Analysis of Inventory Control Planning for P-200 Chip (Semi Dull) Using Material Requirement Planning (MRP) Method at Pt. Indonesia Toray Sinthetic

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Abstract

PT. Indonesia Toray Sinthetic is a textile company. In providing inventory to produce products, it is necessary to have a good inventory control and in accordance with production demand. Inventory control in this company often has problems, one of which is excess stock. Material Requirement Planning (MRP) is a method used to control raw material inventories in a company. A company to implement policies in raw material planning must have the right calculation so that there are no excesses and shortcomings in the supply of raw materials. This study used the forecasting method of Linear Trend Analysis, Constant, Exponential Smoothing and Moving Average. The Material Requirement Planning (MRP) methods used are Lot For Lot (LFL), Economic Order Quantity (EOQ), Fixed Order Quantity (FOQ), and Fixed Period Requirement (FPR). The best forecasting result is the Trend Linear Analysis with the smallest error value and the best results from the Material Requirement Planning (MRP) method used is the Economic Order Quantity (EOQ) with a total save cost of Rp 720,000 and the total order cost of Rp 68,552,500 with a total total cost of IDR 69,272,500. So by using the Material Requirement Planning (MRP) method with the Lot Sizing technique in the Economic Order Quantity (EOQ), the company PT. Indonesia Toray Sinthetic can minimize total inventory costs and be more efficient at Rp 81,887,500. - that is, it can be more than 50%.

Keywords:
Inventory, Forecasting, Material Requirement Planning (MRP), Order Cost, Hoding Cost.

I. Introduction

1.1 Background

The dilemma of a company to determine how much inventory must be provided and when the inventory must be ordered back is a problem that must be solved with good inventory control. Because with good inventory control, the company will know when the inventory will run out and must be ordered again to the supplier, and how much inventory will be ordered related to the company forecasting and customer demand. To solve these problems, especially for raw material requirements planning, a Material Requriements Planning (MRP) system has been developed. MRP is an information system used to calculate the material requirements needed to produce finished goods, Greasley (2008) in Arief (2017). MRP implementation is very helpful in planning raw materials based on planned production quantities.

1.2 Problem Formulation

1.2.1 What is the forecasting method at PT. Indonesia Toray Sinthetic?
1.2.2 What is the P-200 Chip (Semi Dull) raw material control method at PT. Indonesia Toray Sinthetic?

1.3 Research Objectives

1.3.1 Determine the forecasting method of PT. Indonesia Toray Sinthetic.
1.3.2 Determine the method of controlling the supply of raw materials for the P-200 Chip (Semi Dull) at PT. Indonesia Toray Sinthetic.

1.4 Problem Limitation

1.4.1 The object of measurement of raw material inventory control includes the amount of demand data for the production of the P-200 Chip (Semi Dull) from January - December 2017.
1.4.2 The master production schedule obtained from the results of forecasting production demand at PT. Indonesia Toray Sinthetic.
1.4.3 Material planning planning (MRP) in this study was carried out using the lot size method: Lot for lot (LFL), Economic Order Quantity (EOQ), Fix Order Quantity (FOQ), Fix Period Requirement (FPR).
1.4.4 The total costs that will be calculated in this study are ordering costs and storage costs.

II. Literature Review

2.1 Production

According to Gaspersz (2008), production is a field that continues to evolve in harmony with technological developments, where production has a fabric of reciprocal relations (two directions) that are very closely related to technology, where production and technology need each other.

2.2 Forecasting

Forecasting is the process of estimating future demand relating to aspects of quality, quantity, time and location that require the goods or services in question (Haming & Nurnajamuddinn, 2014).

2.2.1 Forcasting Method

1. Trend Analysis Method

In this method, the first thing to do is to calculate the coefficients a and b, to find the value obtained from the time function equation, namely:

$dt = a + bt$ ..... (1)

$t = 1,2,3$ ..... (2)

Value a can be searched using equations:

$$a = \frac{\Sigma t^2 \Sigma dt - \Sigma t dt}{n\Sigma t^2 - (\Sigma t)^2}$$ ..... (3)

While the value of b can be searched by the equation:

$$b = \frac{n\Sigma t dt - \Sigma t \Sigma dt}{n\Sigma t^2 - (\Sigma t)^2}$$ ..... (4)

2. Moving Average Method

The moving average method uses a number of actual data requests that are new to generate forecast values for future demand. The formula for the moving average method is:

$$MA = \frac{\sum_{t-1}^{n} dt}{n}$$ ..... (5)

3. Exponential Smoothing Method

Forecasting using the exponential smoothing model is based on the following formula:

