

The Utilization of the Economic Order Quantity (EOQ) Method to Enhance the Efficiency of Raw Material Inventory at PT. Trimas Madya in Kampar District, Riau Province

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Abstract

With correct raw material inventory control, the company can optimize production results and profits. This study aims to: 1) Analyze the planning and control system of raw material inventory carried out by PT. Trimas Madya; 2) Analyze the application of the Economic Order Quantity (EOQ) method in increasing the Efficiency of Raw Material Inventory at PT. Trimas Madya. 3) Knowing the minimum costs incurred if the company determines the planning method. This research is a type of quantitative research, using all data related to the procurement of supplies of raw materials used. As well as raw material inventory costs. Data collection techniques used are interviews and documentation. The analysis used is the Economic Order Quantity (EOQ) method. The results of the study show that: 1) The ideal number of orders based on the Economic Order Quantity (EOQ) is 910.77, or even 911 M³, 2) The frequency of purchases in one year is 11 orders, meaning that in one month there is 1 order. Meanwhile, the company orders wood 70 times a year. 3) Total safety stock (Safety Stock) of wood raw materials at PT. Trimas Madya is 136 M³. 4) The amount of safety stock that must be controlled by PT. Trimas Madya. The mine must re-order raw materials when the available supply of wood raw materials is 207 M³. 5) The total cost of raw material inventory issued by PT. Trimas Madya. Mine in 2022 is IDR. 23,338,598. From the research results, it can be concluded that the use of the EOQ method can reduce inventory costs and the level of raw material requirements in an economical and optimal manner compared to the methods used by companies.

Keywords: Inventory Control; Economic Order Quantity; Inventory Cost

INTRODUCTION

PT. Trimas Madya is one of the companies included in the wood processing industry into wooden pallets which will be exported abroad. As a company engaged in the process of processing wood into pallets that will be exported to Japan, Korea and China, the company needs to maintain production and production quality well. Therefore, companies must maintain the availability of raw materials so that they can continue to support the production process so that it can run effectively and efficiently. However, the problem faced so far is how to achieve production targets due to insufficient raw materials. This has a negative impact on the company, such as decreasing production, increasing storage costs and also damage to raw materials due to too much raw material being sent by suppliers. Based on company reports, every year the company receives requests for wooden pallets from various countries, as seen in the following table

Table 1. Demand for Pallet Wood Products Based on Destination Countries 2018-2022

Year	Total Exports (Based on destination country) M ³			
	Japan	China	Korea	Total
2018	1000	2500	1000	4500
2019	700	3000	800	4500
2020	500	1000	300	1800
2021	1200	2700	600	4500
2022	2000	3000	1400	6400

Source: PT. Trimas Madya, 2022

Based on the data above, it can be seen that there was a decline in demand for exports in 2020. This was due to regulatory issues prohibiting exports and imports from destination countries, related to the Covid-19 pandemic. However, in 2021, demand for pallet wood will return to normal as in previous years. This of course makes the company have to re-supply raw materials according to market share demand. To maintain a good

supply of raw materials, companies must also pay attention to the pallet production capacity that the company must meet. In 2022, the total need for pallet wood that can be exported will be 6400 M³

The increase in the number of company exports must of course be balanced by an increase in the supply of raw materials. Production of 6400 M³ of pallet wood requires approximately 10,369 M³. Seeing the large number of raw materials that must be met by the company, the company must be able to maintain the supply of raw materials. Production capacity must of course be balanced with the supply of raw materials, so that production can run effectively and efficiently. Apart from that, companies also need to maintain supplies of raw materials, so that production continues. Organizing raw material inventories that are well and precisely controlled is very important for a company because it can guarantee and support its production process activities so that they can run smoothly and efficiently, so as to obtain profits and the survival of the company. Procurement planning and control of raw material inventories is a must for every company that aims to avoid misuse, whether in the form of fraud or waste.

