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PRODUCTION CAPACITY PLANNING BASED ON SALES FORECAST USING CUT AND TRY METHOD

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ABSTRAK

Perusahaan yang berbasis FMCG (Fast Moving Consumer Goods) perlu menaikan produktivitas dan melakukan efisiensi agar tetap bisa bertahan mengimbangi harga bahan baku pangan yang terus mengalami kenaikan sebagai akibat kondisi geopolitik keamanan dunia serta kondisi iklim yang mengalami perubahan drastis. Salah satu yang terdampak adalah PT. DUS yang memproduksi bahan dasar makanan cepat saji. Tujuan penelitian ini adalah mengetahui opsi perencanaan produksi yang paling effisien agar mampu mengurangi beban biaya perusahaan. Metode yang digunakan dalam penelitian ini adalah Metode Exponential Smoothing, Metode Linear Programming dan Metode Mean Absolute Percent Error (MAPE) untuk melakukan Forecasting; Metode Economic Quantity Order termasuk didalamnya penentuan Safety Stock dan Re-Order Point untuk menentukan besaran Inventory; serta Metode Agregat Planning Cut and Try untuk menentukan kapasitas produksi dengan biaya minimum. Hasil penelitian menunjukan rencana produksi dengan opsi rencana tenaga kerja konstan, persediaan konstan dan lembur menghasilkan biaya sebesar Rp. 549.840.000,00 sedangkan opsi rencana tenaga kerja konstan, variasi persediaan dan habisnya persediaan menghasilkan biaya sebesar Rp. 1.548.350.000,00

Kata Kunci: *Exponential Smoothing, Linear Programming, EOQ, Safety Stock, Re-Order Point, Agregat Planning, Cut and Try.*

ABSTRACT

Companies based on FMCG (Fast Moving Consumer Goods) need to increase productivity and improve efficiency in order to stay afloat to keep pace with the increasing prices of food raw materials as a result of global security geopolitical conditions and drastic changes in climatic conditions. One of the affected is PT. DUS produces the basic ingredients of fast food. The purpose of this study was to determine the most efficient production planning option in order to reduce the company's costs. The methods used in this research are Exponential Smoothing Method, Linear Programming Method, and Mean Absolute Percent Error (MAPE) Method for Forecasting; The Economic Quantity Order method includes the determination of Safety Stock and Re-Order Point to determine the amount of Inventory, and the Aggregate Planning Cut and Try Method to determine production capacity with minimum costs. The results showed that the production plan with options for constant labor plans, constant inventory, and overtime resulted in a cost of Rp. 549,840,000.00 while the constant labor plan options, variations in inventory, and running out of inventory result in a cost of Rp. 1,548,350,000.00

Keywords: Exponential Smoothing, Linear Programming, EOQ, Safety Stock, Reorder Point, Aggregate Planning, Cut and Try.

INTRODUCTION

Geopolitical stability and world security are currently uncertain due to wars between countries and climate conditions that are experiencing drastic changes. This has had an effect on the world economy which has

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experienced a setback. One of the impacts is the world's food prices, which continue to rise. FMCG (Fast Moving Consumer Goods) based companies need to increase productivity and efficiency in order to keep up with the rising prices of food raw materials.

Planning and controlling the flow of materials into, within, and out of the factory so that the profit position becomes optimal is the company's goal that must be achieved (Kusuma, 2009). In order to carry out production planning and control, forecasting data taken from the company's marketing department is required. The data is used by production and operations personnel to make periodic decisions that include supplier selection, process selection, capacity planning, and facility layout as well as for ongoing decisions regarding purchasing, production planning, scheduling, and inventory (Heizer & Render, 2019).

Cut and Try is a calculation made in advance of various production planning costs and choosing the best alternative (Jacobs & Chase, 2015).

METHOD

This research was conducted at PT DUS using the Cut and Try method to be able to determine the production capacity planning option at the lowest cost with a focus on line 1 machines which have 6 (six) types of products with a certain quantity according to data taken from the marketing division for the period 2019 - 2021.

The stages of this research consist of several stages, including:

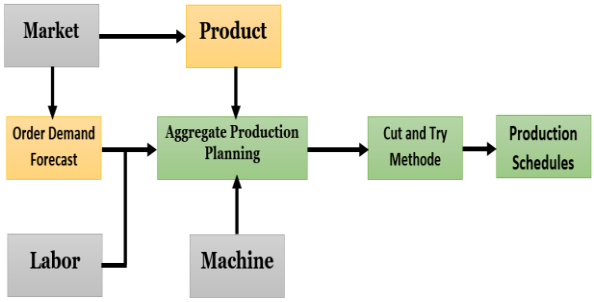

Figure 1. Research Framework

a. Market

The market provides input in the form of product data to be produced and information related to sales history that will be used in the forecasting process.

b. Labor

Labor becomes an entity in the calculation of time allocation that will be used in conjunction with production machinery.

c. Machine

Machines contribute to the process of converting raw materials into production that is ready to be distributed to the market.

d. Aggregate Production Planning

Aggregate production planning is obtained from the results of processing forecasting data, labor, and machinery into the number of production targets within a year.

e. Production Schedule

The production schedule is the final result of processing using the cut-and-try method with the minimum cost.

