

Analysis of Raw Material Control and Planning on Line Assy Sunflower with Material Requirement Planning Method at PT Techno Indonesia

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Abstract

PT Techno Indonesia is a local company engaged in injection molding for electronic and automotive parts. This study describes the control and planning of raw materials for sub-assy products, namely Paper Eject Assy Sunflower for the period July - December 2019. Problems that occur include the accumulation of raw material inventories so that it has the potential to harm the company because the inventory costs should be allocated to other investments. This study aims to determine: (1) (1) The best forecast to estimate the need for new materials per period that will come to PT Techno Indonesia. (2). Planning and controlling raw material inventory using the Material Requirement Planning (MRP) method at PT Techno Indonesia. In this study determined the planning of controlling raw materials with MRP using the calculation of the modeling of material procurement using the Lot For Lot (LFL) and Fixed Order Quantity (FOQ) methods. The results of this study prove that the best forecasting is applied in PT Techno Indonesia, the forecasting method uses Weighted Moving Average and Material Requirement Planning (MRP) using the Lot Fot Lot method.

Keywords: Forecasting, Material Requirement Planning (MRP).

1. Introduction

The development of the industrial world has a significant influence on the pace of the economy in Indonesia. Business competition is increasingly being carried out by maximizing all processes. Starting from receiving customer forecasts to the delivery process. Forecast has a very important role as a reference in calculating raw material requirements including materials, child parts and packaging. All parts of the company have an important role in the whole process. In this case, PPIC is tasked with ensuring that the product arrives at the customer according to the delivery schedule so that there is no stopline at the customer, by carrying out good control over the availability of raw materials, child parts and packaging so that when the production process is available and does not take longer and higher costs.

PT Techno Indonesia is a company engaged in injection molding and mold making for electronic and automotive parts. It has two kinds of production processes, namely injection and second processes. To support the production process, PT Techno Indonesia has 31 injection machines and 3 printing and hot stamp machines. The production process is divided into 2 departments, namely Injection and Second Process. In the 2nd process, the process is divided into several lines, namely printing, export and line assy. In terms of high customer demand, planning must be done carefully and systematically. PPIC receives forecasts and production orders then processes the data by making material requirements, packing (boxes, layers, partitions, polybags, vacuum trays) and other needs to become PPB (Goods Request Request) and make forecasts for suppliers and process orders according to lead time that has been determined. The supply of raw materials must be appropriate and not excessive so that the funds that must be issued by the company for the inventory of raw materials are not too large so that they can be allocated for other investments.

There are several methods used in inventory control. For products whose demand is independent, use the EOQ (Economic Order Quantity) method, while for products whose demand is dependent, use the MRP (Material Requirement Planning) method. In this case, the method that can be used is MRP (Material Requirement Planning) with various choices of existing calculation models. Basically, the MRP (Material Requirement Planning) method ensures the availability of materials, child parts and packaging to meet the production schedule that has been made by PPIC. The MRP concept is very precise and flexible to changes that occur in the business world in the era of globalization. With the MRP system, it can be seen the amount of raw materials needed to complete a product in the future so that the company can optimize the inventory of raw materials needed so that the amount of inventory is not too much but also not too little (Asvin & Achmad, 2015). Material requirements planning is intended so that in carrying out the work, the use of materials becomes efficient and effective so that there are no problems due to the unavailability of materials when needed.

Planning and control of raw materials is very important in the production process, inventory can represent 50% of the total invested capital. On the one hand, the company will try to reduce costs by reducing the amount of inventory. But on the other hand, without inventory, a company cannot run and the production process can stop and consumers become disappointed when the goods are not available (Ristono, 2009). The purpose of inventory control is stated as the company's effort to be able to meet consumer needs or demands quickly. This study aims to determine the best forecasting for estimating the need for raw materials for the coming period at PT. Techno Indonesia and to plan and control raw material inventory using the Material Requirement Planning (MRP) method at PT. Indonesian Techno. Production planning and control can be defined as a process to plan and control the flow of materials into, flows and out of the production or operating system so that market demand can be met with the right quantity, right delivery time, and minimum production costs. From the above definition, the work contained in production planning and control can be broadly divided into two interrelated things, namely production planning and production control (Arman & Yudha, 2008). The work contained in production planning and control can be broadly divided into two interrelated things, namely production planning and production control (Arman & Yudha, 2008) in the journal (Idris, 2015).

