Analysis of Inventory Control with Material Requirement Planning (MRP) Method on IT180-55gsm F4 Paper Product at PT.IKPP, TBK

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Analysis of Inventory Control with Material Requirement Planning (MRP) Method on IT180-55gsm F4 Paper Product at PT.IKPP, TBK

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Abstract:-PT. Indah Kiat Pulp & Paper (IKPP), Tbk Tangerang is one of Sinar Mas Group's subsidiaries producing various types of paper. In providing inventory to make various types of paper, it is necessary to have a good inventory control and in accordance with the demand of production. However, inventory control in these companies often encountered, such as over stock. Material Requirement Planning MRP is a method used to control raw material inventory at the company. In this research, using Moving Average forecasting method, Linear Trend, Double Exponential Smoothing, Constant, and Winter Season. The MRP method used is LFL, EOQ, FOQ, and POQ. The best forecasting result is Winter Seasonal with the smallest error value and the best result of MRP method used is POQ with the overall cost is Rp48,394,597.So, using Material Requirement Planning (MRP) method with Lot Sizing technique used is POQ, Indah Kiat company can minimize total inventory cost.

Keyword:-Inventory, Forecasting, Material Requirement Planning (MRP), Order Cost, Holding Cost, Total Cost.

I. INTRODUCTION

A. *Background*

Indonesia is rich in abundant natural resources, many local companies and foreign companies enter Indonesia to compete in order to become the best company. Every company will also be faced with an era of global market competition, where companies must be able to face tough competition with companies worldwide. To be able to face the competition in order to survive and succeed, the company must manage the resources optimally, so that the goals of the company can be achieved with maximum and sustainable. In improving the quality of the company in the eyes of consumers, all aspects need to be considered, one of which is about planning the material needs of the product or also called of raw materials or inventory control.

PT. Indah Kiat Pulp & Paper (IKPP), Tbk is one of the subsidiary company of Sinarmas group which engaged in paper and have various types of paper products with different demand - different in each product. This causes the company to be precise and quick in controlling the inventory given good inventory control can increase the productivity of the company. PT IKPP uses make to order and make to stock, therefore stock and inventory control must be well managed. However, control with make to stock is sometimes still difficult to control. Therefore, on products that are regulated with make to stock often over stock. It can be seen from this grafik :

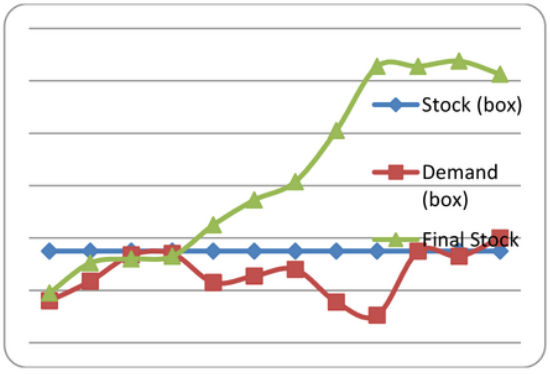

Figure 1. Demand and End Stock

To overcome the above problems, especially the problem of inventory control has been developed method of Material Requirement Planning (MRP). Material Requirement Planning (MRP) method used is Lot For Lot (LFL), Economic Order Quantity (EOQ), Fixed Order Quantity (FOQ), and Period Order Quantity (POQ).

B. *Formulation of the Problem*

How to control inventory of IT180-55gsm paper products with Material Requirement Planning (MRP) method at PT. Indah Kiat Pulp & Paper (IKPP), Tbk which generates the minimum cost?

C. *Research Purposes*

- Conduct inventory control based on Material Requirement Planning (MRP) method.
- Determine the minimum cost by using lot sizing technique.