$F_{t+1} = \alpha A_t + (1 - \alpha) F_t$ ..... (6)

a. Forecast Accuracy Test

Mean Absolute Deviation = MAD

Mathematically MAD is formulated as follows:

$$MAD = \Sigma \left| \frac{At - Ft}{n} \right|$$ ..... (7)

b. Mean Square Error = MSE

Mathematically, MSE is formulated as follows:

$$MSE = \Sigma \frac{(At - Ft)^2}{n}$$ ..... (8)

c. Mean Absolute Percentage Error = MAPE

Mathematically, MAPE is stated as follows:

$$\text{MAPE} = \left(\frac{100}{n}\right) \Sigma \left| At - \frac{Ft}{At} \right| \quad (9)$$

d. Moving Range Map

Moving Range is used to test the stability of a system of causes and effects that affect demand. Moving Range can be defined as:

$$\text{MR} = | (\hat{y}_t - y_t) - (\hat{y}_{t-1} y_t - {}_1) | \quad (10)$$

The Moving Range Average is defined as:

$$\overline{MR} = \sum \frac{MR}{n-1} \quad (11)$$

The center line of the Moving Range map is at the zero point. The upper and lower control limits on the Moving Range map are:

$$\text{UCL} = +2{,}66\ \overline{MR} \quad (12)$$

$$LCL = -2{,}66\ \overline{MR} \quad (13)$$

Meanwhile, the variables to be plotted into the map are Moving Range:

$$\Delta y_t = \hat{y}_t - y \quad (14)$$

4. Master Production Schedule

According to Nasution and Prasetyawan (2008), the Master Production Schedule is based on forecasting at the request of an independent from each final product to be made.

5. Inventory

According to Gozali (2013) inventory is idle resources that await further processing. Inventories are items that are stored for use or sale in the future or period.

6. *Material Requirement Planning* (MRP)

According to Astana (2007) that Material Requirement Planning (MRP) is a concept in production management that discusses the right way in planning the needs of goods in the production process, so that the items needed can be available as planned.

a. Lot For Lot (LFL)
According to Nasution and Prasetyawan (2008), lot size determination techniques are carried out on the basis of discrete orders, besides this technique is the simplest method of all existing lot techniques.

b. Fix Order Quantity (FOQ)
According to Nasution and Prasetyawan (2008), the Number of Fixed Orders (FOQ) is very specific for determining inventory items. Determination of the amount of lot can be in accordance with intuition through empirical factors or according to user experience.

c. Economic Order Quantity (EOQ)
The Economic Order Quantity is the amount of raw material purchases that can provide a minimum inventory cost (Wahyudi, 2015).

d. Fixed Period Requirement (FPR)
According to Nasution and Prasetyawan (2008), lot size determination techniques with Fixed Period Needs (FPR) make orders based on a certain period of time.

III. Results and Discussion

3.1 Demand Data

The demand data for P-200 Chip raw material taken is data for the past year from the period January 2017 - December 2017 as follows:

Tabel 3.1 Consumer Demand Data During 2017

Month	Demand	Unit
January	2000	Kg
February	3000	Kg
March	3400	Kg
April	2000	Kg
May	2100	Kg
June	3000	Kg
July	2500	Kg
August	3700	Kg
September	1900	Kg
Oktober	2000	Kg
November	1100	Kg
December	1500	Kg

Source : (PT. Indonesia Toray Sinthetic)

3.2 Bill Of Material

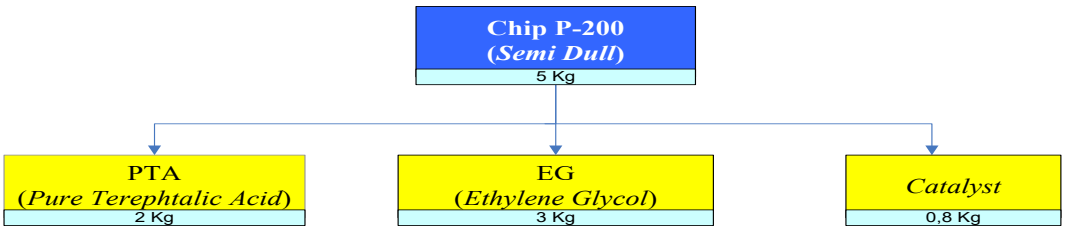

Figure 1. Bill of Material

3.3 Data of Demand

Table 3.2 Trend Linier Analysis Method

MONTH	(t)	(dt)	(d't)	a	b	t2	t.dt	|dt-d't|	(dt-d't)2	|dt-d't|/ dt *100
Jan-17	1	2000	2900	3000	-100.00	1	2000	900	810000	45.00
Feb-17	2	3000	2800	3000	-100.00	4	6000	200	40000	6.67
Mar-17	3	3400	2700	3000	-100.00	9	10200	700	490000	20.59
Apr-17	4	2000	2600	3000	-100.00	16	8000	600	360000	30.00
May-17	5	2100	2500	3000	-100.00	25	10500	400	160000	19.05
Jun-17	6	3000	2400	3000	-100.00	36	18000	600	360000	20.00
Jul-17	7	2500	2300	3000	-100.00	49	17500	200	40000	8.00
Aug-17	8	3700	2200	3000	-100.00	64	29600	1500	2250000	40.54
Sep-17	9	1900	2100	3000	-100.00	81	17100	200	40000	10.53
Oct-17	10	2000	2000	3000	-100.00	100	20000	0	0	0.00
Nov-17	11	1100	1900	3000	-100.00	121	12100	800	640000	72.73
Dec-17	12	1500	1800	3000	-100.00	144	18000	300	90000	20.00
TOTAL	78	28,200	28200			650	169000	6400	5280000	293

From the table 3.2 above, the following error is calculated:

1) MAD $= \Sigma \left|\frac{At-Ft}{n}\right| = \frac{6400}{12}$

MAD = 533,33

2) MSE $= \Sigma\Sigma \frac{(At-Ft)^2}{n} = \frac{5280000}{12}$

MSE = 440.000

3) MAPE $= \left(\frac{100}{n}\right) \Sigma \left|At - \frac{Ft}{At}\right| = \frac{293}{12}$