The risk of possible loss, damage to the quality of the raw materials due to being stored for too long or possibly a fire, these risks can be minimized with a control system. On the other hand, if the supply of raw materials is too small compared to the needs in the production process, then the production process will not run smoothly and this will result in the company being unable to meet consumer demand for the products produced. A shortage of raw materials can also result in idle machine capacity and labor, resulting in losses for the company.

Based on company reports, the planned raw materials needed for the company's production are 4,500 meters³ per year. This means the company must provide 375 cubic meters per month. However, based on reports from PT. Trimas Madya, it can be seen that as of December 31 2020 the company still had 63.47 meters³ of wood stock left. These available raw materials are of course a burden for the company, because the raw materials will easily be damaged (rotted). Meanwhile, based on the raw material receipt report of PT. Trimas Madya As of January 2021 to July 2021, it can be seen that from January to February no raw materials were included, so employees were forced not to produce.

The graduation rate for training participants is that the company still has insufficient raw materials to meet export needs, because until December 2022, the amount of wood supplied as raw materials is only 10,455.29 m³. Meanwhile, the raw material requirements required are 10,369 meters³ per year. The condition of the supply of wood as a raw material for pallets also experiences fluctuating conditions, there are times when the supply exceeds production capacity, and there are also times when the supply of raw materials is not sufficient for the company's production needs. There is a shortage of raw materials at certain times, for example from October to December because it is difficult to remove raw materials from the location, due to the rainy season. So the supply of raw materials becomes constrained and production will be hampered. Therefore, so that the company can continue to produce, the company must pay attention to Lead Time or the time to order raw materials again.

Based on data on the supply of wood raw materials used for wood pallet production activities, companies must pay attention to the time to order raw materials, or Lead Time. According to Murdifin and Mahfud (2007), inventory is divided into two types, namely independent and dependent. Independent inventory is a form of inventory where determining the amount of raw materials itself is not tied to the number of final products, while dependent inventory is bound and the amount of raw material inventory is based on the number of final products to be made or produced. The majority of companies that use dependent inventory are companies that manufacture their products by assembling or arranging raw materials or product components.

In the product manufacturing process, raw materials in assembling production require a plan in arranging them. Raw materials in products do not immediately become finished products, sometimes they become raw materials for processes or, more easily, become the form of a new component to complement other components. These components are then put together to form a finished product as planned by the company. The formation of components originating from this raw material cannot be processed directly. In general, it takes time to bring in or obtain raw materials before they are processed. The time to get raw materials from suppliers to the company for processing is called order lead time, while the time needed to process raw materials into components is called process lead time. For raw materials that are easy to get, it may not be a problem, but it

will be a problem for raw materials that take time to get or get. Scarcity of raw materials causes lead times for messages to become longer. Sometimes certain production processes cannot be carried out on raw materials that require time to arrive, as a result there is a shift in the planned production schedule.

Schedule shifts that have been planned will indirectly affect the number of output units produced. When a certain number of products are produced in a certain amount of time with certain raw material inputs, a change in the Lead Time message occurs or is planned. This will result in changes in the amount of output produced. If the amount produced does not match the planned target, it will indirectly affect the company's sales and profits.

Observations that researchers have made at PT. Trimas Madya in planning raw material inventory still uses the owner's estimates without proper planning in managing their raw materials. It was proven that the company was still placing reorders (Reorder Point) when there were very few raw materials in the warehouse and did not set a safety stock (Safety Stock) to maintain the amount of raw material inventory. As a result, the company experienced problems in the production process, for example running out of wood raw materials for the production process, which was running low.

Availability of wood raw materials at PT. Trimas Madya often exceeds needs, and often lacks raw materials, so the company is forced to stop producing. Excess raw materials often become a problem, because excess wood will pile up and rot if not managed properly. This increases the burden of raw materials that cannot be used. This can be seen from the following data:

Table 2. Cost of Excess Raw Materials PT. Trimas Madya

No	Year	Cost of Damage to Wood Raw Materials
1	2018	56,518,000.00
2	2019	51,375,000.00
3	2020	57,850,000.00
4	2021	63,858,000.00
5	2022	70,125,000.00

Source: PT. Trimas Madya, 2022

Based on the excess raw material cost report at PT. Trimas Madya, it can be seen that the costs incurred by the company tend to increase. Companies often experience excess costs incurred for remanaging their raw materials because of these things. Indirectly, this reduces the company's profit to less than its maximum because it is still deducted from inventory costs, production costs and other costs which are still not neatly arranged. Therefore, an appropriate inventory management planning system is needed to overcome this.

