

Analysis of Raw Material Inventory Control for a Minimum Total Cost Method with EOQ (Economy Order Quantity) in PT. Citra Abadi Bosco Gresik

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ABSTRACT

PT Citra Abadi Bosco Gresik is a company engaged in the manufacturing industry that management production on plywood wood. The company is long established, but for the past two years the company has received orders from a market that is strong enough in the production of plywood types so the demand for plywood is very optimal. The optimal supply of raw materials is one of the ways emphasis in production cost. This effort is able to minimize the cost of inventory which is the trend of raw materials inventory among companies. Raw material inventory levels are efficient enough, not too much so as to minimize expenses such as ordering costs, raw material storage costs, the frequency of raw materials purchases and the amount of raw material needs optimal, the point of reorder so that companies can obtain optimal benefits. To anticipate fluctuations in demand, seasonal demand and out of stock resulting in customers moving to other companies, so far the company is in demand to be able to serve customer demand in a timely manner, appropriate materials and exact amount of production. Smooth process in production, it is necessary a control system to get a minimum total cost. One is the Economy Order Quantity (EOQ) method. Predicting past data by predicting future forecasts is very influential and helpful in predicting future production figures by requiring existing data in the past. The results of the calculations performed on the forecast using the method of winter multiplicative model obtained from meranti raw materials of 1892.146 m³, melamine raw material of 3188.136 liters, resin raw material of 6064.477 liters, and raw materials gumtape of 1727.495 kg. Control of plywood raw material inventory according to EOQ method can be seen that the value of raw materials meranti large amount economical order 19 m³. Frequency of booking every year 99 times. Timing between ordering of meranti timber 3 days. Safety stock 51 m³. Reorder point 76.47 m³. Total cost of supplies is Rp. 3,788,373,732. Melamine raw material large number of economical orders 152 liters. Frequency of booking every year 21 times. Intermediate time between melamine orders 17 days. Safety stock 96 liters. Reorder point 114.39 liters. Total inventory cost Rp.163.631.791. Raw material resin large amount of economic order amounted to 332 liters. Frequency of booking every year 18 times. Time between 20 days resin ordering. Safety stock 12 liters. Reorder point 47 liters. Total cost of inventory is Rp.93.732.802. Large gumtape raw material the order amount of economy 103 kg. Frequency of booking every year 16 times. The time between gumtape reservation 21 days. Safety stock of 0.699 kg. Reorder point 10 kg. Total cost of supplies Rp.35.853.476.

Keywords: Raw Material Inventory, Economy Order Quantity, Safety Stock, Reorder Point.

Article History

Received 05 February 17

Received in revised form 04 March 17

Accepted 03 July 17

1. Introduction

Developments in this era of globalization is a challenge for companies in growing and growing rapidly, so the company is required to have a stronger competitiveness from year to year. The company is currently in competition also has a goal to advance its business in order to grow rapidly and gain an optimal advantage. Enterprise management system also has an important role as a control tool to run the company's activities in order to move efficiently and able to generate optimal benefits. With the optimal inventory the company must also be able to determine how much the appropriate supply of raw materials, so as not to cause the nature

of waste on the cost of suppression, because it can balance from the needs of raw materials are not too much or little (Taufiq, 2014).

Every manufacturing company must be able to determine the appropriate strategies and decisions in the supply of raw materials in accordance with the needs so that the production process can run smoothly. One of the inventory methods used is the Economy Order Quantity (EOQ) method or called the order amount. According to Heizer and Render (2011) said the EOQ method is a method of order quantity where one of the techniques used in control is very well known.

Jose L and Danial G. (2010) Economy Order Quantity and Reorder Point (EOQ/ROP) models have been used for years, but some companies have not been taken advantage of it. Quantity of economic orders can help in decide what it will become best optimal order quantity in your company lowest prices. Similar to EOQ, the reorder point will suggest

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when for place an order For Specific product c based on there historically demand Stevenson and Choung (2014) explain that inventory is the stock or stock of goods held by the company in the inventory to be performed. Inventory is an existing property within the enterprise in the form of inventories of raw materials (raw materials), work in process (finished goods), and finished goods (Prawirosentomo, 2009). Forms of supply can be distinguished based on way and intent of purchase among others Batch stock or lot size inventory is a greater amount in the supply of the required amount while the use of and spending a small amount, Fluctuation stock is a stock that is available to deal with fluctuations requests that cannot be predicted and if there is fluctuation in demand, demand decreases, while Anticipation stock is the inventory to anticipate the demand for fluctuations that is predicted based on the seasonal pattern contained in one year.