D. Scope of Problem

- Master production schedule obtained from forecasting of production demand in PT.Indah Kiat Pulp & Paper (IKPP), Tbk.
- The calculation of each material starts from level 0.
- Once the message is received.
- Assumptions at the time of data collection and the factors that influence it constant.
- Analysis is done only based on data obtained in research both primary and secondary data.
- The total cost to be calculated in this research is the ordering cost and the storage cost.
- The object of measurement of raw material inventory control includes the amount of demand data of F4 size paper production with type IT180 - 55GSM from January - December 2016.
- Approach of raw material requirement planning method (MRP) in this research used lot size method; Lot For Lot (LFL), Economic Order Quantity (EOQ), Fixed Order Quantity (FOQ), Period Order Quantity (POQ). And forecasting production by Constant method, Moving Average, Linear Trend and Double Exponential

II. LITERATURE REVIEW

A. Inventory

Inventory is the idle resources that wait further process. The meaning of such further process is in the form of production activities on manufacturing systems, marketing activities on distribution systems or food consumption activities in household systems (Baroleh, 2014). The result of inventory that has not run optimally is the occurrence of excess or shortage of inventory. If the excess inventory (inventory is too large), it will result in storage costs rather than raw material inventories will be high, retained capital, and reduced funds for investment in other fields.

B. Forecasting

Forecasting is a process to estimate some future needs that include the needs in quantity size, quality, time and location required in order to meet the demand for goods or services (Nasution and Prasetyawan, 2008). Things to watch out for in forecasting are:

- Types of Forecasting
- Forecasting Approach

C. Forecasting Data Patterns

Forecasting data patterns include:

- Horizontal Pattern (H), occurs when the value of the data fluctuates around a constant average value (such a series "stationary" to the average value). A product that does not increase or decrease over a certain time is included in this type.
- Seasonal Patterns (S), occurs whenever a series is influenced by seasonal factors (eg a particular year's quarter, monthly, or days on a given week).
- Cycle Pattern (C), occurs when data is affected by long-term economic fluctuations related to business cycles.
- Trend Pattern (T), occurs when there is a long-term secular increase.

D. Forecasting Method

In doing the forecasting calculation there are several methods that can be used. Frequently used forecasting methods are:

- Constant
- Moving Average
- Trend Linier
- Single / Double Exponential Smoothing
- Winter Seasonal Factors
- Cyclical

E. Accuracy of Forecasting Results

Here is an analysis of forecasting errors using several statistical measures, among others (Nasution & Prasetyawan, 2008);

- Mean Absolute Deviation (MAD)

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

Where:
A = Actual demand in period t
F1 = Forecasting demand in period t
n = Number of forecasting periods visible

- Mean Square Error = MSE

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

- Mean Forecast Error = MFE

$$MFE = \sum \frac{(A_t - F_t)}{n}$$

- Standard Error of Estimate SEE

$$SEE = \sqrt{\frac{\sum (A_t - F_t)^2}{n-f}}$$

- Mean Absolute Percentage Error = MAPE

$$MAPE = [\frac{100}{n}] \times \sum |A_t \frac{F_t}{A_t}|$$

F. Verification and Control of Forecasting

During the base period (the period when calculating forecasting), the Moving Range map is used to perform engineering verification and forecasting parameters. After the forecasting method is determined, the Moving Range map is used for testing the stability of the causal system affecting demand (Nasution & Prasetyawan, 2008).
Moving Range is defined as:

$$MR = |(y`_t - y_t) - (y`_{t-1} - y_{t-1})|$$

The Moving Range averages are defined as:

$$\overline{MR} = \sum \frac{MR}{n-1}$$

The center line on the Moving Range map is at zero. The upper control limits and lower control limits on the Moving Range map are; BKA = +2.66 $\overline{MR}$ dan BKB = -2.66 $\overline{MR}$

The changes or differences described in the Moving Range are:

$$\Delta y_t = y`_t - y$$

I. Material Requirement Planning (MRP)

Material Requirement Planning (MRP) is a method used to control raw material inventory at the company. A company to implement policies in the planning of raw materials must have an appropriate calculation in order to avoid any advantages and disadvantages in raw material inventory (Wahyuni, 2015).