The aim of control is to reduce operational costs to a minimum so as to optimize company performance. To carry out reliable and trustworthy inventory control, various factors related to inventory must be taken into account. Determining and grouping costs related to inventory needs special attention from management in making the right decisions. Because basically a company plans and controls raw materials with the aim of minimizing costs and maximizing the company's profits, here the researcher assumes that by using Economic Order Quantity (EOQ) analysis. The EOQ method tries to achieve minimum inventory levels, low costs and better quality. Inventory planning that uses the EOQ method in a company will be able to minimize the occurrence of out of stock so that it does not disrupt the production process in the company and can save raw material inventory costs in the company.

Economic Order Quantity (EOQ) is the most economical volume or amount of raw material purchases to be made each time a raw material is purchased. This method tries to achieve minimum inventory levels, lowest possible costs and good quality of raw materials. Planning this EOQ method in a company will be able to minimize the occurrence of out of stock so that it does not disrupt the production process within the company

and will be able to save company costs incurred by the company due to the efficiency of raw material inventory within the company.

This research was conducted to analyze the optimum supply of raw materials at PT. Trimas Madya so that the amount of raw material inventory can support the production process. Application of Economic Order Quantity (EOQ) in Increasing Raw Material Inventory Efficiency at PT. Trimas Madya

Formulation of the problem

Based on the background that has been described, the researcher will discuss several things formulated in the form of a research problem formulation, including the following:

1. What is the appropriate order quantity according to the Economic Order Quantity (EOQ) method?
2. What is the order frequency according to the Economic Order Quantity (EOQ) method?
3. How is the number of Return Orders (ROP) in accordance with the Economic Order Quantity (EOQ) method?
4. How is the amount of safety stock that must be controlled according to the Economic Order Quantity (EOQ) method?
5. What is the total inventory cost according to the Economic Order Quantity (EOQ) method?

Research purposes

Based on the background and problem formulation that has been described, this research aims to achieve and obtain the following information:

1. Analyze the number of orders according to the Economic Order Quantity (EOQ) method.
2. Analyze order frequency according to the Economic Order Quantity (EOQ) method.
3. Analyzing the number of Reorders (ROP) in accordance with the Economic Order Quantity (EOQ) method.
4. Analyze the amount of safety stock that must be controlled according to the Economic Order Quantity (EOQ) method.
5. Analyze total inventory costs according to the Economic Order Quantity (EOQ) method.

LITERATURE REVIEW

Understanding Raw Materials

According to Jaya Atmaja (2010:9), raw materials are materials used in the production process in the relevant period. The use of raw materials in companies is usually obtained from local purchases, imported purchases or can be from their own processing. Meanwhile, according to Wibowo (2014:12), the definition of raw materials is goods that will become part of a finished product whose costs can easily be followed.

According to Fauziah, Febriningtias, and Utomo (2014:12) Raw materials are divided into two types, sometimes these raw materials are something that must be obtained or produced by nature, without any substitute. There are also those that come from nature, however, you can look for other materials to replace existing materials. When a producer wants to produce goods or services, one of the things he must think about is raw materials. If raw materials are available well, then production will run smoothly, otherwise it will hamper the progress of production. Therefore, a producer must first study the channels providing raw materials, so that production activities run well.

Based on the definition above, raw materials can be interpreted as the main components needed to be processed in production to produce semi-finished goods or finished goods that have selling value.

Understanding Raw Material Inventory

Inventory is a component that has an important role in a business activity. The smoothness of the production process and fulfillment of demand (sales) will be greatly influenced by how to manage this component well. Inventory also has an investment value that must always be taken into account, because inventory contains

capital that cannot be used for other activities (Hidayat T, 2013). Meanwhile, according to Handoko (2016), inventory is a general term that indicates everything or organizational resources that are stored in anticipation of fulfilling demand. This demand includes raw materials, goods in process, finished goods, or final products (finished products).

