IOP RCCP

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Implementation of The Rought Cut Capacity Planning (RCCP) Methods for The Planning of Bottled Drinking Water Production Capacity: A study case

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Abstract. Syifa Ltd is a manufacturing company that produces bottled drinking water with several types of products produced from their production floor. The main objective of this research was to predict the total quantity production of the 220 ml bottled mineral water to meet the consumer demand as scheduled time. In forecasting the demand for production of the 220 ml glass bottle packaging, the methods used were the Weighted Moving Average (WMA) method and the Single Exponential Smoothing (SES) method by comparing the size of forecasting errors using Mean Absolute Deviation (MAD), Mean Square Error (MSE), and Mean Absolute Percentage Error (MAPE). To determine the supply of glass bottles used the EOQ (Economy Order Quantity) method to determine the purchase of the most economical glass bottles. The Rought Cut Capacity Planning (RCCP) analysis result shows that there was insufficient capacity/lack of capacity in the filling and packing work center. Alternative capacity management used to optimize production utility to 95% and make capacity adjustments (re-adjustment). So that alternative capacity management was able to meet the capacity shortages that occur

1. Introduction

The development of the Industrial Revolution that continues and seems to be endless, requires every company to continue to improve and requires companies to respond carefully to the changes that occur [1]. The main problem faced by companies today is how the company be able to create the best strategy so that the company can survive and continue to grow and minimize the risk of this uncertainty, and can be fulfilled the best forecasting method to determine how much demand for an item in the future [2]. Knowledge of future needs will greatly support the planning process on the production floor.

In production planning, as in Gyulai et al. [3], the forecast results in the form of production plans for future needs sometimes not in line with the available capacity on the production floor. The demand for fluctuating products results in the available capacity sometimes being able to produce more than the results of forecasting needs and or even lacking for each period. Therefore capacity planning needs to be done at first, so that the demand was in line with an available capacity [4].

Syifa Ltd. is a company that has several types of products produced at its production floor, including the 220 ml glass packaging, the 600 ml bottle packaging, and 19-liter gallon packaging. However, in general, the production process takes place intuitively, where the company cannot anticipate the occurrence of low or high needs of existing demand. The research objectives expected from this study was to forecast the future demand and determining the best outcome forecast as a production plan, as well as validating the production plan using.

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2. Research method

The data were observed and processed according to Gyulai et al. [3] and [5] sequence:

1. Determination of the data using demand and actual data. As mention by Najy [6], the time series analysis is very appropriate to be used to predict demand whose demand patterns in the past are quite consistent over a long period [7][3].
2. Quantitative forecasting methods can be defined in a number of ways [8]:
   a. Single Moving Average (SMA)

$$F_t = \frac{A_{t-1} + A_{t-2} + \cdots + A_{t-n}}{n}$$

   b. Weighted Moving Weight (WMW)

$$F_t = \frac{(w1A_{t-1}) + (w2A_{t-2}) + \cdots + (wnA_{t-n})}{w1 + w2 + \cdots + wn}$$

   c. Single Exponential Smoothing (SES)

F_t = F_ (t-1) + α (A_ (t-1) -F_ (t-1))

3. Measuring Forecasting Accuracy. In determining forecasting accuracy, there are some commonly used calculations:
   a. Mean Absolute Deviation (MAD), The MAD value can be calculated using the following formula.

$$MAD = \frac{\sum|A_t - F_t|}{n}$$

   b. Mean Square Error (MSE), is another method for evaluating forecasting methods. This method produces moderate errors which are probably better for small mistakes, but sometimes make a big difference.

$$MSE = \frac{\sum(A_t - F_t)^2}{n}$$

   c. Mean Absolute Percentage Error (MAPE), indicates how much error in predicting compared to the real value.

$$MAPE = \frac{\sum(\left(\frac{|A_t - F_t|}{A_t}\right)}{n} x100$$

4. Determining the efficiency and utility factors on the production floor, and determine the standard time used in the production process
5. Validateingforecast results with Rough Cut Capacity Planning (RCCP) calculations
6. Determining the Master Production Schedule (MPS).

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3. Result

The selection of forecasting methods is based on the data patterns that are formed in scatter diagrams as presented in Figure 1. The data patterns formed are random data patterns or random data patterns, this happens because of irregular fluctuating requests. Historical conditions of actual demand that exist allow the most appropriate forecasting method is the method of forecasting the WMA and the SES method.