MAPE = 24,42

Table 3.3 Constant Method

Month	(t)	(dt)	(d't)	|dt-d't|	(dt-d't)	(dt-d't)2	|dt-d't/dt| X 100
Jan-17	1	2000	2350	350	-350	122,500	17.50
Feb-17	2	3000	2350	650	650	422,500	21.67
Mar-17	3	3400	2350	1050	1050	1,102,500	30.88
Apr-17	4	2000	2350	350	-350	122,500	17.50
May-17	5	2100	2350	250	-250	62,500	11.90
Jun-17	6	3000	2350	650	650	422,500	21.67
Jul-17	7	2500	2350	150	150	22,500	6.00
Aug-17	8	3700	2350	1350	1350	1,822,500	36.49
Sep-17	9	1900	2350	450	-450	202,500	23.68
Oct-17	10	2000	2350	350	-350	122,500	17.50
Nov-17	11	1100	2350	1250	-1250	1,562,500	113.64
Dec-17	12	1500	2350	850	-850	722,500	56.67
Total	78	**28200**	**28200**	**7700**	**0**	**6710000.0**	**375.09**

From the table 3.3 above, the following error is calculated:

1) MAD $= \Sigma \left|\frac{At-Ft}{n}\right| = \frac{7700}{12}$
MAD = 642

2) MSE $= \Sigma\Sigma \frac{(At-Ft)^2}{n} = \frac{6710000}{12}$
MSE = 559.167

3) MAPE $= \left(\frac{100}{n}\right) \Sigma \left|At - \frac{Ft}{At}\right| = \frac{375,09}{12}$

MAPE = 31,2

Table 3.4 Exponential Smothing Method

				ES α 0,9		
MONTH	(t)	(At)	Ft α 0,9	|At-Ft|	(At-Ft)2	|At-Ft|/At*100
Jan-17	1	2000	0	2000	4000000	100
Feb-17	2	3000	1800	1200	1440000	40.0
Mar-17	3	3400	2880	520	270400	15.3
Apr-17	4	2000	3348	1348	1817104	67.4
May-17	5	2100	2135	35	1211	1.7
Jun-17	6	3000	2103	897	803748	29.9
Jul-17	7	2500	2910	410	168385	16.4
Aug-17	8	3700	2541	1159	1343200	31.3
Sep-17	9	1900	3584	1684	2836205	88.6
Oct-17	10	2000	2068	68	4680	3.4
Nov-17	11	1100	2007	907	822361	82.4
Dec-17	12	1500	1191	309	95676	20.6
TOTAL	**78**	**28200**	**26568**	**10537**	**13602970**	**497**

From the table 3.4 α = 0.9 above, the following error error calculation is performed:

1) MAD $= \Sigma \left|\frac{At-Ft}{n}\right| = \frac{10537}{12}$
MAD = 878,11

2) MSE $= \Sigma\Sigma \frac{(At-Ft)^2}{n} = \frac{13602970}{12}$
MSE = 1.133.580,87

3) MAPE $= \left(\frac{100}{n}\right) \Sigma \left|At - \frac{Ft}{At}\right| = \frac{487}{12}$
MAPE = 41,42

Table 3.5 Moving Average Method

Demand and Forecasting					2 Months		
MONTH	(t)	(dt)	d't 2 Months	d't 3 Months	|dt-d't|	(dt-d't)2	|dt-d't|/ dt x 100
Jan-17	1	2000	0	0	2000	4000000	100
Feb-17	2	3000	0	0	3000	9000000	100
Mar-17	3	3400	2500	0	900	810000	26
Apr-17	4	2000	3200	2800	1200	1440000	60
May-17	5	2100	2700	2800	600	360000	29
Jun-17	6	3000	2050	2500	950	902500	32
Jul-17	7	2500	2550	2367	50	2500	2
Aug-17	8	3700	2750	2533	950	902500	26
Sep-17	9	1900	3100	3067	1200	1440000	63
Oct-17	10	2000	2800	2700	800	640000	40
Nov-17	11	1100	1950	2533	850	722500	77
Dec-17	12	1500	1550	1667	50	2500	3
TOTAL	**78**	**28200**	**25150**	**22967**	**12550**	**20222500**	**558**

From table 3.5, N = 2 months above, the following error deviation is calculated:

1) MAD $= \Sigma \left|\frac{At-Ft}{n}\right| = \frac{12550}{12}$
   MAD = 1.045,83
2) MSE $= \Sigma\Sigma \frac{(At-Ft)^2}{n} = \frac{20222500}{12}$
   MSE = 1.685.208,33
3) MAPE $= \left(\frac{100}{n}\right) \Sigma \left|At - \frac{Ft}{At}\right| = \frac{558}{12}$
   MAPE = 46,5

Table 3.6 The Best Forecasting Results

Forecasting Method	MAD	MSE	MAPE
Trend Linier Analysis	**533,33**	**440.000,00**	**24,42**
Constant	642	559.166,667	31,26
Exponential Smoothing α = 0,9	878,11	1.133.580,87	41,42
Moving Average 2 Months	1.045,83	1.685.208,33	46,51

From the table3.6 above, it can be seen that the results of several forecasting methods, which have the smallest error value are forecasting with the Trend Linear Analysis method which has a MAD value of 533.33, MSE value of 440,000.00, and MAPE value of 24.42.