Based on expert opinions, it can be seen that raw material inventory is one of the company's assets that requires special handling to expedite the production process, so that with company inventory it is always ready to anticipate consumer demand and the company can still obtain maximum profits.

Based on the description of the definition above, what is meant by inventory control is the efforts made by the company to ensure that inventory is safe by calculating optimal quantities and knowing when the company must reorder. Raw material control activities in the company include activities to provide observation, monitoring, investigation and evaluation to all parts of management so that the set goals can be achieved optimally.

Economic Order Quantity

EOQ (Economic Order Quantity) is the most economical volume or number of purchases to be made at each purchase. To meet these needs, the most economical fulfillment of needs (purchases) can be taken into account, namely a number of goods that can be obtained by purchasing at a minimum cost. (Heizer and Barry, 2010).

According to Handoko (2016) "the EOQ concept is also called the fixed-order-quantity model, which is a simple model and is used to determine inventory order quantities that minimize direct storage costs and indirect costs and can minimize ordering costs.

Determination of Economic Order Quantity (EOQ)

1. Order Fees

Order costs are costs that will be directly related to order activities carried out by the company. Order costs fluctuate not with the quantity ordered, but with the frequency of orders. Order costs not only consist of explicit costs, but also opportunity costs. For example, time is wasted processing orders, carrying out order administration and so on. Some examples of order costs include: 1) Preparation costs 2) Telephone costs 3) Shipping costs 4) Invoicing costs. To find ordering costs, according to Heizer and Render (2010), the formula is used:

$$\text{Order Fees} = \frac{D}{Q} \times S$$

Information:

D = Demand for inventory items (units per year)

Q = Number of items per order

S = Ordering Cost for each order

2. Storage Fees

Storage costs are costs that must be borne by the company in connection with the raw materials stored in the company. Storage costs include: 1) Maintenance costs, 2) Insurance costs, 3) Costs of damage during storage, 4) Building rental costs, 5) Storage facility costs. Heizer and Render (2010:95) to calculate storage costs are formulated as follows:

$$\text{Order Fees} = \frac{Q}{2} \times H$$

Information:

Q = Number of items per order

H = Storage costs per unit (units) per year

In determining inventory costs, there are 2 costs that need to be considered, namely ordering costs and storage costs. After determining these two costs, then determine the total required inventory costs (TC) by adding up order costs and storage costs. According to Heizer and Render, (2010) the formula for total inventory costs is as follows:

$$\text{Total Inventory Cost (TC)} = \left(\frac{D}{Q} \times S\right) + \left(\frac{Q}{2} \times H\right)$$

Information:

TC = Total inventory cost

Q = Number of items per order

D = Annual demand for inventory items in units per year

S = Order cost for each time you place an order

H = Storage costs per unit per year.

After determining the costs mentioned above, then calculate the economic order quantity to minimize inventory costs using the Economic Order Quantity (EOQ) method. The EOQ formula according to Heizer and Render (2010:95) is as follows:

$$Q^* = \sqrt{\frac{2SD}{H}}$$

Information:

Q* = Economic order quantity

D = Total needs in units (units) per year

S = Order cost for one order.

H = Storage costs per unit per year.

3. Safety Stock(Safety Stock)

In the production process, apart from requiring raw material supplies, safety supplies are also needed so that if there is a shortage of raw materials supplies, safety stocks can be used to expedite the production process. According to Subagyo (2009) "Safety Stock is the minimum inventory of goods to avoid material shortages". Meanwhile, according to Rangkuti (2004) "Safety Stock is additional inventory held to protect or guard against the possibility of a shortage of materials (stock out)".