2. Literature Review

Obedience Raw Material Planning and Control

In a manufacturing company, every management must have good competence to be able to manage and hold effective inventory in order to create an effective and efficient operational workflow. Inventory is material or goods available for use at any time in the future. Inventory is intended so that the production process of a company can take place flexibly (Indratjahaj, Maimuna, & Qadariyanti,

2012). MRP is a request consisting of a list of material requirements (BOM), and an accurate inventory record (Heizer & Render, 2014). Based on this understanding, it can be interpreted that MRP is a material planning and control technique in a product unit produced. A company in planning raw materials must have careful and precise calculations so that there is no excess or shortage of raw materials (Asvin & Achmad, 2015). Inventories are generally intended for goods owned by companies, in the form of wholesale or retail businesses when these goods have been purchased in a condition ready for sale (Stice, K.Stice, & Skousen, 2011). In a company, inventory is the biggest asset that must be managed properly and correctly. Therefore, inventory must be controlled by the company so that it can support a production process.

Material Requirements Planning (MRP)

Material requirement planning (MRP) is a way of controlling raw material inventory in item items (components) that depend on higher level items (Ginting, 2010). The steps that will be taken in the process of forecasting this product are, namely:

- a. Defining the purpose of forecasting
- b. Make a scatter diagram
- c. Choose a forecasting method that is considered appropriate.
- d. Calculating forecast function parameters
- e. Calculating the error of each forecasting method
- f. Choose the best method, that is, the one with the smallest error
- g. Perform forecast verification.

3. Methodology

This research is a quantitative research on products at Line Assy Sunflower, precisely on inventory control using the Material Requirement Planning (MRP) method in the form of data on the number of product requests in one year in numerical form rather than narrative.

Conceptual framework

Research design is a procedure or applicable research steps that are useful as a guide in carrying out scientific research for the researcher concerned. The research design must be set openly so that other people can repeat the procedures carried out to prove the truth of the scientific research that has been carried out.

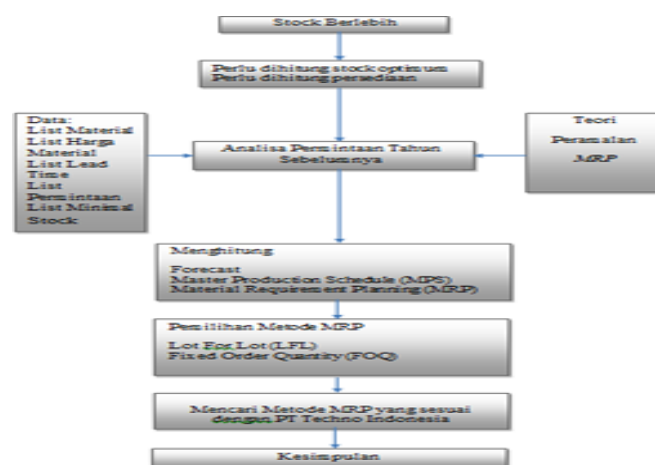


Figure 1. Research Design

Lot For Lot (LFL)

In this technique, the amount ordered is equal to the total net requirement in one period. This technique is effectively used for the fluctuating nature of demand. The costs incurred are in the form of ordering fees only. The costs incurred in this order are:

1. Determine the order plan appropriately against net requirements.
2. Produce exactly what is needed each week without any excess carried over to the next period.
3. Minimize inventory costs.
4. Avoid procurement costs or capacity limitations.