Tabel 3.7 Moving Range

Month	t	y'	Y	y'-Y	MR	|MR|	UCL	LIMIT A	LIMIT B	LIMIT B	LIMIT A	LCL
Jan.	1	2900	2000	900	0	-	2,176	1,451	725	(725)	(1,451)	(2,176)
Feb.	2	2800	3000	-200	-1100	1,100	2,176	1,451	725	(725)	(1,451)	(2,176)
March	3	2700	3400	-700	-500	500	2,176	1,451	725	(725)	(1,451)	(2,176)
April	4	2600	2000	600	1300	1,300	2,176	1,451	725	(725)	(1,451)	(2,176)
May	5	2500	2100	400	-200	200	2,176	1,451	725	(725)	(1,451)	(2,176)
June	6	2400	3000	-600	-1000	1,000	2,176	1,451	725	(725)	(1,451)	(2,176)
July	7	2300	2500	-200	400	400	2,176	1,451	725	(725)	(1,451)	(2,176)
August	8	2200	3700	-1500	-1300	1,300	2,176	1,451	725	(725)	(1,451)	(2,176)
Sept.	9	2100	1900	200	1700	1,700	2,176	1,451	725	(725)	(1,451)	(2,176)
Oct.	10	2000	2000	0	-200	200	2,176	1,451	725	(725)	(1,451)	(2,176)
Nov.	11	1900	1100	800	800	800	2,176	1,451	725	(725)	(1,451)	(2,176)
Dec.	12	1800	1500	300	-500	500	2,176	1,451	725	(725)	(1,451)	(2,176)
TOTAL	78	28200	28200	0	-600	9000	26116	17411	8705	-8705	-17411	-26116

Example of MR table calculation:

$$\overline{MR} = \frac{\sum_{i=1}^{n-1} MR_i}{n-1}$$

$$= \frac{9000}{12-1}$$

$$= \frac{9000}{11} = 818$$

$$UCL = + 2{,}66\ \overline{MR}$$

$$= 2.176$$

$$LCL = - 2{,}66\ \overline{MR}$$

$$= - 2.176$$

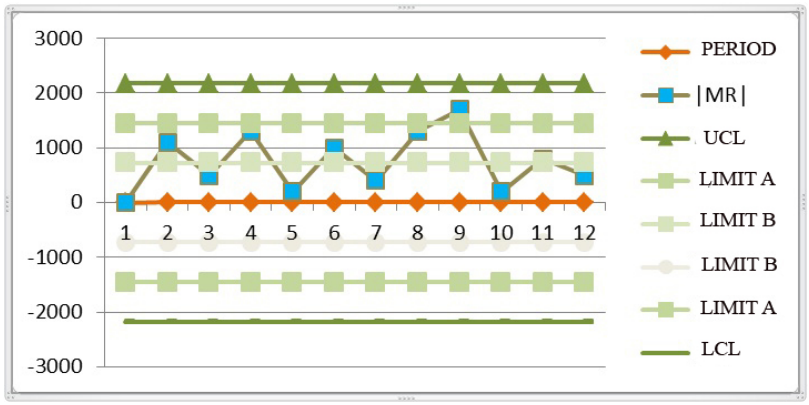

Figure 2. the Upper Control Limit (UCL) and the Lower Control Limit (LCL)

From the chart results of the moving range chart above, it can be seen that the error value does not exceed the Upper Control Limit (UCL) and the Lower Control Limit (LCL). This indicates that the system or data is still within the control limit (normal), so the linear trend analysis method is the chosen method that can be used for forecasting the next 12 periods.

Table 3.8 Forecasting the Next 12 Periods

MONTH	(t)	(dt)	(d't)	a	b	t2	t.dt	|dt-d't|	(dt-d't)2	|dt-d't|/dt *100
Jan-18	13	2000	2900	4200	-100.00	169	26000	900	810000	45.00
Feb-18	14	3000	2800	4200	-100.00	196	42000	200	40000	6.67
Mar-18	15	3400	2700	4200	-100.00	225	51000	700	490000	20.59
Apr-18	16	2000	2600	4200	-100.00	256	32000	600	360000	30.00
May-18	17	2100	2500	4200	-100.00	289	35700	400	160000	19.05
Jun-18	18	3000	2400	4200	-100.00	324	54000	600	360000	20.00
Jul-18	19	2500	2300	4200	-100.00	361	47500	200	40000	8.00
Aug-18	20	3700	2200	4200	-100.00	400	74000	1500	2250000	40.54
Sep-18	21	1900	2100	4200	-100.00	441	39900	200	40000	10.53
Oct-18	22	2000	2000	4200	-100.00	484	44000	0	0	0.00
Nov-18	23	1100	1900	4200	-100.00	529	25300	800	640000	72.73
Dec-18	24	1500	1800	4200	-100.00	576	36000	300	90000	20.00

3.4 Calculation of Aggregate Planning

Aggregate Planning is developed to plan monthly production needs or for product groups as predicted in demand forecasting. Before determining Aggregate Planning we must know in advance how much time is needed to make a product.