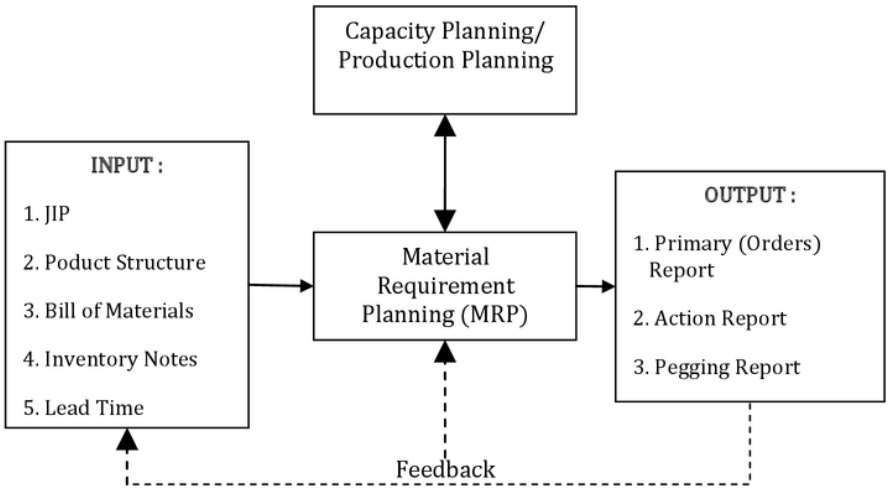

Figure 2. MRP Input

G. MRP Output

MRP output simultaneously also reflects the capabilities and characteristics of MRP, ie (Heizer and Render, 2015);

a. Planned Order Schedule is the determination of the amount of material requirement and the time of ordering for the time to come.
b. The Order Release Report is useful for buyers who will be used to negotiate with suppliers and also useful for manufacturing managers who will be used to control the production process.
c. Changes to Planning Orders is a reflect order cancellation, order reduction, and changing order quantity.
d. Performance Report is a display showing the extent to which the system works, in relation to stock void

H. Step of Making MRP

Once all the requirements and assumptions are obtained properly, the basic steps of the MRP system can work well. The basic steps in the MRP process are as follows (Nasution and Prasetyawan, 2008).

a. Netting is a calculation process to determine the number of net needs, which amount is the difference between the gross requirement with the state (which is in stock and which is being ordered).
b. Lotting is the process to determine the optimal size of individual orders based on the calculation of net needs.
c. Offsetting is a process to determine when to do the order plan in order to meet the needs of the net.
d. Explosion is the process of calculating the gross requirement for the level item / component is lower

J. Lot Sizing Method on MRP

- Lot For Lot (LFL)
  Lot for Lot (LFL) is a booking technique based on discrete orders and is the simplest technique of all other lot sizing techniques. The use of this technique aims to minimize the cost of save, so often used for goods that have a very expensive price.

- Fixed Period Requirement (FPR)
  Fixed Period Requirement (FPR) is an ordering technique over a predetermined period of time, both empirically and intuitively. The amount of the order is not based on the forecast, but by summing up the net requirement in the coming period.

- Fixed Order Quantity (FOQ)
  Fixed Order Quantity (FOQ) or fixed order quantity, is a very specific technique for determining inventory. The lot size determination can be based on empirical or

intuitive factors. This policy can be applied to goods with a high set up cost.

- Period Order Quantity (POQ)
  Period Order Quantity (POQ) is a lot sizing technique that performs orders at intervals of a certain period. POQ is basically similar to FPR. The difference lies in the basis of determining the intervals between the booking periods. Intervals between order periods at POQ are defined by EOQ divided by average demand per period (eg 1 week). POQ is an order quantity that includes a request during that interval. The order quantity is calculated from each time the order is. The Formula for POQ is :

$$\text{POQ} = \frac{Q}{averagedemandpermonth}$$

- Economic Order Quantity (EOQ)
  Economic Order Quantity (EOQ) is another form of FOQ. The EOQ model is used to determine the number of inventory orders that minimize the cost of direct inventory and inventory ordering costs. The assumption to be met for the EOQ model, ie product demand (D) is known, constant, and uniform, constant price per unit, per unit per year (H) constant cost, constant order (S), constant lead time, and none shortage of goods. The formula for EOQ is :

$$\text{EOQ} = \sqrt{\frac{2SD}{H}}$$

EOQ = The most optimal order quantity
S = Order Cost
D = Demand
H = Holding Cost

III. METHOD

A. Types of Research

This research is quantitative research type because this research is research on a company in the field of paper production that is precisely about inventory control with Material requirement planning (MRP) method which is data of product demand quantity in one year in the form of numbers rather than narrative.