According to Sumayang (2003) inventory cost consists of booking fees and storage costs and inventory shortage. The types of inventory can be grouped into inventories of raw materials, in-process goods, finished goods and spare parts (Sudana, 2011). Inventory may be interpreted as items to be stored for use or to be sold in the future or in the period to come.

The company in producing the product must be able to balance several factors regarding product quantity, product durability, cycle of production period, storage facility and inventory cost, distribution time requirement, capital adequacy, and risk in inventory (Maftukhah, 2013).

According to Donald Delmar (1985) in Harming and Mahfud (2017), planning and inventory control, there are several factors, namely, inventory turnover is a turnover frequency of inventory that has been replaced during a specific time period, Lead time is the time interval between the time pemesanan and receipt of orders supplies from the supplier, the Customer service level is a service provided by the customer from the percentage of orders based on the date of the approved date, Stock out cost is the cost of inventory shortage that occurs when the demand exceeds the level of inventory owned by the company, cost of inventory is the cost of ordering, storage costs and payment fees. Economy Order Quantity (EOQ) is an approach to establish the quantity of goods to be ordered to meet demand demand with minimized inventory cost (Fahmi, 2012).

Basically all companies in the planning and control of materials should also emphasize the cost to maximize profit from a certain time. In the planning and control of raw materials is the activity to maintain the amount of inventory at the level that will be desired with the policy of raw material inventory to be applied and used by the company. PT Citra Abadi Bosco is a company engaged in the manufacturing industry that performs wood processing into plywood and veneer. The company was founded in 2008, but this new company engaged in the processing of wood into plywood and veneer products in 2015. Plywood is a board material composed of several layers of wood, while the wood veneer is a layer that has a certain thickness that is used to coat plywood (Kholidin, 2010). The company purchases raw materials in the form of local wood, but the products are plywood and veneer which will be exported to India and Nepal. PT Citra Abadi Bosco develops and implements a management system to demonstrate its ability to comply with the applicable requirements and regulations to remain competitive to date. The underlying problem in this background is to establish the amount of raw

material inventory to meet production needs and how to get the minimum total cost using EOQ method in PT. Citra Abadi Bosco Gresik.

2. Methods

In any decision affecting the amount of inventory, variable costs include. Storage fee and booking fee. The stages in this study is to describe the application of EOQ in an effort to minimize the cost of raw material inventory. This research is done in the form of data of raw material needs in the past, raw material price, lead time and inventory cost. The data of raw material demand is done by using minitab software tool which, to predict some estimation of demand requirement in the future by Moving Average method, Single Exponential Smoothing, Double Exponential Smoothing, Winters' multiplicative. After the forecasting then select and form the smallest value of MSD to get the best forecasting method and can be used as further research.

Choosing the best forecasting method, After data is forecasted with Moving Average method, Single Exponential Smoothing, Double Exponential Smoothing, Winters' multiplicative. Then select and specify the smallest MSD to get the best forecasting method, and use the forecasting as your next research. The data used for raw material needs for two years, raw material order data, warehouse cost data, and raw material price data.

Do the calculation by EOQ method, Determine the amount of raw material that is economical and ordering frequency. EOQ aims to determine the amount of raw material each time the order and each period so as to minimize the total cost of inventory. In general, these inventory costs are outlined based on cost components such as purchase costs, procurement fees, storage costs, and inventory shortage costs. Economy Order Quantity with the equation:

2.1. Calculation of Economy Order Quantity (EOQ):

The optimal amount of raw material purchase every time a message with minimum cost.

$$Q = \frac{\sqrt{2 \cdot D \cdot S}}{H + C} \quad (1)$$

Where:

Q = The EOQ order quantity

D = Usage or demand estimated per time period

S = Ordering cost per order

H = Storage cost per unit per time period

C = Unit Cost

2.2. Reorder Point (ROP)

Determining the point of reorder or Reorder point is the level of inventory where the ordering back must be done with the determination of ROP, when the amount of raw material inventory becomes zero, then the raw materials that have been ordered also to the exact time.

$$\text{Reorder Point} = \text{Daily usage} * \text{Lead Time (in days)} \quad (2)$$

When a safety stock is maintained, then the reorder point is written as the following :

$$\text{Reorder Point} = [\text{Daily usage} * \text{Lead Time (in days)}] + \text{safety stock} \quad (3)$$