Table 3.9 Time Assumptions and Costs needed

Number of working days	22 Days
Number of effective working hours	8 Hours/Day
Cycle Time	65 Minutes
Inventory Cost	5% From the price of the product = Rp. 2,500,-/unit
Subcontract Cost	Rp. 20.000
Overtime Cost	Rp. 12.000
Maximum Overtime	2 Hours/Day
Reguler Production	$\frac{8\ Hours/Day}{0{,}065\ m}\ x\ 22\ Days = 2708\ Unit/month$
Overtime Production / Month	25% From Regular Production = 677

Table 3.10 Data of *Agregat Planning*

No	Demand	Regular Production	Additional Units Needed	Cumulative Production	Overtime Production	Inventory Cost	Overtime Cost	Subcontract	Total	Total Production
1	2900	2708	192	192	677	Rp 480.000	Rp 8.124.000	-	Rp 8.604.000	3385
2	2800	2708	92	284	677	Rp 710.000	Rp 8.124.000	-	Rp 8.834.000	3385
3	2700	2708	-8	292	0	Rp 730.000	0	-	Rp 730.000	2708
4	2600	2708	-108	400	0	Rp 1.000.000	0	-	Rp 1.000.000	2708
5	2500	2708	-208	608	0	Rp 1.520.000	0	-	Rp 1.520.000	2708
6	2400	2708	-308	916	0	Rp 2.290.000	0	-	Rp 2.290.000	2708
7	2300	2708	-408	1324	0	Rp 3.310.000	0	-	Rp 3.310.000	2708
8	2200	2708	-508	1832	0	Rp 4.580.000	0	-	Rp 4.580.000	2708
9	2100	2708	-608	2440	0	Rp 6.100.000	0	-	Rp 6.100.000	2708
10	2000	2708	-708	3148	0	Rp 7.870.000	0	-	Rp 7.870.000	2708
11	1900	2708	-808	3956	0	Rp 9.890.000	0	-	Rp 9.890.000	2708
12	1800	2708	-908	4864	0	Rp 12.160.000	0	-	Rp 12.160.000	2708

Table 3.11 Master Production Schedule (MPS)

Year	Month	MPS
2017	January	3385
	February	3385
	March	2708
	April	2708
	May	2708
	June	2708
	July	2708
	August	2708
	September	2708
	October	2708
	November	2708
	December	2708

Table 3.12 Lot For Lot (LFL)

Lead Time	1 Month	Chip P-200 (*Semi Dull*)														Order Cost	Rp 0
On Hand	3025															Cost Saved	Rp 5.000
Safety Stock	0	Month														Inventory Cost	
Lot Size	LFL	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		3385	3385	2708	2708	2708	2708	2708	2708	2708	2708	2708	2708	33850	Total of Order Cost	Rp 0
	On Hand	3025	0	0	0	0	0	0	0	0	0	0	0	0	3025		
	Net Requirement		-360	-3385	-2708	-2708	-2708	-2708	-2708	-2708	-2708	-2708	-2708	-2708	-30825	Total of Cost Saved	Rp 15.125.000
	Plant Order Receipt		360	3385	2708	2708	2708	2708	2708	2708	2708	2708	2708	2708	30825		
	Plant Order Release	360	3385	2708	2708	2708	2708	2708	2708	2708	2708	2708	2708		30825	Total	Rp 15.125.000

Lead Time	1 Month	PTA (2 Kg)														Order Cost	Rp 20.000
On Hand	5500															Cost Saved	Rp 100
Safety Stock	0	Month														Inventory Cost	
Lot Size	LFL	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	Total of Order Cost	Rp 240.000
Unit	Gross Requirement		6770	6770	5416	5416	5416	5416	5416	5416	5416	5416	5416	5416	67700		
	On Hand	5500	0	0	0	0	0	0	0	0	0	0	0	0	5500		
	Net Requirement		-1270	-6770	-5416	-5416	-5416	-5416	-5416	-5416	-5416	-5416	-5416	-5416	-62200	Total of Cost Saved	Rp 550.000
	Plant Order Receipt		1270	6770	5416	5416	5416	5416	5416	5416	5416	5416	5416	5416	62200		
	Plant Order Release	1270	6770	5416	5416	5416	5416	5416	5416	5416	5416	5416	5416		62200	Total	Rp 790.000

Lead Time	1 Month	EG (Kg)														Order Cost	Rp 30.000
On Hand	8250															Cost Saved	Rp 100
Safety Stock	0	Month														Inventory Cost	
Lot Size	LFL	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	Total of Order Cost	Rp 360.000
Unit	Gross Requirement		10155	10155	8124	8124	8124	8124	8124	8124	8124	8124	8124	8124	101550		
	On Hand	8250	0	0	0	0	0	0	0	0	0	0	0	0	8250		
	Net Requirement		-1905	-10155	-8124	-8124	-8124	-8124	-8124	-8124	-8124	-8124	-8124	-8124	-93300	Total of Cost Saved	Rp 825.000
	Plant Order Receipt		1905	10155	8124	8124	8124	8124	8124	8124	8124	8124	8124	8124	93300		
	Plant Order Release	1905	10155	8124	8124	8124	8124	8124	8124	8124	8124	8124	8124		93300	Total	Rp 1.185.000