B. Primary Data

Includes data obtained from the company directly either through direct observation of the field or interviews and so forth, in other words the primary data is raw data that before the processed or processed before. The primary data for this study are:

- Cost data of ordering of product material.
- Data storage costs of material products.
- Product material price.

C. Secondary Data

Includes data obtained from directly processed or computed companies. Secondary data obtained for this research are;

- Company profile, company product, company brand, production process, businessprocess obtained in company document.
- Number of product requests investigated in 2016.
- Bill Of Material (BOM) of the product under study.
- Lead Time material product used as research object.

D. Data Collection Technique

In this study, researchers used several data collection techniques as follows:
Observation (Participant Observation and Non participant Observation), Interview, Documentation.

IV. RESEARCH RESULT AND DISCUSSION

A. Demand

Month	Demand (Quantity)	Unit
Jan	160	Box
Feb	235	Box
March	335	Box
Aprl	340	Box
May	230	Box
June	255	Box
July	280	Box
August	155	Box
Sept	105	Box
Oct	350	Box
Nov	330	Box
Des	400	Box

Table 1. IT180-55gsm Paper Request Data

B. Product Structure

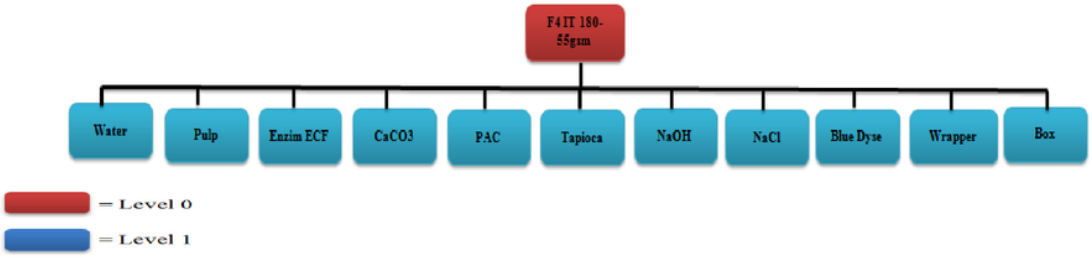

Figure 3. Product Structure

C. List of Material Requirements

Level	Component	Qty	Satuan	Sumber
0	Kertas IT 180	1	Box	Buat
1	Water	150	ml	Buat
1	Wrapper	5	Pcs	Buat
1	Box	2	Pcs	Buy
1	Pulp	4	Kg	Buy
1	CaCO3	0,005	kg	Buy
1	PAC	0,05	kg	Buy
1	Tapioca	0,08	kg	Buy
1	NaOH	0,005	kg	Buy
1	NaCl	0,005	kg	Buy
1	Enzim ECF	0,05	kg	Buy
1	Blue Dyes	0,002	kg	Buy

Table 2. List of Material Requirements

D. Lead Time

Level	Component	Lead Time
1	Water	0
1	Wrapper	0
1	Box	2 week
1	Pulp	2 week
1	CaCO3	1 week
1	PAC	1 week
1	Tapioca	1 week
1	NaOH	1 week
1	NaCl	1 week
1	Enzim ECF	1 week
1	Blue Dyes	2 week

Table 3. Lead Time

E. Material Price

Component	Qty	Satuan	Price
Water	150	ml	Rp 0,-
Wrapper	5	pcs	Rp 0,-
Box	2	pcs	Rp 4.000,-
Pulp	4	kg	Rp 6.000,-
Enzim ECF	0,05	kg	Rp 6.000,-
CaCO3	0,005	kg	Rp 7.500,-
PAC	0,05	kg	Rp10.500
Tapioca	0,008	kg	Rp 8.500,-
NaOH	0,005	kg	Rp 3.000,-
NaCl	0,005	kg	Rp 9.500,-
Blue Dyes	0,002	kg	Rp 10.000,-

Table 4. Material Price

F. Order Cost and Holding Cost

Order Cost and Holding Cost are assumed based on the journal Maulana & Setyorini (2014) ie for the order cost of 15% of the price and for holding cost is 10% of the price.

