, and purchase calculation. By using product structure (of the raw material list, product material list) and the scheduled completion date of each component combination, the MRP system could complete these three functions after getting the amount of product demand. To accomplish these three functions, the input items of MRP systems are product structure, inventory status, lot sizing rule, and master production schedule. Moreover, the output items are the number of components that should be ordered, the capacity demands, and the manufacturing demands [21].

2.4. Rough Cut Capacity Planning (RCCP)

Rough Cut Capacity Planning (RCCP) is a process of analyzing and evaluating the capacity of the production facilities available on the factory floor to match or support the master production schedule that will be prepared. Rought-cut Capacity Planning (RCCP) is then made to analyze the capability of the factory capacity at critical points of the production process based on the MPS that have been made. RCCP focuses on special operations such as final assembly, painting is possible. The RCCP will determine the feasibility of the MPS made, where the RCCP will convert the MPS into capacity requirements for key resources with existing capacity limitations [4] [22].

2.5. Capacity Requirement Planning (CRP)

According to Gaspersz, (2004) Capacity Requirement Planning (CRP) is a method that can be used to plan production capacity requirements, which is a function to determine, measure, and adjust the level of capacity or process to determine the amount of manpower and machine resources required for carrying out production. The CRP verifies the availability of sufficient capacity over the planning span. From these problems, research is carried out with a method that can be used to plan production time capacity requirements, namely CRP, so that the production process in a company can run well [23] [13].

Basically, there are several steps needed to carry out a CRP analysis, namely:
1. Obtain information about production orders issued (planned order release) from MRP.
2. Obtain information about standard run-time per unit and standard setup time per lot size.
3. Calculate the required capacity of each work center.
4. Create CRP reports.

3. Methods

3.1. Object of researc

The object of research is Work Station Jaw Crusher, Work Station Bucket Elevator, Work Station Ball Mill, and Work Station Silo Flour at PT. ABC [24].

3.2. Procedure

1. Forecasting the amount of fertilizer demand
   The results of forecasting the number of requests will be used to calculate the production plan. Forecasting methods used are cyclical and decomposition.
2. Calculation of standard time
   Considering the rating factor and allowance, time measurement is done using the stopwatch time study method.
3. Planning for capacity requirements
   Step by step :
   a. Determine the master production schedule from the forecasting results by disaggregating it using MPS.
   b. Perform RCCP calculations
   c. Develop material requirements planning from MPS using MRP.
   d. Analyze production capacity based on MRP planning using CRP.

4. Results and Discussion

4.1. Forecasting

Forecasting is done to find out the estimated demand for the next 12 periods, namely for the period January to December 2020 using demand data from the previous 36 periods starting from January 2017 to December 2019. Based on the demand data pattern, the forecasting method used is the decomposition and regression method with cyclical tendencies. After testing the error rate using the MSE (Mean square error) method of the two forecasting methods, it was found that the chosen forecasting method was the decomposition method. The results of forecasting dolomite fertilizer products using the decomposition method can be seen in table 1.

Table 1. Forecasting Results

No.	Periods	A	B	Equation of Line (Y)	Season Index	Forecast value (YX)
1	1	883,089	-7194	616,91	0,995	871.516
2	2	883,089	-7194	609,72	1,016	882.600
3	3	883,089	-7194	602,52	0,977	841.692
4	4	883,089	-7194	595,33	1,015	867.128
5	5	883,089	-7194	588,14	1,002	848.813
6	6	883,089	-7194	588,14	0,949	797.089
7	7	883,089	-7194	573,75	0,996	829.400
8	8	883,089	-7194	566,53	1,028	848.652
9	9	883,089	-7194	559,36	0,971	794.611
10	10	883,089	-7194	552,17	1,005	815.205
11	11	883,089	-7194	544,97	1,004	807.171
12	12	883,089	-7194	573,78	0,961	765.687
				Sum		9.969.564

Table 1 shows that the forecasting methods used are decomposition and regression methods with cyclical tendencies. After testing the error rate using the MSE (Mean square error) method of the two forecasting methods, the estimated value of 9,969.564.

4.2. Master Production Schedule

The master production schedule is made using one-year data starting from January to December, which is shown in Table 2 .