4. Reorder Point(Back Order)

According to Riyanto (2001) "Reorder Point is a point where another order must be placed in such a way that the arrival or receipt of the ordered material is on time where the inventory above Safety Stock is equal to zero". Reorder Point occurs when the amount of inventory in stock continues to decrease so we have to determine the minimum inventory level that must be considered so that there is no shortage of inventory. The expected amount is calculated during the grace period, perhaps also adding Safety Stock which usually refers to

the possibility of a stock shortage during the grace period. To calculate ROP, you can use the formula according to Handoko (2016), namely:

$$OP = (\text{Lead Time} \times \text{Daily Users})$$

RESEARCH METHODS

Research sites

The research was conducted at the company PT. Trimas Madya, Tambang District on Jl. Pekanbaru-Bangkinang KM. 27.5. Kualu Nenas Village, District. Mine, Kab. Kampar, Riau Province.

Data Types and Sources

This research uses secondary data as follows:

- 1) Company order data for ordering wood raw materials.
- 2) Raw material components used in the production process.
- 3) Literature research from previous studies.
- 4) Literature related to the research conducted.
- 5) Organizational Structure and Company History.

Operational Definition of Variables

1. Raw material inventory control is all activities or activities carried out to determine how much inventory is needed by paying attention to the balance between the amount of inventory stored and the costs incurred from the inventory.
2. EOQ is the simplest production control method which aims to determine the economic order quantity so that there is no shortage of goods (out stock).

Data Analysis

The analytical method used in this research is Quantitative Descriptive. The quantitative descriptive method is a writing method that describes the actual situation of an object being studied, in this case the supply of raw materials and measuring or calculating the optimal supply of raw materials using the Economic Order Quantity (EOQ) method. The formula used in this research is as follows Heizer and Render (2010):

- a. Determination of economic order quantity (EOQ)

$$Q^* = \sqrt{\frac{2SD}{H}}$$

Information:

Q^* = Economic order quantity

D = Total needs in units (units) per year

S = Order cost for one order.

H = Storage costs per unit per year.

- b. TIC (total inventory cost)

$$(TC) = \left(\frac{D}{Q} \times S\right) + \left(\frac{Q}{2} \times H\right)$$

Information:

TC = Total inventory cost

Q = Number of items per order

D = Annual demand for inventory items in units per year

S = Order cost for each time you place an order

H = Storage costs per unit per year.

RESEARCH RESULT

a. Number of orders with the Economic Order Quantity (EOQ) Method

The formula for calculating economic order quantity (EOQ) is Heizer and Render (2010):

$$EOQ = \sqrt{\frac{2(D)(OC)}{CC}}$$

Information:

EOQ =Economic Order Quantity

D =Annual demand (demand)

O.C =Ordering costs (ordering costs)

CC =Storage costs (carrying costs)

After knowing the Economic Order Quantity (EOQ) calculation formula, what you need to know includes:

- 1) Determine the annual demand amount (D). The annual demand for wood raw materials in 2022 will be 10,369 M³.
- 2) Calculate ordering costs (OC). Ordering costs can be calculated by calculating the total ordering costs in one year: ordering frequency = Rp. 1050,000;
- 3) Calculate holding costs (CC). The total storage costs (CC) used for one year (2022) can be calculated as the percentage of storage costs x price per unit. So we get 10% X R0. 250,000 = 25,000
- 4) Based on the data above, the calculation of Economic Order Quantity (EOQ) is as follows Heizer and Render (2010):

$$EOQ = \sqrt{\frac{2(10369)(1050.000)}{2.5000}}$$

$$EOQ = 910.77$$

Or complete it into the 911 M³,

The Economic Order Quantity (EOQ) policy is the number of orders for inventory that can minimize total inventory costs. The aim of this model is to determine the quantity of each order so as to minimize total inventory costs. In determining the economical order quantity, the company must strive to minimize ordering and storage costs. The most economical order quantity (EOQ) model is carried out with the following assumptions:

- 1) Raw material requirements can be determined, relatively fixed, and continuous.
- 2) The order deadline can be determined and is relatively fixed.