RESULTS AND DISCUSSION

Forecasting

The forecasting process takes marketing data for 3 (three) years starting in 2019-2021.

Table 1. Sales Data of PT DUs for the period 2019-2021

(in thousand pcs)

Years	Quarters	Product					
		A	B	C	D	E	F
2019	1	28.500	22.300	24.000	21.700	21.300	20.100
	2	33.200	19.600	26.300	22.600	21.600	20.700
	3	33.500	18.500	27.300	22.300	21.700	19.300
	4	26.800	16.300	22.000	17.900	16.800	16.200
2020	1	37.200	24.400	25.900	24.000	24.500	20.200
	2	42.100	23.100	33.100	27.400	28.100	23.400
	3	39.700	18.000	30.200	23.000	25.700	18.200
	4	43.800	23.000	27.500	22.300	25.500	17.000
2021	1	53.000	30.000	33.500	29.000	20.500	35.500
	2	43.500	18.500	32.000	25.800	14.900	26.100
	3	50.500	21.000	36.900	29.500	15.500	28.700
	4	43.000	22.900	26.300	21.600	15.000	26.500
Maximum Warehouse Capacity		5.000	3.000	4.000	4.000	3.000	4.000
Storage Costs / pcs		Rp 15	Rp 9	Rp 12	Rp 12	Rp 9	Rp 12
Order Costs /pcs		Rp 225	Rp 135	Rp 180	Rp 180	Rp 135	Rp 180
Price /pcs		Rp 600	Rp 640	Rp 800	Rp 700	Rp 550	Rp 520

In table 1, it can be seen the amount of demand in each quarter of the current year along with the maximum storage capacity of the warehouse, storage costs, order costs and Cost of Goods Manufactured for each product. Based on the results of calculations carried out after making forecasting projections using the Exponential Smoothing and Linear Programming methods, it can be seen that the smallest percentage deviation between actual and forecasting is the sales projection using the Linear Programming method as can be seen in table 2.

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Table 2. Comparison of MAPE Forecasting

	Forecasting average		
	LP	**SMA**	**ES**
Product A	**15,61%**	21,57%	26,75%
Product B	**22,50%**	27,79%	26,87%
Product C	**14,47%**	19,57%	17,92%
Product D	**16,19%**	20,80%	16,93%
Product E	**20,11%**	22,14%	27,96%
Product F	**19,57%**	20,18%	20,02%

The average deviation of forecasting results using the Linear Programming method shows that products A, B, C, D, E and F are 15.61%; 22.50%; 14.47%; 16.19%; 20.11% and 19.57% respectively. The next process is to make projections in 2022 which are then indexed in each current month. The forecasting results can be seen in the data table 3.

Table 3. Sales Forecasting Results on 2022

in thousand pcs

	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22
Product A	13.745	15.874	13.718	17.826	23.846	16.539	16.951	19.049	16.802	23.823	22.647	20.281
Product B	6.337	5.752	5.273	6.881	13.107	10.813	9.994	8.637	7.620	7.879	9.532	7.263
Product C	10.242	10.404	10.108	11.805	13.319	9.362	9.578	10.906	10.183	15.198	15.243	14.457
Product D	8.254	7.160	8.009	9.871	11.130	7.167	7.976	8.494	8.163	11.795	12.654	10.559
Product E	6.171	6.154	4.679	7.344	7.830	6.664	6.925	6.655	6.160	6.518	7.095	5.685
Product F	6.793	7.271	6.297	8.818	10.581	10.313	8.788	10.181	9.858	10.632	12.219	10.509

Inventory

The next process after getting the forecast demand in 2022 is to make inventory calculations using the EOQ (Economic Order Quantity) method along with the amount of reorder point value to maintain the optimal level of inventory. The EOQ and ROP calculation process uses the formula below:

$$Q = \sqrt{\frac{2.D.S}{H}} \quad \text{and} \quad R = \bar{d}\, L \qquad (1)$$

Where:
Q: Order quantity
D: Total annual demand
S: Order cost per unit
H: Storing cost per unit
R: Number of re-order points
$\bar{d}$: Average daily demand
L: Daily procurement lead time

By substituting data into the formula above, the results are obtained as shown in Figure 2.