Table 2. 2020 Master Production Schedule

Time Periods	Jan	Feb	March	April	May	June	July	Augt	Sept	Oct	Nov	Dec
Sales Plan	871,52	882,60	841,69	867,13	848,81	797,09	829,40	848,65	794,61	871,52	882,60	841,69
Actual Order	923,12	634,79	900	567,91	843,52	700	986,29	929,09	702,73	0	0	0
PAB	-51,61	196,21	137,89	137,89	137,89	137,89	-18,99	-99,44	-99,44	-99,44	-99,44	-99,44

ATP	583,18	1174,82	509,61	1142,73	705,29	1083,38	772,21	622,28	91,884	871,52	882,60	841,69
Cumulative ATP	583,18	1730,99	2240,59	3383,33	4088,63	5172,01	5944,21	6566,84	6658,38	7529,84	8421,49	9254,186
MPS	571,52	882,60	841,69	867,13	848,82	797,09	829,40	848,66	794,52	871,52	882,60	841,69

Table 1 shows that there were no orders from October to December. Orders are also erratic every month, sometimes high orders, and sometimes down.

4.3. Material Requirement Planning (MRP)
The Master Production Schedule that has been verified by the RCCP is then forwarded to material requirements planning or MRP. MRP is structured so that companies can plan their production material requirements well so that materials can be obtained on time and come in the right quantity.

The MRP is prepared for a period of one year, namely January – December 2020 with a weekly period, and it is assumed that 1 month consists of 4 weeks. The preparation of the dolomite fertilizer production plan for January 2020 after it was calculated that it was 217,879 ton.

MRP assumes that what is scheduled can be implemented, regardless of capacity limitations. Based on the capacity requirements that have been obtained previously, then verification is carried out to check the availability of capacity to run production according to the work order issued by the MRP. after the calculation is carried out to determine the right time to plan the order to meet the level of net need for the ordering period based on lead time (grace time). The lead time for ordering raw materials in 1 week is 746,522 tons.

4.4. Rough Cut Capacity Planning (RCCP)
The CRP report on Capacity Needs can be seen at work station I, namely the time available in each period of 46 hours, utility rate 0.85 in actual conditions, efficiency level 0.95 in actual conditions, available capacity 36.74 hours, actual needs 36 Hours, thus getting an excess capacity calculation of 0.74 Hours. at work station II the available time in each period is 46 hours, the utility rate is 0.85 in actual conditions, the efficiency level is 0.95 in actual conditions, the available capacity is 36.74 hours, the actual need is 14.4 hours so that we get the calculation excess capacity of 22.34 Hours and so on.

4.5. Efforts to balance production capacity at PT. ABC
After the above efforts have been made to balance/close to the capacity balance or not, a comparison of the available capacity with the required capacity (load) is carried out. Here is the comparison:
1. Work station Jaw Crusher
   The available capacity at work station jaw crusher is 36.74 hours/week while the required capacity (load) is 36 hours/week. So that the comparison of available capacity and required capacity (load) can be analyzed, namely there is an excess capacity of 0.74 hours/week. The excess capacity that occurs is considered reasonable because it is close to the capacity balance. On the other hand, if the capacity is increased, there will be excess capacity.
2. Work station Bucket Elevator
   The available capacity at workstation bucket elevator is 36.74 hours/week while the required capacity (load) is 14.4 hours/week. So that the comparison of the available capacity and the required capacity (load) can be analyzed, namely there is an excess capacity of 22.34 hours/week. The excess capacity that occurs is considered reasonable because it is close to the capacity balance. On the other hand, if the capacity is increased, there will be excess capacity.
3. Work station Ball Mill
   The available capacity at work station 3 is 36.74 hours/week while the required capacity (load) is 45.6 hours/week. So that the comparison of available capacity and required capacity (load) can be analyzed, namely there is a capacity shortage of 8.86 hours/week. Lack of capacity is met by scheduling overtime and adding equipment (machinery).
4. Work station Silo Flour
   The available capacity at work station 4 is 36.74 hours/week while the required capacity (load) is 51.59 hours/week. So that the comparison of available capacity and required capacity (load) can be analyzed, namely there is a capacity shortage of 14.85 hours/week. Shortage of capacity is met by scheduling overtime and adding equipment.

5. Conclusion

In the company's production capacity, two work stations have excess capacity and two work stations have insufficient capacity. Work stations that have excess capacity are at station 1 and station 2, namely, at station 1 the excess capacity is 0.74 hours/week, work station 2 has an excess capacity of 22.34 hours/week. Meanwhile for station 3 and work station 4 there is a capacity shortage, namely at work station 3 there is a capacity shortage of 22.34 hours/week, and work station 4 there is a shortage of capacity of 14.85 hours/week. Efforts to balance capacity by scheduling overtime and adding equipment (machinery) to work centers that lack capacity, so that the company's production targets are achieved.

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