Fixed Order Quantity (FOQ)

This technique uses the concept of a fixed number of orders, usually this is done because of limited warehouse facilities, supplier capabilities or factory production capabilities (for manufacturing). The number of fixed orders to be ordered is calculated based on the average daily request. The number of orders can be enlarged to match the net requirement (by calculating multiples of the fixed quantity determined by the supplier)

Data Collection

In every study, to be able to obtain data, data collection techniques are needed. Data collection techniques are the most strategic steps in research, because the main goal in research is to obtain data (Sugiyono, 2010). Data collection techniques used at the time of the study are:

a) *Structured Non-Participant Observation*

Where the researcher is not directly involved with the activities of the people being observed, the author only acts as an independent observer. Referred to as structured observation because it has been designed systematically, about what will be observed, when and where the place is known. So structured observation is done if the researcher knows for sure about what variables will be observed.

b) *Interview*

Interviews were conducted by asking related information that we need to data sources. Where the purpose of this interview is to be able to answer all the problems that we have formulated, or the problems that we will examine.

c) *Documentation*

Documentation comes from the word document, which means written items. In carrying out the documentation method, researchers investigate written objects such as books, magazines, documents, regulations, meeting minutes, and so on. In addition to obtaining documentation from research subjects, a literature study was also carried out.

Analysis Method

The data analysis method in this research proposal is carried out with the following steps:

- a) Collecting master production schedule data (Master Production Schedule), product structure data (Bill Of Materials), and inventory records (Inventory Records).
- b) Determine the number of net needs and the optimal order size for each product item based on the results of the calculation of net needs.
- c) Determine the right time in determining the order plan to meet net needs.
- d) Take into account the needs of each raw material used to meet the clean needs.
- e) Analyze the efficiency measured from the lowest result by comparing the lot sizing techniques used.

The technique used in analyzing the data that has been obtained is descriptive analysis which is used to obtain an overview of the MRP method on the inventory of raw fabric materials at PT. Indonesian Techno. For manual calculations using the following steps

1. Creating Product Structure
2. Lead time of each product is known
3. Make a Gross Raw Material Requirement Plan
4. Plan Net Raw Material Requirements
5. Determine the planned order release (Planned Order Release)
6. Determine the right lot size

Determining the right Lot Sizing will produce an efficient total cost of inventory. The calculation technique with Lot Sizing is done by comparing the total cost of inventory obtained based on the company's calculations with the total cost obtained through the lot sizing method contained in the MRP, Lot for Lot (LFL) and Fixed Order Quantity (FOQ).

4. Result and Discussion

In forecasting, there are 2 approaches that are usually used. namely approaches with qualitative methods and quantitative methods. Qualitative methods are used if there is no historical data. While the quantitative method is used if there is data in the past that is collected regularly and uses the right technique. To determine forecasting in the future period, this study uses three methods, namely Single Moving Average, Weighted Moving Average, Single Exponential Smoothing with $\alpha = 0.1 - 0.9$. Then the smallest value of MAD, MSE and MAPE is determined from each method.

Single Moving Average

Moving Average is one period ahead of the average period. The method used in this study was 5 months ($N = 5$ months). The problem that arises in this method is in determining the value of t (average period). The greater the value of t , the forecasting is getting further away from the data pattern. The data used is always a fixed amount and includes the data for the last period. Assuming market demand remains stable over time. (Jay Heizer, Barry Render, 2015). The following is a forecasting calculation using the Single Moving Average method for a period of 5 months:

$$dt' = \frac{d(t-1) + d(t-2) \dots + d(t-N)}{N}$$
$$= \frac{\sum_{i=1}^N d(t-i)}{N}$$

Information:

- $d(t)$ = actual forecast
- dt' = forecast value for period t
- N = number of periods desired

Table 1. SMA Forecasting Results

Waktu	Bulan	Penjualan	Forecast
t		dt	$dt' = \sum dtt - n/n$
1	Jan-18	5751	
2	Feb-18	5271	
3	Mar-18	4439	
4	Apr-18	5310	
5	May-18	2899	
6	Jun-18	2184	4734
7	Jul-18	3312	4021
8	Aug-18	4464	3629
9	Sep-18	3780	3634
10	Oct-18	1751	3328
11	Nov-18	3781	3098
12	Dec-18	3755	3418
13	Jan-19	3178	3506
14	Feb-19	3276	3249
15	Mar-19	3636	3148
16	Apr-19	3204	3525
17	May-19	4689	3410
18	Jun-19	2628	3597
19	Jul-19	3312	3487
20	Aug-19	4464	3494
21	Sep-19	3780	3659
22	Oct-19	1260	3775
23	Nov-19	684	3089
24	Dec-19	2088	2700