Lead Time	1 Month	*Catalyst* (0,8 Kg)														Order Cost	Rp 10.000
On Hand	1050															Cost Saved	Rp 100
Safety Stock	0	Month														Inventory Cost	
Lot Size	LFL	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	Total of Order Cost	Rp 120.000
Unit	Gross Requirement		2708	2708	2166	2166	2166	2166	2166	2166	2166	2166	2166	2166	27080		
	On Hand	1050	0	0	0	0	0	0	0	0	0	0	0	0	1050		
	Net Requirement		-1658	-2708	-2166	-2166	-2166	-2166	-2166	-2166	-2166	-2166	-2166	-2166	-26030	Total of Cost Saved	Rp 105.000
	Plant Order Receipt		1658	2708	2166	2166	2166	2166	2166	2166	2166	2166	2166	2166	26030		
	Plant Order Release	1658	2708	2166	2166	2166	2166	2166	2166	2166	2166	2166	2166		26030	Total	Rp 225.000

Table 3.13 Economic Order Quantity (EOQ)

Lead Time	1 Month	Chip P-200 (*Semi Dull*)														Order Cost	Rp 0
On Hand	3025															Cost Saved	Rp 5.000
Safety Stock	0	Month														Inventory Cost	
Lot Size	EOQ	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	Total of Order Cost	Rp 0
Unit	Gross Requirement		3385	3385	2708	2708	2708	2708	2708	2708	2708	2708	2708	2708	33850		
	On Hand	3025	3025	3025	317	317	317	317	317	317	317	317	317	317	12245		
	Net Requirement		-360	-360		-2391	-2391	-2391	-2391	-2391	-2391	-2391	-2391	-2391	-22239	Total of Cost Saved	Rp 61.225.000
	Plant Order Receipt		3385	3385		2708	2708	2708	2708	2708	2708	2708	2708	2708	31142		
	Plant Order Release	3385	3385	2708	2708	2708	2708	2708	2708	2708	2708	2708	2708		33850	Total	Rp 61.225.000

Lead Time	1 Month	PTA (2 Kg)														Order Cost	Rp 20.000
On Hand	5500															Cost Saved	Rp 100
Safety Stock	0	Month														Inventory Cost	
Lot Size	EOQ	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	Total of Order Cost	Rp 240.000
Unit	Gross Requirement		6770	6770	5416	5416	5416	5416	5416	5416	5416	5416	5416	5416	67700		
	On Hand	5500	3934	2368	2156	1944	1732	1520	1308	1096	884	672	460	248	23822		
	Net Requirement		-1270	-2836	-3048	-3260	-3472	-3684	-3896	-4108	-4320	-4532	-4744	-4956	-44126	Total of Cost Saved	Rp 2.382.200
	Plant Order Receipt		5204	5204	5204	5204	5204	5204	5204	5204	5204	5204	5204	5204	62448		
	Plant Order Release	5204	5204	5204	5204	5204	5204	5204	5204	5204	5204	5204	5204		62448	Total	Rp 2.622.200

Lead Time	1 Month	EG (Kg)														Order Cost	Rp 30.000
On Hand	8250															Cost Saved	Rp 100
Safety Stock	0	Month														Inventory Cost	
Lot Size	EOQ	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	Total of Order Cost	Rp 360.000
Unit	Gross Requirement		10155	10155	8124	8124	8124	8124	8124	8124	8124	8124	8124	8124	101550		
	On Hand	8250	5901	3552	3234	2916	2598	2280	1962	1644	1326	1008	690	372	35733		
	Net Requirement		-1905	-4254	-4572	-4890	-5208	-5526	-5844	-6162	-6480	-6798	-7116	-7434	-66189	Total of Cost Saved	Rp 3.573.300
	Plant Order Receipt		7806	7806	7806	7806	7806	7806	7806	7806	7806	7806	7806	7806	93672		
	Plant Order Release	7806	7806	7806	7806	7806	7806	7806	7806	7806	7806	7806	7806		93672	Total	Rp 3.933.300

Lead Time	1 Month	EG (Kg)													Order Cost	Rp 30.000
On Hand	8250														Cost Saved	Rp 100
Safety Stock	0	Month													Inventory Cost	
Lot Size	EOQ	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		10155	10155	8124	8124	8124	8124	8124	8124	8124	8124	8124	8124	101550	Total of Order Cost	Rp 360.000
	On Hand	8250	5901	3552	3234	2916	2598	2280	1962	1644	1326	1008	690	372	35733		
	Net Requirement		-1905	-4254	-4572	-4890	-5208	-5526	-5844	-6162	-6480	-6798	-7116	-7434	-66189	Total of Cost Saved	Rp 3.573.300
	Plant Order Receipt		7806	7806	7806	7806	7806	7806	7806	7806	7806	7806	7806	7806	93672		
	Plant Order Release	7806	7806	7806	7806	7806	7806	7806	7806	7806	7806	7806	7806		93672	Total	Rp 3.933.300