G. Forecasting

- *Forecasting Moving Average Method (MA)*

Here are the results of calculations using the Moving Average method with (n = 6 months):

Month	Period (t)	Demand (y)	Forecast (y')	Forecast MA 3-month (y')	y-y'	(y-y')^2	|y-y'|	(|y-y'|/y) x 100
Jan	1	160						
Feb	2	235						
Mar	3	335						
Apr	4	340						
May	5	230						
June	6	255	259					
Jul	7	280	63	259	21	434	21	7
Augst	8	155	-3	63	92	8428	92	59
Sept	9	105	-39	-3	108	11621	108	103
Okt	10	350	-5	-39	389	151166	389	111
Nov	11	330	16	-5	335	112091	335	101
Des	12	400	27	16	384	147558	384	96
Total	**78**	**3175**	**319**	**292**	**1328**	**431298**	**1328**	**478**

Table 5. Moving Average (n = 6 months) Result

- *Forecasting Trend Linier Method*

Here is the demand forecast calculated using Linear Trend calculation method.

Month	Period (t)	Demand (y)	Forecast (y')	y -y'	(y-y')^2	|y-y'|	(|y-y'|/y) x 100
Jan	1	160	268,15	-108	11696,2	108	67,59
Feb	2	235	275,93	-41	1675,16	41	17,42
Mar	3	335	283,71	51	2630,82	51	15,31
Apr	4	340	291,49	49	2353,39	49	14,27
May	5	230	299,27	-69	4798,04	69	30,12
June	6	255	307,05	-52	2708,96	52	20,41
Jul	7	280	314,83	-35	1212,95	35	12,44
Augst	8	155	322,61	-168	28092,1	168	108,13
Sept	9	105	330,39	-225	50799,2	225	214,65
Okt	10	350	338,17	12	140,031	12	3,38
Nov	11	330	345,95	-16	254,283	16	4,83
Des	12	400	353,73	46	2141,29	46	11,57
Total	**78**	**3175**	**3731,25**	**-556,25**	**108502**	**872,072**	**520,12**

Table 6. Trend Linier Result

- *Forecasting Method Double Exponential Smoothing*

Here is the calculation of Double Exponential Smoothing. With smoothing using $\alpha = 0.9$:

Month	Period (t)	Demand (y)	Forecast $\alpha = 0,9$ (y')	y-y'	(y-y')^2	|y-y'|	(|y-y'|/y) x 100
Jan	1	160	70	90,40	8171,33	90,40	56,50
Feb	2	235	118	116,77	13635,61	116,77	49,69
Mar	3	335	167	168,15	28273,67	168,15	50,19
Apr	4	340	215	124,52	15506,21	124,52	36,62
May	5	230	264	-34,10	1162,80	34,10	14,83
June	6	255	313	-57,72	3332,03	57,72	22,64
Jul	7	280	361	-81,35	6617,43	81,35	29,05
Augst	8	155	410	-254,97	65010,43	254,97	164,50
Sept	9	105	459	-353,60	125029,62	353,60	336,76
Okt	10	350	507	-157,22	24717,85	157,22	44,92
Nov	11	330	556	-225,84	51005,04	225,84	68,44
Des	12	400	604	-204,47	41806,67	204,47	51,12
Total	**78**	**3175**	**4044**	**-869,4282**	**384268,70**	**1869,106**	**925,25**

Table 7. Double Exponential Smoothing Calculation Result

- *Forecasting of Winter Seasonal Factor Methods*

Here is a demand forecast calculated using the Seasonal Factor's calculation method:

Month	Period (t)	Demand (y)	Forecast (y')	y-y'	(y-y')^2	|y-y'|	(|y-y'|/y) x 100
Jan	1	160	96,76	63	3999,82	63,24	39,53
Feb	2	235	208,72	26	690,41	26,28	11,18
Mar	3	335	424,16	-89	7949,06	89,16	26,61
Apr	4	340	436,91	-97	9392,20	96,91	28,50
May	5	230	199,94	30	903,78	30,06	13,07
June	6	255	245,76	9	85,31	9,24	3,62
Jul	7	280	296,31	-16	266,18	16,31	5,83
Augst	8	155	90,80	64	4121,24	64,20	41,42
Sept	9	105	41,67	63	4010,78	63,33	60,31
Okt	10	350	462,99	-113	12767,22	112,99	32,28
Nov	11	330	411,59	-82	6657,02	81,59	24,72
Des	12	400	604,72	-205	41912,08	204,72	51,18
Total	**78**	**3175**	**3520,35**	**-345,35**	**92755,09**	**858,04**	**338,27**

Table 8. Winter Seasonal Factor Result

- *Forecasting of Constant Methods*

Here is a demand forecast calculated using the Constant calculation method:

Month	Period (t)	Demand (y)	Forecast (y')	y-y'	(y-y')^2	|y-y'|	(|y-y'|/y) x 100
Jan	1	160	265	-105	10937,67	105	65,36
Feb	2	235	265	-30	875,17	30	12,59
Mar	3	335	265	70	4958,51	70	21,02
Apr	4	340	265	75	5687,67	75	22,18
May	5	230	265	-35	1196,01	35	15,04
June	6	255	265	-10	91,84	10	3,76
Jul	7	280	265	15	237,67	15	5,51
Augst	8	155	265	-110	12008,51	110	70,70
Sept	9	105	265	-160	25466,84	160	151,98
Okt	10	350	265	85	7296,01	85	24,40
Nov	11	330	265	65	4279,34	65	19,82
Des	12	400	265	135	18337,67	135	33,85
Total	**78**	**3175**	**3175**	**0**	**91372,917**	**895**	**446,2200757**

Table 9. Constant Calculation Results

- *Measurement of Forecasting Results*

After the calculation of forecasting, then performed a comparison of error values of each - each method of forecasting to get the smallest error value. Here is a comparison of calculation results using forecasting method:

Forecast Method	SEE	MAPE	MAD
Moving Averange (N = 6)	328,37	328,37	221,36
Trend Linier	104,16	43,34	72,67
Double Smoothing Exponential α = 0,9	196,03	77,1	155,76
Winter Seasonal Factor	**96,31**	**28,19**	**71,5**
Constant	95,59	39,49	82,92

Table 10. Comparison of Niali Error

Having obtained the smallest error value is to see the Moving Range Chart to see the results of the perceived gain out of control limits or not. Here are the results of the Moving Range Chart:

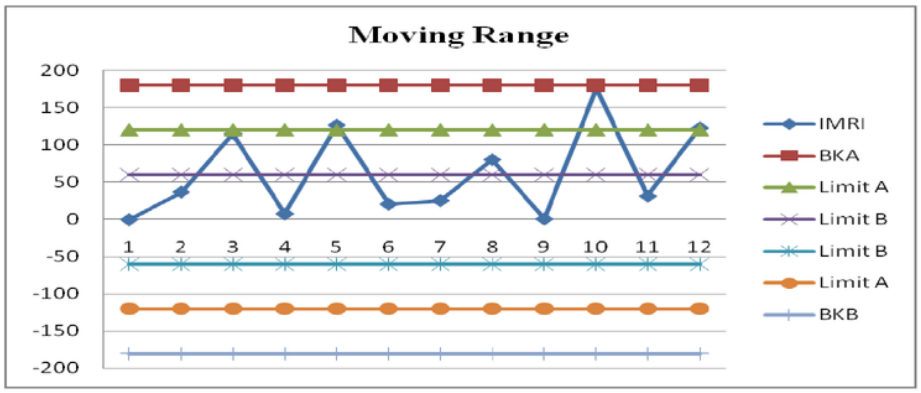

Figure 6. Moving Range Chart

H. Aggregate Planning

Aggregate Planning is an operational activity to determine the amount and time of production in the future. Aggregate Planning is also defined as an attempt to match the supply and demand of a product by determining the exact amount and timing of input, transformation, and output. Here is the calculation of Aggregate Planning to get the optimum total production:

Demand	Regular Production	Additional Units Needed	Cummulatif Production	Overtime Production	Total Production
97	252	-155	155	0	252
209	252	-43	449	0	252
424	252	172	277	126	378
437	252	185	92	126	378
200	252	-52	144	0	252
246	252	-6	151	0	252
296	252	44	106	126	378
91	252	-161	267	0	252
42	252	-210	478	0	252
463	252	211	267	126	378
412	252	160	107	126	378
605	252	353	-246	126	132

Table 11. Agregat Planning Calculation

I. Master Production Schedule

Based on the smallest forecasting and has recalculated the most optimal production capacity with aggregate planning, it can be obtained the amount of demand as the Master Schedule Production, which can be seen in the following table:

Year	Month	Master Production Schedule (box)
2017	Jan	252
	Feb	252
	March	378
	Aprl	378
	May	252
	June	252
	July	378
	August	252
	Sept	252
	Okt	378
	Nov	378
	Des	132

Table 12. Production Master Schedule

J. Calculation of Material Requirement Planning (MRP)

Based on data that has been obtained from forecasting and Aggregate Planning that has been calculated before, in this research will use MRP method with lot sizing technique.

K. Calculation of MRP with Lot For Lot (LFL)

Here is the result of total cost obtained by using lot sizing technique that is calculation with Lot For Lot.

No.	Material	Cost		Total Cost
		Order	Holding	
1	IT 180 Paper	Rp0	Rp30.775.000	Rp30.775.000
2	Pulp	Rp0	Rp38.512.800	Rp38.512.800
3	CaCo3	Rp10.125	Rp0	Rp10.125
4	PAC	Rp23.625	Rp0	Rp23.625
5	Tapioca	Rp16.200	Rp0	Rp16.200
6	NaOH	Rp4.050	Rp0	Rp4.050
7	NaCl	Rp16.875	Rp0	Rp16.875
8	Blue Dyes	Rp13.500	Rp0	Rp13.500
9	Box	Rp6.750	Rp0	Rp6.750
10	Enzim ECF	Rp8.100	Rp0	Rp8.100
Total		**Rp99.225**	**Rp69.287.800**	**Rp69.387.025**

Table 13. Calculation Result of LFL Method

L. Calculation of MRP with Economic Order Quantity (EOQ)

Here is the result of total cost obtained by using lot sizing technique that is calculation with Economic Order Quantity (EOQ):

No.	Material	Cost		Total Cost
		Order	Holding	
1	IT 180 Paper	Rp0	Rp166.562.500	Rp166.562.500
2	Pulp	Rp10.800	Rp38.680.890	Rp38.691.690
3	CaCo3	Rp13.500	Rp5.936.426	Rp5.949.926
4	PAC	Rp31.500	Rp10.162.338	Rp10.193.838
5	Tapioca	Rp21.600	Rp7.399.841	Rp7.421.441
6	NaOH	Rp5.400	Rp2.374.570	Rp2.379.970
7	NaCl	Rp22.500	Rp1.398.855	Rp1.421.355
8	Blue Dyes	Rp18.000	Rp7.565.494	Rp7.583.494
9	Box	Rp9.000	Rp0	Rp9.000
10	Enzim ECF	Rp10.800	Rp4.119.609	Rp4.130.409
Total		**Rp143.100**	**Rp244.200.523**	**Rp244.343.623**

Table 14. Calculation Result of EOQ Method

M. Calculation of MRP with Fixed Order Quantity (FOQ)

Here is the total cost obtained by using lot sizing technique that is calculated by Fixedc Order Quantity (FOQ):