2.3. Simple moving average

Calculating the demand of product based on the time period required (quarter, weekly, daily). Calculated over the periods length.

$$F = \frac{\sum_{i=1}^n S_{i-1}}{n} \quad (4)$$

Where,

F = the forecast of the period

S = the sales of the period

i = the periods

n = the fix period amount

2.4. Weighted moving average

The technique is similiar to the simple moving average, but each sale period is multiplied by a different weight which will total to 100 percent for the amount of period (Jose, 2010).

$$F = \frac{\sum_{i=1}^n W * S_{i-1}}{n} \quad (5)$$

2.5. Total Costing (TC)

The EOQ method refers to the determination of the same amount in each purchase. Therefore, the number of purchasing activities in one year can be known by dividing the material needs in one year with the number of purchases every time to place an order. Frequency of purchase according to Sritomo (2003):

$$TC = DP + \frac{D}{Q} S + \frac{Q}{2} H \quad (6)$$

Where:

TC = Total Cost

S = Booking fee

D = Number of requests

H = Storage cost

Q = Economy Order Quantity

P = Raw Material P

2.6. Security Supplies

Safety stock or inventory is a stock of goods held as a reserve when the ordering of goods come longer than the time of waiting (lead time) that has been set. Security provision can be explained in the formula:

$$SS = SD * Z \quad (7)$$

Where:

SS = Safety stock (safety stock)

SD = Standard Deviation

Z = The security factor is determined on the company's capability

Additional inventories are held to anticipate the occurrence of shortages or run out of raw materials.

2.7. Calculate standart deviation

$$SD = \sqrt{\frac{\sum (X - \bar{X})^2}{N}} \quad (8)$$

Where:

SD = Standard Deviation

X = Real usa

X bar = Estimated usage

N = Number of Data

2.8. Demand per day (d)

Demand per day is calculated by dividing the year request (D) by the number of working days in a year:

$$\text{Demand per day} = \frac{D}{\text{jumlah hari kerja per tahun}} \quad (9)$$

3. Result and Discussion

The data are evaluated for analysis and calculation in order to facilitate the calculation of safety stock and reorder point calculation.

a. Demand needs analysis by forecasting

Estimated demand requirement is done by using forecasting, among others Moving Average method, Single Exponential Smoothing, Double Exponential Smoothing, Winters' Multiplicative.

b. Choosing the Best Forecasting Method

After data is forecasted with Moving Average method, Single Exponential Smoothing, Double Exponential Smoothing, winters 'Multiplicative. Then select and specify the smallest MSD to get the best forecasting method, and use the forecasting as your next research.

c. Doing Calculations by EOQ Method

Determining the Number of Economical Raw Materials (EOQ) and Order Frequency. Economic Order Quantity is an amount of material purchase that will be able to achieve the most minimal inventory cost.

Data were extracted from January 2016 to December 2017. Data on demand for raw materials were collected and processed using Minitab software that could be used to predict future demand demand forecasts. The data will be used to forecast future demand periods, regarding raw material data shown in Table 1. Source : Company Data Year 2016-2017

Table 1. Raw Material Requirement Data

Month	Meranti/kubik	Melamin/liter	Resin/liter	Gumtape/kg
1	150	270	480	140
2	160	280	480	160
3	180	275	500	150
4	170	270	520	140
5	180	260	500	145
6	160	260	480	150
7	180	265	480	140
8	170	250	520	140
9	160	270	500	150
10	160	260	500	120
11	170	265	480	140
12	180	260	480	150
13	160	270	500	140
14	180	280	520	160
15	170	275	500	150
16	160	270	480	140
17	160	260	480	145
18	160	260	520	150
19	170	265	500	140
20	170	250	500	140
21	160	270	480	150
22	160	260	480	120
23	170	265	500	140
24	160	260	520	150
Total	4000	6370	11900	3450

d. Cost Data

Cost data is the data or records of outgoing booking fees used to obtain information about the required raw materials (Sritomo, 2003).

1. The cost of booking

Data on the cost of ordering raw materials can be seen in Table 2.

Table 2. Booking Costs on Plywood Type

Type of material	Phone charges	Administrative costs	Total Cost
Meranti	10.000	10.000	20.000
Melamin	10.000	10.000	20.000
Resik	10.000	5.000	15.000
Gum tape	10.000	5.000	15.000

Source : Company Data Year 2016-2017

2. Raw material prices

Data on the price of raw materials obtained from interviews with the purchasing and data of the company, the price of this raw material can be indicated on.