- 3) Stock shortages are not permitted, meaning that once the needs and deadlines can be determined with certainty, inventory shortages can be avoided.
- 4) Orders are coming in all at once and will increase inventory.
- 5) The cost structure does not change, ordering or preparation costs are the same regardless of the quantity ordered, holding costs are based on a linear function of the average inventory, and the purchasing price or purchasing cost per unit is constant (no discounts).
- 6) Warehouse capacity and capital are sufficient to accommodate and purchase orders.
- 7) Purchases are one type of item.

b. Frequency of orders using the Economic Order Quantity (EOQ) Method

The order frequency formula that can be used is as follows Heizer and Render (2010):

$$\text{order frequency (f)} = \frac{D}{EOQ}$$

Information:

f = Frequency of purchases in one year
D = Total raw material requirements for a year
EOQ = Optimum purchasing quantity

$$\begin{aligned} \text{order frequency (f)} &= \frac{10,369}{911} \\ \text{order frequency (f)} &= 11.38 \end{aligned}$$

Or increase it to 11 times a year. Based on the results of the Economic Order Quantity calculation, the optimal number of orders for each order is 911 M³ with a purchase frequency in one year of 11 orders, meaning that in one month there is 1 order. Meanwhile, the company orders wood 70 times a year. The difference in inventory ordering frequency between the EOQ model and company policy influences the amount of ordering costs and storage costs that must be borne. Apart from that, the frequency of orders also affects the smoothness of the production process. With the right ordering frequency, inventory is not stored for too long but is always available to support the production process, so the quality of material supplies is more guaranteed.

c. Safety Inventory (Safety Stock)

Safety stock is additional stock held by the company to guard against the possibility of a shortage of materials (stock-out) during the production process. A shortage of raw materials can be caused by the use of raw materials that are greater than the predetermined plan. By having safety stock, companies can reduce losses due to shortages of raw materials (stock-out), but on the other hand it will increase costs in terms of carrying costs.

With the discovery of EOQ, there is actually still a possibility that there will be a shortage of inventory (out of stock) in the production process, it is possible that a shortage of inventory will arise if orders or purchases of raw materials cannot arrive on time. If receiving an order exceeds the deadline, it can result in a shortage of inventory. Likewise, if it is received earlier than the deadline, the company must bear extra costs.

Analysis of total inventory costs at max. In calculating total inventory costs, the aim is to prove that with the optimal amount of raw material purchases, calculated using the EOQ method, this will be achieved if the total cost of raw material inventory is minimal. Based on the explanation from Heizer and Render, the total cost calculation can be done using the Heizer and Render formula (2010):

$$TC = \frac{D}{Q} S + \frac{Q}{2} H$$

Information:

TC = Total cost

D = Number of requests in a certain period

Q = EOQ

S = Ordering cost

H = Storage costs

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the analysis above, it can be seen that:

1. The ideal order quantity based on the Economic Order Quantity (EOQ) is 910.77, or evened out to 911 M³,
2. The frequency of purchases in one year is 11 orders, meaning that in one month there is 1 order. Meanwhile, the company orders wood 70 times a year
3. Number of safety stocks (Safety Stock) of wood raw materials at PT. Trimas Madya is 136 M³.
4. The amount of safety stock that must be controlled by PT. Trimas Madya. The mine must order raw materials again when the available wood raw material inventory is 207 M³.
5. The total cost of raw material inventory issued by PT. Trimas Madya. Mining in 2022 will be IDR. 23,338,598. Meanwhile, the results of calculating the total cost of wood raw material supplies are based on the method used by PT. Trimas Madya. Mining in 2022, the company will have to pay Rp. 95,102,000. The difference between calculating total inventory costs using the EOQ method and the company method is IDR 71,763,402.

Suggestion

Based on the research results, the following recommendations are formulated:

1. PT. Trimas Madya should pay more attention to controlling the inventory of wood raw materials and wood glue and is advised to use the Economic Order Quantity (EOQ) method because the company can optimize the supply of wood raw materials and wood glue and can save inventory costs for wood raw materials and wood glue.
2. PT. Trimas Madya should determine safety stock and reorder points to anticipate excesses or shortages of wood raw materials and wood glue, so as to minimize inventory costs.

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