No.	Material	Cost		Total Cost
		Order	Holding	
1	IT 180 Paper	Rp0	Rp60.759.375	Rp60.759.375
2	Pulp	Rp0	Rp36.594.000	Rp36.594.000
3	CaCo3	Rp6.750	Rp0	Rp6.750
4	PAC	Rp15.750	Rp0	Rp15.750
5	Tapioca	Rp10.800	Rp0	Rp10.800
6	NaOH	Rp2.700	Rp0	Rp2.700
7	NaCl	Rp11.250	Rp0	Rp11.250
8	Blue Dyes	Rp9.000	Rp0	Rp9.000
9	Box	Rp4.500	Rp0	Rp4.500
10	Enzim ECF	Rp4.500	Rp0	Rp4.500
Total		**Rp65.250**	**Rp97.353.375**	**Rp97.418.625**

Table 15. FOQ Method Calculation Result

N. Calculation of MRP with Period Order Quantity (POQ)

Here is the total cost obtained by using lot sizing technique that is calculated with Period Order Quantity (POQ):

No.	Material	Cost		Total Cost
		Order	Holding	
1	IT 180 Paper	Rp0	Rp46.162.500	Rp46.162.500
2	Pulp	Rp7.200	Rp804.000	Rp811.200
3	CaCo3	Rp2.250	Rp24.593	Rp26.843
4	PAC	Rp5.250	Rp573.825	Rp579.075
5	Tapioca	Rp3.600	Rp425.088	Rp428.688
6	NaOH	Rp900	Rp9.837	Rp10.737
7	NaCl	Rp3.750	Rp40.988	Rp44.738
8	Blue Dyes	Rp1.500	Rp20.256	Rp21.756
9	Box	Rp6.750	Rp0	Rp6.750
10	Enzim ECF	Rp7.200	Rp295.110	Rp302.310
Total		**Rp38.400**	**Rp48.356.197**	**Rp48.394.597**

Table 16. Calculation Results POQ Method

V. ANALYSIS

O. The Best Forecasting Analysis

From the results of several methods of forecasting the above demand, then performed comparison of forecasting results to see which forecasting method has the smallest error value. Here are the results of several forecasting methods that have been done:

Forecast Method	SEE	MAPE	MAD
Moving Averange (N = 6)	1906,29	708,54	1531,81
Trend Linier	104,16	43,34	72,67
Double Smoothing Exponential α = 0,9	196,03	77,1	155,76
Winter Seasonal Factor	**96,31**	**28,19**	**71,5**
Constant	95,59	39,49	82,92

Table 17. Calculation of Demand Forecasting

From the table above, it can be seen that the results of some forecasting method, which has the smallest error value is forecasting with the seasonal winter method that has a SEE value of 96.31, MAPE value of 28.19, and MAD value of 71.5.

P. Mrp Calculation Analysis

Here is a comparison of all calculations of the Material Requirement Planning (MRP) method with methods used by the Company;

Comparison of MRP and Company Methods

Methods	Ordering Cost	Holding Cost	Total Cost
Company Methods	Rp102.600.000	Rp153.900.000	Rp256.500.000
LFL	Rp69.287.800	Rp99.225	Rp69,387,025
EOQ	Rp143.100	Rp244.200.523	Rp244,343,623
FOQ	Rp65.250	Rp97.353.375	Rp97,418,625
POQ	**Rp38.400**	**Rp48.356.197**	**Rp48,394,597**

Table 18. Comparison of MRP and Company Methods

Based on the above results, it can be seen that from the Material Requirement Planning (MRP) method, lot sizing Periodic Order Quantity (POQ) technique yields the least cost of all MRP methods and methods used in the company.

VI. CONCLUSION

Planning using Material Requirement Planning (MRP) method with Lot Sizing technique used Lot-For-Lot (LFL), Quantity Order (EOQ), Fixed Order Quantity (FOQ) and Period Order Quantity (POQ). From result of comparison of all sizing measure method can be known method Quant Order (POQ) is method. (MRP) that generates or fills the message and keeps the minimum.

By using Material Requirement Planning (MRP) method with Lot Sizing technique used is Period Order Quantity (POQ), PT.Indah Kiat Pulp & Paper (IKPP), Tbk company can minimize total cost and more efficient from Rp208.105.403, - that is can be more than 100%.

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