Tabel 3. Raw material prices

Type of material	Cost
Meranti/kubik	2.000.000
Melamin/liter	50.000
Resin/liter	70.000
Gumtape/kg	20.000

Source : Company Data Year 2016-2017

e. Time Series Analysis

As a basis for determining forecasting model is to look at the initial plot of existing data series for meranti wood data, data plot can be shown in Figure 1.

f. Plot of Meranti Wood Raw Material Demand Data

As a basis for determining forecasting model is to see the initial plot of the existing data series for meranti wood data. Plot image data can be shown in Figure 1. The plot of demand data of meranti wood which does not give a clear indication about the existence of a certain pattern, so that it is necessary to search the optimal parameters which will result in the smallest MSD (Mean Square Deviation) value of the three methods used with minitab software.

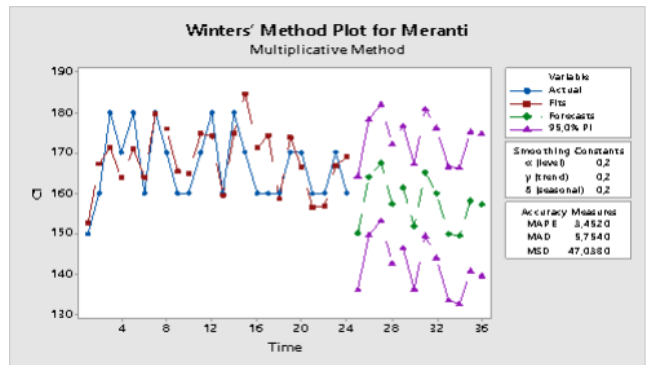


Figure 1. Plot of demand data of meranti wood raw material

From the data processing can be determined the optimal parameters for each method can be shown in Table 4. The optimal parameter values of meranti wood raw materials based on the value of MAPE, MAD, and MSD value.

Table 4. The optimal parameter values of meranti wood raw materials are based on MAPE, MAD, and MSD values

No	Forecasting Method	MAPE	MAD	MSD
1	<i>Moving Average</i>	3,8193	6,3235	51,0621
2	<i>Singel Exponential smoothing</i>	4,5831	7,6010	75,8768
3	<i>Double Exponential Smoothing</i>	4,9457	8,2465	90,5330
4	<i>Winters' multiplicative</i>	3,4520	5,7540	47,0380

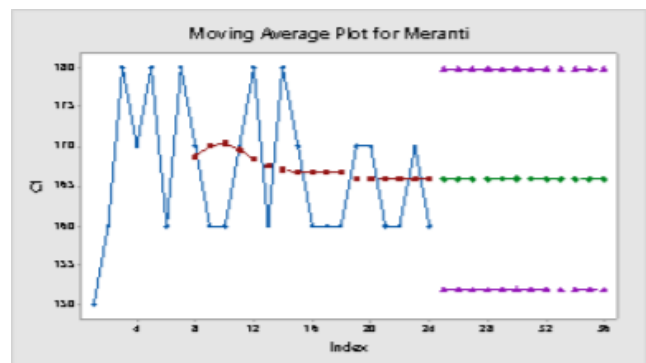


Figure 2. Moving Average plot of meranti wood raw material

While in Figure 3. Exponential Smoothing Singles shows that this image has a value of 75.8768. From data processing can be determined parameters in brief these values.

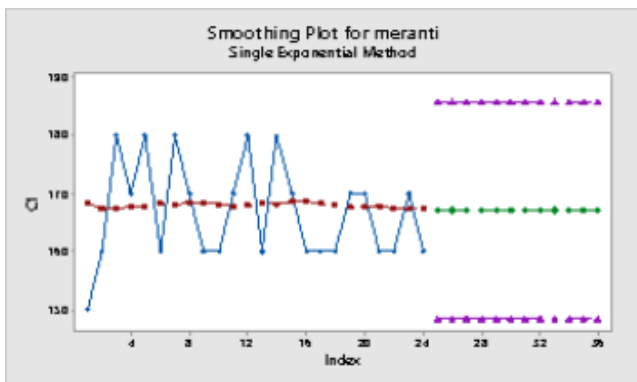


Figure 3. Singel Exponential Smoothing plot of meranti wood raw material

Double Exponential Smoothing shows that this image has a value of 90.5330, from the data processing can be determined the parameters in summary these values