Lead Time	1 Month	*Catalyst* (0,8 Kg)													Order Cost	Rp 10.000
On Hand	1050														Cost Saved	Rp 100
Safety Stock	0	Month													Biaya Persediaan	
Lot Size	EOQ	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		2708	2708	2166	2166	2166	2166	2166	2166	2166	2166	2166	2166	27080	Total of Order Cost	Rp 120.000
	On Hand	1050	669	288	449	609	770	930	1091	1252	1412	1573	1733	1894	13720		
	Net Requirement		-1658	-2039	-1878	-1718	-1557	-1397	-1236	-1075	-915	-754	-594	-433	-15254	Total of Cost Saved	Rp 1.372.000
	Plant Order Receipt		2327	2327	2327	2327	2327	2327	2327	2327	2327	2327	2327	2327	27924		
	Plant Order Release	2327	2327	2327	2327	2327	2327	2327	2327	2327	2327	2327	2327		27924	Total	Rp 1.492.000

Table 3.14 Fixed Order Quantity (FOQ)

Lead Time	1 Month	Chip P-200 (*Semi Dull*)													Order Cost	Rp 0
On Hand	3025														Cost Saved	Rp 5.000
Safety Stock	0	Month													Inventory Cost	
Lot Size	FOQ	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		3385	3385	2708	2708	2708	2708	2708	2708	2708	2708	2708	2708	33850	Total of Order Cost	Rp 0
	On Hand	3025	3025	3025	317	994	1671	2348	3025	317	994	1671	2348	3025	25785		
	Net Requirement		-360	-360		-2391	-1714	-1037	-360		-2391	-1714	-1037	-360	-11724	Total of Cost Saved	Rp 128.925.000
	Plant Order Receipt		3385	3385		3385	3385	3385	3385		3385	3385	3385	3385	33850		
	Plant Order Release	3385	3385	3385	3385	3385	3385	3385	3385	3385	3385	3385	3385		40620	Total	Rp 128.925.000

Lead Time	1 Month	EG (Kg)													Order Cost	Rp 30.000
On Hand	8250														Cost Saved	Rp 100
Safety Stock	0	Month													Inventory Cost	
Lot Size	FOQ	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		10155	10155	8124	8124	8124	8124	8124	8124	8124	8124	8124	8124	101550	Total of Order Cost	Rp 360.000
	On Hand	8250	8250	8250	126	2157	4188	6219	8250	126	2157	4188	6219	8250	66630		
	Net Requirement		-1905	-1905		-7998	-5967	-3936	-1905		-7998	-5967	-3936	-1905	-43422	Total of Cost Saved	Rp 6.663.000
	Plant Order Receipt		10155	10155		10155	10155	10155	10155		10155	10155	10155	10155	101550		
	Plant Order Release	10155	10155	10155	10155	10155	10155	10155	10155	10155	10155	10155	10155		121860	Total	Rp 7.023.000

Lead Time	1 Month	PTA (2 Kg)													Order Cost	Rp 20.000
On Hand	5500														Cost Saved	Rp 100
Safety Stock	0	Month													Inventor Cost	
Lot Size	FOQ	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		6770	6770	5416	5416	5416	5416	5416	5416	5416	5416	5416	5416	67700	Total of Order Cost	Rp 240.000
	On Hand	5500	5500	5500	84	1438	2792	4146	5500	84	1438	2792	4146	5500	44420		
	Net Requirement		-1270	-1270		-5332	-3978	-2624	-1270		-5332	-3978	-2624	-1270	-28948	Total of Cost Saved	Rp 4.442.000
	Plant Order Receipt		6770	6770		6770	6770	6770	6770		6770	6770	6770	6770	67700		
	Plant Order Release	6770	6770	6770	6770	6770	6770	6770	6770	6770	6770	6770	6770		81240	Total	Rp 4,682,000

Lead Time	1 Month	*Catalyst* (0,8 Kg)													Order Cost	Rp 10.000
On Hand	1050														Cost Saved	Rp 100
Safety Stock	0	Month													Inventory Cost	
Lot Size	FOQ	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		2708	2708	2166	2166	2166	2166	2166	2166	2166	2166	2166	2166	27080	Total of Order Cost	Rp 120.000
	On Hand	1050	1050	1050	1592	2133	2675	508	1050	1592	2133	2675	508	1050	19066		
	Net Requirement		-1658	-1658	-1116	-575	-33		-1658	-1116	-575	-33		-1658	-10081	Total of Cost Saved	Rp 1.906.600
	Plant Order Receipt		2708	2708	2708	2708	2708		2708	2708	2708	2708		2708	27080		
	Plant Order Release	2708	2708	2708	2708	2708	2708	2708	2708	2708	2708	2708	2708		32496	Total	Rp 2.026.600

Table 3.15 Fixed Period Requirement (FPR)

Lead Time	1 Month	Chip P-200 (*Semi Dull*)													Order Cost	Rp 0
On Hand	3025														Cost Saved	Rp 5.000
Safety Stock	0	Month													Inventory Cost	
Lot Size	FPR	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		3385	3385	2708	2708	2708	2708	2708	2708	2708	2708	2708	2708	33850	Total of Order Cost	Rp 0
	On Hand	3025	3385	0	2708	0	2708	0	2708	0	2708	0	2708	0	19950		
	Net Requirement		-360		-2708		-2708		-2708		-2708		-2708		-13900	Total of Cost Saved	Rp 99.750.000
	Plant Order Receipt		3745		5416		5416		5416		5416		5416		30825		
	Plant Order Release	3745		5416		5416		5416		5416	0	5416			30825	Total	Rp 99.750.000