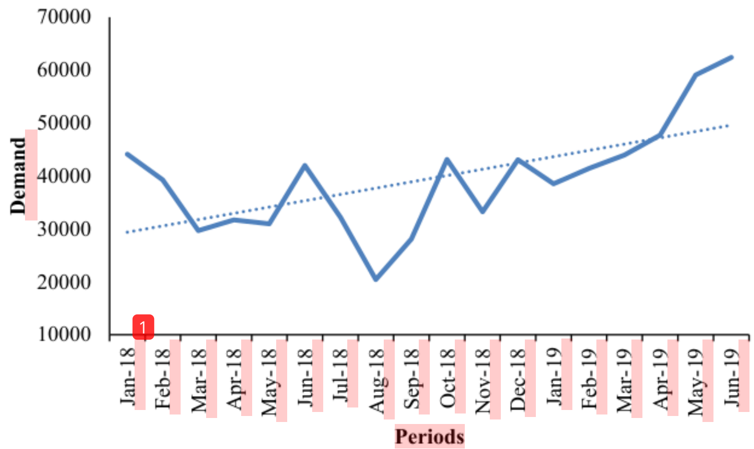

Figure 1. Scatter diagram of demand historical data

The next step is to perform forecasting needs using forecasting methods by referring to the data patterns that are formed. Forecasting using the weighted moving average method is carried out using weighting value. The choice of weights value is intuitive because there is no formula that sets them. Calculation of weighted moving average forecasting is done with an average of three and five months. Forecasting using the weighted moving average method is done using a smoothing constant (α), where the value of α is a value with a range of $0<\alpha<1$. The determination of constants is intuitive because there is no formula that sets them. Single exponential smoothing forecasting calculations are done using three constants: 0.3; 0.5; and 0.9. The comparison of MAD, MSE, and MAPE for each forecasting method is presented in Table 1.

Table 1. Comparison of MAD, MSE and MAPE

METHOD	MAD	MSE	MAPE (%)
WMA 3	5.393.92	57,560,046.59	0.759
WMA 5	5,405.87	60,327,815.32	0.761
SES 0,3	7,478.69	80,738,201.74	1.052
SES 0,5	6,467.63	66,301,854.65	0.910
SES 0,9	6,521.47	62,213,669.42	0.918

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The efficiency factor is a condition of how far the work station can use the available capacity efficiently. At the filling work center, the actual average production output was 37.5 cartons per hour, and production output 72 per hour. The utility factor is a measure of the ability of a work station to utilize available capacity effectively. That is the percentage ratio of actual processing time and effective processing time. At filling the work center, the average available work hours are 15 hours of work per day, and only an average of 10 hours per day is used as the actual work hours. The utility and efficiency factors for each work center are presented in Table 2.

Table 2. Utility and efficiency factor

Work Centre	Efficiency (%)	Utility (%)
Filling	52.1	66.7
Packing	72.5	66.7
Display	75.0	66.7
Average	66.5	66.7

Based on the data uniformity test and the calculation of standard time that has been done, it can be seen the standard time needed at each work center to produce one carton of the 225 ml is as shown in Table 3. The Rough Cut Capacity Planning (RCCP) is shown in Table 4.

Table 3. Processing time of each work center

No	Work Centre	Processing Time	
		Second	Hour
1	Filling	50	0.0139
2	Packing	89	0.0247
3	Display	21	0.0058
	Total	160	0.0444

Table 4. Rough Cut Capacity Planning

No	Period (2019-2020)	Forecasting	Rough Cut Capacity Planning
1	October	26,606	31,988
2	November	34,072	40,059
3	December	35,163	36,854
4	January	40,107	40,059
5	February	38,814	40,059
6	March	40,881	41,661
7	April	42,107	41,661
8	May	45,305	41,661
9	June	52,609	41,661
	Total	355,664	355,664

4. Conclusion

The production plan is validated using the RCCP approach by means of CPOF method and the BOLA method. The validation carried out to determine whether the capacity available is able to meet the required capacity. Capacity management by optimizing production utilities was able to meet capacity shortages in the filling work center periods on the period of October 2019, November 2019, December 2019, February 2020, and March 2020 as well as meeting all capacity shortages in overall work center packing. Meanwhile, the remaining capacity deficiencies can be fulfilled with the re-adjustment approach MPS made from the production plan RP which is the result of the forecast. Furthermore, it was validated with the RCCP approach to finding out capacity shortages. Capacity shortages were met by optimizing production utilities and making adjustments (re-adjustments) so that a master production schedule is feasible to run.

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