Weight Moving Average

The next method is Weighted Moving Average. In the Weighted Moving Average, data is taken for a certain period and then given a weight, if it is closer to the present, the greater the weight will be. Weights are determined based on experience at the company. The formula is as follows:

$$= \frac{(d-1)d(t-1)+C(t-2)d(t-2)...+C(t-N)d(t-N)}{\sum c}$$

Information:

- d (t 1) = actual demand
- dt' = forecast value at t
- N = number of periods t
- Ct = weight assigned to t

Table 2. WMA Forecasting Results

No.	Bulan	Penjualan	Forecast
t		dt	$dt' = \sum dtt - n/n$
1	Jan-18	5751	
2	Feb-18	5271	
3	Mar-18	4439	
4	Apr-18	5310	
5	May-18	2899	
6	Jun-18	2184	4356
7	Jul-18	3312	3506
8	Aug-18	4464	3270
9	Sep-18	3780	3549
10	Oct-18	1751	3597
11	Nov-18	3781	3072
12	Dec-18	3755	3299
13	Jan-19	3178	3412
14	Feb-19	3276	3302
15	Mar-19	3636	3311
16	Apr-19	3204	3474
17	May-19	4689	3367
18	Jun-19	2628	3793
19	Jul-19	3312	3470
20	Aug-19	4464	3412
21	Sep-19	3780	3736
22	Oct-19	1260	3776
23	Nov-19	684	2938
24	Dec-19	2088	2136

Single Exponential Smoothing

The calculation method using the Single Exponential Smoothing method is to find the coefficient first, where the coefficient depends on the number of samples available. After that, the calculation is done by multiplying with the actual demand and the results of the calculation are added up with the result of 1 minus multiplied by the forecast in the previous period. Constants commonly used in research are between 0.1 -0.9 then look for the smallest constant value. After calculating, in this study the most appropriate constant to be used is 0.9. Formula to calculate Single Exponential Smoothing according to (Render & Heizer, 2015).

Forecasting values can be found using the following formula:

$$Ft = F(t - 1) + a(A(t - 1) - (F(t - 1)))$$

Information:

- Ft = new fortune teller
- $F(t - 1)$ = forecast beforehand
- a = constant
- $A(t - 1)$ = actual forecast of the previous period

Table 3. SES Forecasting Results

No.	Bulan	Penjualan	Forecast
1	Jan-18	5751	5751
2	Feb-18	5271	5176
3	Mar-18	4439	4744
4	Apr-18	5310	3995
5	May-18	2899	4779
6	Jun-18	2184	2609
7	Jul-18	3312	1966
8	Aug-18	4464	2981
9	Sep-18	3780	4018
10	Oct-18	1751	3402
11	Nov-18	3781	1576
12	Dec-18	3755	3403
13	Jan-19	3178	3380
14	Feb-19	3276	2860
15	Mar-19	3636	2948
16	Apr-19	3204	3272
17	May-19	4689	2884
18	Jun-19	2628	4220
19	Jul-19	3312	2365
20	Aug-19	4464	2981
21	Sep-19	3780	4018
22	Oct-19	1260	3402
23	Nov-19	684	1134
24	Dec-19	2088	615,6

Forecasting Accuracy Value Calculation

There are many methods of forecasting that can be used, but not all methods can suit the case that occurs in the company. To see how big the error value is, in general three calculations are:

a) MAD (Mean Absolute Deviation)

MAD is a calculation used to calculate the average absolute error, MAD is calculated by the formula (Render & Heizer, 2015) with the following formula:

$$MAD = \sum I \text{ actual} - \text{forecast } I / n$$

Information:

$\sum I \text{ actual} - \text{forecast } I$ = the result of subtraction between the actual and the forecast, then absolute and adding up. N = number of periods used

b) MSE (Mean Square Error)

MSE is the calculation used to calculate the average power of error. . MSE is calculated by the formula (Render & Heizer, 2015) as follows:

$$MSE = \sum (I \text{ actual} - \text{forecast } I)^2 / n - 1$$

Information:

$\sum (I \text{ actual} - \text{forecast } I)^2$ = the result of subtraction between the actual and the forecast squared and then added up, n= the number of periods used

c) MAPE (Mean Absolute Percent Error)