Lead Time	1 Month	PTA (2 Kg)													Order Cost	Rp 20.000
On Hand	5500														Cost Saved	Rp 100
Safety Stock	0	Month													Inventory Cost	
Lot Size	FPR	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		6770	6770	5416	5416	5416	5416	5416	5416	5416	5416	5416	5416	67700	Total of Order Cost	Rp 120.000
	On Hand	5500	6770	0	5416	0	5416	0	5416	0	5416	0	5416	0	39350		
	Net Requirement		-1270		-5416		-5416		-5416		-5416		-5416		-28350	Total of Cost Saved	Rp 3.935.000
	Plant Order Receipt		8040		10832		10832		10832		10832		10832		62200		
	Plant Order Release	8040		10832		10832		10832		10832	0	10832			62200	Total	Rp 4.055.000

Lead Time	1 Month	EG (Kg)													Order Cost	Rp 30.000
On Hand	8250														Cost Saved	Rp 100
Safety Stock	0	Month													Inventory Cost	
Lot Size	FPR	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		10155	10155	8124	8124	8124	8124	8124	8124	8124	8124	8124	8124	101550	Total of Order Cost	Rp 180.000
	On Hand	8250	10155	0	8124	0	8124	0	8124	0	8124	0	8124	0	59025		
	Net Requirement		-1905		-8124		-8124		-8124		-8124		-8124		-42525	Total of Cost Saved	Rp 5.902.500
	Plant Order Receipt		12060		16248		16248		16248		16248		16248		93300		
	Plant Order Release	12060		16248		16248		16248		16248		16248			93300	Total	Rp 6.082.500

Lead Time	1 Month	*Catalyst* (0,8 Kg)													Order Cost	Rp 10.000
On Hand	1050														Cost Saved	Rp 100
Safety Stock	0	Month													Inventory Cost	
Lot Size	FPR	-1	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL		
Unit	Gross Requirement		2708	2708	2166	2166	2166	2166	2166	2166	2166	2166	2166	2166	27080		Rp 60.000
	On Hand	1050	2708	0	2166	0	2166	0	2166	0	2166	0	2166	0	14590		
	Net Requirement		-1658		-2166		-2166		-2166		-2166		-2166		-12490	Total of Cost Saved	Rp 1.459.000
	Plant Order Receipt		4366		4333		4333		4333		4333		4333		26030		
	Plant Order Release	4366		4333		4333		4333		4333	0	4333			26030	Total	Rp 1.519.000

Table 3.16 Results of MRP Calculation and Company Method

Comparison of Total Cost Saved and Order costs			
Method	**Cost Saved**	**Order Cost**	**Total Cost**
Metode Perusahaan	Rp 1.150.000	Rp 150.000.000	Rp 151.150.000
LFL	**Rp 720.000**	**Rp 16.605.000**	**Rp 17.325.000**
EOQ	**Rp 720.000**	**Rp 68.552.500**	**Rp 69.272.500**
FOQ	Rp 720.000	Rp 141.936.600	Rp 142.656.600
FPR	Rp 360.000	Rp 111.046.500	Rp 111.406.500

The best Material Requirement Planning (MRP) that produces an ordered value or cost and keeps the minimum for the Lot For Lot (LFL) method, the total cost obtained is Rp. 17,325,000. In theory, the method does have the minimum total inventory cost due to production conditions. the same as the number of orders that exist so as to reduce stock inventory and minimize storage costs. However, if it is realized, the method is not appropriate if applied to the company because there is no spare, so the Economic Order Quantity (EOQ) method is also chosen which also has a minimum total cost of Rp. 69,272,500. PT. Indonesia Toray Sinthetic can minimize total inventory costs and be more efficient at Rp 81,887,500. - that is, it can be more than 50%.

IV. Conclusion and Suggestion

1.1 Conclusion

1. After doing calculations with several forecasting methods, namely Linear Trend method, Constant, Moving Average N = 2 - N = 6, Exponential Smoothing α = 0.1 - α = 0.9. Through several forecasting methods, the Trend Linear Analysis forecasting method is the best and most appropriate forecasting method because it has the smallest error value and does not exceed the control limit in the Moving Range Chart.

2. Inventory control planning is carried out by the Material Requirement Planning (MRP) method with Lot Sizing techniques used are LFL, EOQ, FOQ, FPR. From the results of a comparison of all lot sizing methods, it can be seen that the Lot For Lot (LFL) method and Economic Order Quantity (EOQ) are the best Material Requirement Planning (MRP) methods that produce order values or fees and keep the minimum but for the Lot For Lot method (LFL) if it is realized the method is not appropriate if applied to the company because there is no spare, so the Economic Order Quantity (EOQ) method is also chosen which also has a minimum total cost of Rp 69,272,500. PT. Indonesia Toray Sinthetic can

minimize total inventory costs and be more efficient at Rp 81,887,500. - that is, it can be more than 50%.

1.2 Suggestion

1. In system forecast, the company should consider the other forcasting methods not only rely on one forecasting method, so the company can use a better forecasting method later because at PT. Indonesia Toray Sinthetic has not yet had a clear inventory control method, so for the future the company should implement a material requirements planning method with the appropriate Material Requirement Planning (MRP) method.

2. For raw material inventories, based on problem solving analysis, companies are expected to be able to apply the Economic Order Quantity (EOQ) method to minimize the total cost of inventory and to plan for ordering raw materials optimally.

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