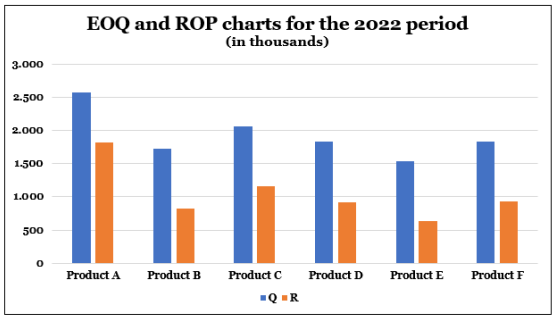

Figure 2. Graph of EOQ and ROP Data in 2022

In the figure, it can be seen that the optimal order quantity (Q) for products A, B, C, D, E and F is 2,575,000 pcs; 1,724,000 pcs; 2,055,000 pcs; 1,827,000 pcs; 1,529,000 pcs and 1,835,000 pcs with a backorder quantity (R) of 1,817,000 pcs; 814,000 pcs; 1,157,000 pcs; 914,000 pcs; 640,000 pcs and 923,000 pcs, respectively.

Production Planner

The production planning process is carried out by engineering the data from forecasting and inventory results using the Cut and Try method using options including:

a. Production plans 1

The assumptions used in this production plan are to simulate a constant amount of labor and variations in inventory and the exhaustion of inventory using the services of a 3rd party (three) to carry out storage due to overproduction.

b. Production plans 2

The assumptions used in this production plan are to simulate a constant number of workers; constant inventory at the minimum point as well as the maximum capacity of the storage warehouse and overtime.

There is a significant difference in terms of costs for the two options. The costs that arise in production plan 1 and production plan 2 are Rp. 1,548,350,000 per year and Rp. 549,840,000 per year, respectively. Based on this value, it can be seen that alternative production plan 2 is the right choice to be implemented because it has a value of 35.51% of the cost of production plan 1 (Figure 3).

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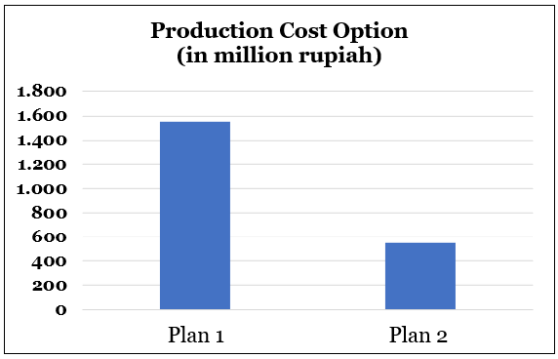

Figure 3. Production Cost Options in 2022

After determining production plan 2 as the basis for determining the production schedule to be implemented by the company, detailed plotting can be done as can be seen in Figure 4.

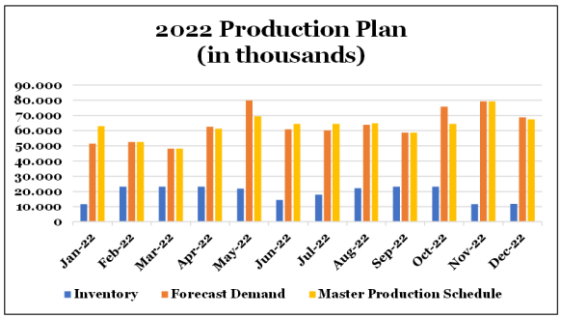

Figure 4. Production Plan in 2022

In the figure, it can be seen that the amount of Inventory, Forecast Demand and Master Production Schedule respectively in January 2022 is 11,545,000 pcs, 51,541,000 pcs and 62,996,000 pcs; February 2022 is 23. 000,000 pcs, 52,614,352 pcs, 52,614,352 pcs; March 2022 by 23,000,000 pcs, 48,084,600 pcs, 48,084,600 pcs; April 2022 by 23,000,000 pcs, 62,546,266 pcs, 61,378,560 pcs; May 2022 by 21,832,294 pcs, 79,812,239 pcs, 69,525. 204 pcs; June 2022 by 14,284,500 pcs, 60,856,144 pcs, 64,447,488 pcs; July 2022 by 17,875,844 pcs, 60,210,972 pcs, 64,447,488 pcs; August 2022 by 22,112,360 pcs, 63,921,310 pcs, 64,808,950 pcs; September 2022 by 23,000. 000 pcs, 58,785,065 pcs, 58,785,065 pcs; October 2022 by 23,000,000 pcs, 75,846,074 pcs, 4,447,488 pcs; November 2022 by 11,601,414 pcs, 79,389,044 pcs, 79,332,888 pcs; December 2022 by 11,816,472 pcs, 68,753,706 pcs, 67,516,416 pcs.

CONCLUSIONS

Based on the results and discussion, it can be seen that PT DUS can make cost efficiency using the Cut and Try method by engineering the production of a constant number of labor; constant inventory at the minimum point and maximum capacity of storage warehouses and overtime at a total cost of Rp. 549,840,000 per year or cheaper than engineering the production of a constant number of workers and inventory variations and the exhaustion of inventory using 3rd party services to carry out storage due to overproduction at a total cost of Rp. 1,548,350,000 per year.

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