MAPE Is a calculation used to calculate the average absolute error percentage. The MAPE formula is as follows:

$$MAPE = \sum (I \text{ actual} - \text{forecast } I / \text{actual}) * 100 / n$$

Information:

$\sum (I \text{ actual} - \text{forecast } I / \text{actual})$ = the result of subtraction between the actual and the forecast then divided by the actual value of each period and then added together. n = the number of periods used

Table 4. Recap of Calculation of MAD, MAPE and MSE

No.	Metode Peramalan	MAD	MSE	MAPE
1	Single Moving Avarage	897	1435225	52%
2	Weighted Moving Avarage	853	1380952	49%
3	Single Exponential Smooting	950	1413314	36%

Forecasting Result Measurement

After the forecasting method is selected, it is then checked and ascertained whether the forecasting method can represent the data and is suitable for the demand for the product in question. Measurement of forecasting results can be done with a simple control chart, namely a moving range map. Moving range maps are used to verify forecasting techniques and parameters. After the forecasting method is determined, the moving range map is used to test the stability of the causal system that affects demand. The following are the results of calculations with a moving range map

Table 5. Moving Average

No.	Bulan	Penjualan	Forecast	Average	Standar Deviasi	UCL	LCL	Outlier
6	43252	2184	4356	3409	433	4707	-10712	4356
7	43282	3312	3506	3409	433	4707	-10712	3506
8	43313	4464	3270	3409	433	4707	-10712	3270
9	43344	3780	3549	3409	433	4707	-10712	3549
10	43374	1751	3597	3409	433	4707	-10712	3597
11	43405	3781	3072	3409	433	4707	-10712	3072
12	43435	3755	3299	3409	433	4707	-10712	3299
13	43466	3178	3412	3409	433	4707	-10712	3412
14	43497	3276	3302	3409	433	4707	-10712	3302
15	43525	3636	3311	3409	433	4707	-10712	3311
16	43556	3204	3474	3409	433	4707	-10712	3474
17	43586	4689	3367	3409	433	4707	-10712	3367
18	43617	2628	3793	3409	433	4707	-10712	3793
19	43647	3312	3470	3409	433	4707	-10712	3470
20	43678	4464	3412	3409	433	4707	-10712	3412
21	43709	3780	3736	3409	433	4707	-10712	3736
22	43739	1260	3776	3409	433	4707	-10712	3776
23	43770	684	2938	3409	433	4707	-10712	2938
24	43800	2088	2136	3409	433	4707	-10712	2136

Calculation of Master Production Schedule (MPS)

The Master Production Schedule (MPS) represents a plan for the execution of production. Master Production Schedule (MPS) is made based on forecasting results and consumer demand. In this study, the Master Production Schedule (MPS) obtained is the result of a comparison of the Single Moving Average, Weighted Moving Average, Single Exponential Smoothing method. And based on the two forecasting methods that have been done, the more suitable method to use is the Weighted Moving Average Method because it has the smallest MAD, MSE, and MAPE values, namely (MAD = 853), (MSE = 1380952), (MAPE = 63.5%) with the following data: Product Name:

Paper Eject Assy Sunflower

Cycle Time: 157

Maximum Production: 3680 pcs / month Overtime Fee: Rp 27,746, -

Table 6. MPS Summary

N	Period	Peramala	Regular Production	Productin Plan	Overtime	Biaya Overtime
1	43.983	2.184	3.680	3.680	-	-
2	44.013	3.312	3.680	3.680	-	-
3	44.044	4.464	3.680	3.545	-	-
4	44.075	3.780	3.680	3.273	-	-
5	44.105	1.751	3.680	2.258	-	-
6	44.136	3.781	3.680	3.775	95	Rp114.953
7	44.166	3.755	3.680	3.611	-	-
8	44.197	3.178	3.680	3.203	-	-
9	44.228	3.276	3.680	3.366	-	-
10	44.256	3.636	3.680	3.528	-	-
11	44.287	3.204	3.680	3.575	-	-
12	44.317	4.689	3.680	4.174	494	Rp597.757
13	44.348	2.628	3.680	2.799	-	-
14	44.378	3.312	3.680	3.600	-	-
15	44.409	4.464	3.680	4.293	613	Rp741.751
16	44.440	3.780	3.680	3.150	-	-
17	44.470	1.260	3.680	1.116	-	-
18	44.501	684	3.680	1.035	-	-
19	44.531	2.088	3.680	1.566	-	-

Discussion

Calculation of Material Requirements Planning (MRP)

In the discussion of this study the methods used are Lot for Lot (LFL) and Fixed Order Quantity (FOQ) where from the results of these calculations a comparison will be made to determine the most appropriate method to be applied at PT Techno Indonesia. In this study, the ordering cost is assumed to be IDR 10,000 for every one-time order and the storage cost is IDR 1 per unit.