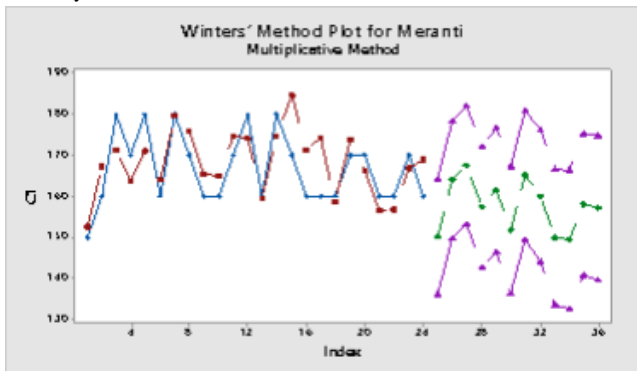


Figure 4. Winters' Multiplicative plot of Meranti wood raw material

Figure 4 Winters' Multiplicative shows that this image has a value of 47.0380, from the processing of data can be determined the parameters in summary these values

g. Analysis of Raw Material Inventory Control Using Method Economic Order Quantity

The value of the total minimum cost of controlling the supply of raw materials of plywood according to EOQ method can be seen that the value of raw materials meranti large amount economical order 19 m3. Frequency of booking every year 99 times. Timing between ordering of meranti timber 3 days. Safety stock 51 m3. Reorder point 76.47 m3. Total cost of Rp. 3,788,373,732. Melamine raw material large number of economical orders 152 liters. Frequency of booking every year 21 times. Intermediate time between melamine orders 17 days. Safety stock 96 liters. Reorder point 114.39 liters. Total inventory cost Rp.163.631.791. To determine safety stock, assume normal distributed demand with service approach of 95% and obtained value of N equal to = 1.645.Q.

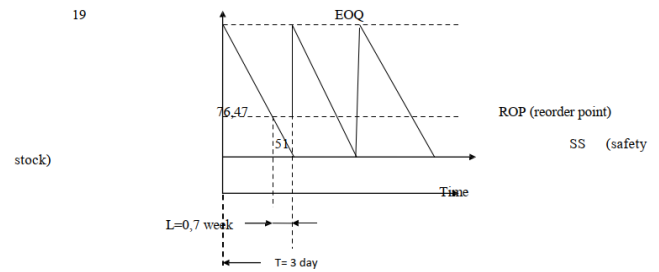


Figure 5. Meranti wood raw material inventory

From the results of data processing above can be determined the value of forecast of raw material needs for the period of 1 year ahead.

Table 5. The prediction of plywood raw material needs

Period of Need	Meranti/ kubik	Melamin/liter	Resin/ liter	Gumtape/kg
25	150,114	268,819	495,702	139,271
26	163,918	279,150	506,643	159,433
27	167,628	274,504	506,743	149,699
28	157,434	269,816	507,023	139,916
29	161,460	260,085	498,131	145,096
30	151,748	260,317	509,909	150,266
31	165,167	265,532	499,921	140,385
32	160,023	250,674	520,468	140,504
33	150,005	270,890	500,904	150,651
34	149,401	260,993	501,753	120,597
35	158,099	266,135	503,125	140,774
36	157,149	261,221	514,155	150,903
Total	1892.146	3188.136	6064.477	1727.495

Based on the result of the calculation of raw material inventory control in chapter IV obtained the following conclusions: The value of the forecast using the method of winter multiplicative model of meranti raw materials of 1892.146 M3, raw material melamine 3188.136 liter, raw material resin 6064.477 liter, and raw materials gumtape 1727.495 kg

The value of the total minimum cost of controlling the supply of raw materials of plywood according to EOQ method can be seen that the value of raw materials meranti large amount economical order 19 m3. Frequency of booking every year 99 times. Timing between ordering of meranti timber 3 days. Safety stock 51 m3. Reorder point 76.47 m3. Total cost of Rp. 3,788,373,732. Melamine raw material large number of economical orders 152 liters. Frequency of booking every year 21 times. Intermediate time between melamine orders 17 days. Safety stock 96 liters. Reorder point 114.39 liters. Total inventory cost Rp.163.631.791. Raw material resin large amount of economic order 332 liters. Frequency of booking every year 18 times. Time between 20 days resin ordering. Safety stock 12 liters. Reorder point 47 liters. Total cost of inventory is Rp.93.732.802. Large gumtape raw material the order amount of economy 103 kg. Frequency of booking every year 16 times. The time between gumtape reservation 21 days. Safety stock 0.699 kg. Reorder point 10 kg. Total cost of supplies Rp.35.853.476, -

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