Table 7. MPS Summary

No	Nama	Biaya Lot For Lot	Biaya Fixed Order Quanti
1	C-Ring. 5103.F/UC-3C	Rp 5.331.662	Rp 8.617.862
2	Spur Gear , 18 B	Rp 25.340.827	Rp 32.729.774
3	Roller,Paper Eject,Driven (102530600)	Rp 5.263.786	Rp 6.648.368
4	Roller Paper Eject Drive (1025305-01)	Rp 1.354.500.712	Rp 1.460.030.554
5	Holder Paper Eject Driven	Rp 72.261.288	Rp 86.947.368
6	Compression Spring 0.392	Rp 35.044.701	Rp 40.047.868
7	Spur Gear , 15	Rp 20.015.953	Rp 21.646.274
8	Sound Absorber 92x29x8T	Rp 61.281.910	Rp 65.752.922
9	Sound Absorber 75x29x8T	Rp 31.950.430	Rp 37.951.548
	Total	Rp 1.610.991.268	Rp 1.760.372.537

In table 7 it is explained that the total cost of providing material for Paper Eject Assy Sunflower pairs from the results of processing the Lot for Lot and Fixed Order Quantity techniques which are then compared. From the results of these comparisons, the analysis in this study is to use the Lot for Lot technique for calculating MRP, because processing using the Lot for Lot technique produces a minimum cost for all materials, with the total cost required is Rp. 1,610,991,268, - compared to by using the Fixed Order Quantity technique which results in greater costs with the total cost generated is Rp. 1,760.372,537, - and the comparison of the total cost of supply is Rp. 149.381,268, -. (Supriyanto & Barus, 2015) in the journal Analysis of Raw Material Requirements Planning To Use the MRP (Material Requirement Planning) Method and the Jit Method (Just In Time) published in the Journal of Business Administration Volume 04, Number 02, 2015, 101-116 with the conclusion UD. Am

Mabel being a company engaged in manufacturing that makes various types of cabinets and tables which are produced on a make-to-order basis, which means that products are made based on orders from consumers. Based on the results of the calculation of product sales data, the forecasting method in accordance with the data is the cyclical method, so the next calculation to predict product demand for the next nine months is the cyclical method. The best method used is the Period Order Quantity (POQ) method because from the calculation of the Period Order Quantity method, the smallest total cost is Rp. 23.372.166, -. when compared with the Lot for Lot calculation, which is Rp. 28,567,200, -, and the calculation of the Economic Order Quantity is Rp. 37,209,031, -. because the POQ method can minimize ordering costs and storage costs so that the total costs incurred are small compared to the EOQ and L-F-L methods. while the biggest cost is the EOQ method, because in the calculation of the EOQ method the cost of ordering and storing costs is very large (Sungkono & Sulistiyowati, 2016)

5. Conclusion

From the results of data analysis and discussion, it can be concluded that to estimate the need for raw materials in the coming period PT. Techno Indonesia can forecast every month using the Weighted Moving Average method, because in this analysis a comparison has been made with other methods, namely the Single Moving Average and Single Exponential Smoothing methods and it is proven that the Weighted Moving Average method is more efficient because it produces an error value (MAD, The smallest MSE and MAPE are: (MAD = 853), (MSE = 1380952), (MAPE = 49%). To carry out the planning and control of raw materials PT. Techno Indonesia can use the Lot for Lot technique, because the total cost of supply is smaller, which is Rp. 1,610,991,268 compared to the total cost of supplying using the Fixed Order Quantity technique which results in higher costs with the total cost generated is Rp. 1,760,372,537 and a total comparison the cost of providing it is Rp. 149,381,268, -.

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