




Implementation of EOQ Method in Controlling Wood Raw Material Inventory at PT. XYZ

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Abstract. The success of a manufacturing company is influenced by inventory control. The purpose of this study is to determine the inventory policy in controlling the company's raw materials and to determine the extent of inventory cost efficiency if the company applies the EOQ method. This study uses a descriptive method with direct data collection from field research, interviews, and library research. From the results of the analysis that has been carried out, it can be concluded that the inventory policy implemented by the company is not optimal.

Keywords: *Economic Order Quantity, Reorder Point, Safety Stock.*

1 Introduction

Currently, Indonesia has experienced rapid population growth, along with the rapid growth rate so that housing becomes a basic need and has a very important function for human life. However, there are still many members of society who do not have a house, especially for low-income people. In meeting the need for a house, low-income people find it very difficult to have a house in cash. Therefore, the government provides a million houses program, this is done to meet the needs of private housing for low-income people, namely the Home Ownership Credit (KPR) program, one of which is the community in Tasikmalaya.

Table 1. Development of Housing Needs in Tasikmalaya City

No.	Subdistrict	Number of Families in 2003	Home Needs (Unit)		
			2005	2010	2015
1	Kawalu	12,299	13,094	13,940	14,540
2	Tamansari	24,880	16,492	24,204	26,026
3	Cibeureum	14,128	15,041	16,013	18,047
4	Purbaratu	18,821	20,040	21,335	22,713
5	Tawang	14,967	14,934	15,963	18,059
6	Cihideung	18,306	19,489	20,748	22,089
7	Mangkubumi	12,132	12,916	13,751	14,639
8	Indihiang	12,003	12,779	13,604	15,483
9	Bungursari	20,262	21,571	22,965	24,449

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10	Cipedes	7,309	7,861	8,284	8,919
	Total	155,107	154,217	170,807	184,964

Based on Table 1. it can be seen that the need for houses is growing so that several companies are needed to support the needs of raw materials for housing building components. The increasingly tight competition between companies encourages each company to establish control over the inventory of raw materials appropriately so that the company can continue to advance to achieve its desired goals.

Every company, whether it is a service company or a manufacturing company, must have the same goal, which is to achieve a level of effectiveness and efficiency of a company. One of the factors that influences this is the issue of smooth production. Production problems are very important for companies because they greatly affect the profits obtained by the company. If the production process runs smoothly, the company's goals can be achieved, but if the production process does not run smoothly, the company's goals will not be achieved. Basically, all companies carry out material planning and control with the main goal of reducing (minimizing) costs and maximizing profits within a certain time. In the planning and control of raw materials, the main problem that occurs is organizing the most appropriate material inventory so that production activities are not disrupted and funds invested in material inventory are not excessive. This problem affects the determination of :

- (1) how much quantity will be purchased in a certain accounting period,
- (2) how much or quantity will be purchased each time a purchase is made,
- (3) when the ordering of materials must be done,
- (4) what is the minimum quantity of materials that must always be in safety stock so that the company can avoid production bottlenecks due to late materials, and what is the maximum quantity of materials in inventory so that the funds held are not excessive.

Table 2. Amount of Wood Raw Material Inventory

No	Month	Purchase (m ³)	Demand (m ³)	Difference (m ³)
1	January	3.595,45	3.700,25	-104,8
2	February	4.673,33	4.512,75	160,58
3	March	3.202,11	2.950,24	251,87
4	April	3.341,89	3.837,66	-495,77
5	May	2.028,51	2.025,22	3,29
6	June	6.025,62	4.982,81	1042,81
7	July	5.196,35	3.792,45	1403,90
8	August	4.113,35	6.390,62	-2.277,27
9	September	3.850,16	3.111,72	738,44
10	October	3.928,67	4.824,13	-895,46

11	November	15.532,13	18.021,22	-2.489,09
12	December	13.214,05	16.002,79	-2.788,74
Total		68.701,62	74.151,86	-5.450,24

Stockout that occurs in the company can be seen from the difference between the amount of demand for raw materials available of 5,450.24 m³. In meeting its raw material needs, the company uses conventional methods based on the intuition and experience of the owner. So that stockouts often occur which result in the disruption of the smooth production process.

The problem of inventory control that arises is how to manage inventory so that there is no excess inventory and high ordering costs, to be able to manage this inventory is not easy because the amount of inventory is too large, it will result in large inventory costs, high idle funds embedded in inventory, increased storage costs, in addition the risk of damage to goods will be greater. However, if the amount of inventory is too small, it will result in stockouts, disruption of production, or shortage costs. Implementing inventory control does not mean that it can eliminate all risks, but it can reduce or minimize the occurrence of these risks as small as possible with the minimum total cost, so that production activities can be carried out optimally. One of the inventory methods that will be used in this study uses the Economic Order Quantity (EOQ) method with the aim of making total inventory costs more efficient and calculating ROP so that the right time to reorder can be determined.

2 Literature Review

Operations management is a series of activities that produce value in the form of goods and services by changing input into output. Operational management is an activity to organize and coordinate the use of resources in the form of human resources, equipment resources and financial resources, and materials effectively and efficiently to create and increase the utility of a good or service [6]. Operational management as decision making with all other operational functions can be seen as a transformation system that changes inputs into outputs.

Inventory control is the ability of a company to organize and manage every need for goods, both raw materials, semi-finished goods and finished goods so that they are always available in both stable and fluctuating market conditions. Controlling is the process of an organization's performance and taking action so that the targeted performance elements remain within the desired limits. Raw material inventory control is a series of things in determining the level of inventory, time of purchase and the amount of inventory that must be provided. Raw material inventory control aims to make inventory costs efficient, one way is to make the right purchases according to the production plan so that there is no shortage or excess in raw material inventory. Controlling inventory

also aims to keep a company from making small purchases that result in large ordering costs [3].

Optimal inventory is able to make the company's expenses more efficient, such as ordering and storing raw materials. So that the management policy on inventory will help the company. In the process, the company will face situations to make inventory decisions [4]. Inventory is an idle resource waiting for further processing. With inventory planning, the company can fulfill buyer orders quickly and accurately, and will not cause excess inventory that can result in inefficient use of funds [3].

If the supply of raw materials exceeds the needs, it will cause high extra costs and if the inventory is stored in the warehouse for too long, it will result in damage. While if the amount of inventory is too little, it will cause losses, namely disruption of the production process and also result in the loss of opportunities to make a profit if demand is greater than expected. Therefore, raw materials are an absolute input that must be planned well by a company [2]. Inventory is an asset that includes goods owned by a company with the intention of being sold in a normal business period, or inventory of goods that are still in the process of being worked on or finished, or inventory of raw materials waiting in the production process [4].

Determining the optimal quantity of raw materials can be done using a method that has long been known to be effective, namely the Economic Order Quantity (EOQ) method. Raw material inventory can be made to a minimum, the cost is as low as possible, and the quality is better. The use of this method in making decisions about purchasing raw materials will be able to minimize out of stock so that the production process can run smoothly and can also realize the efficiency of raw material inventory [1]. Economic Order Quantity (EOQ) is the quantity of goods that can be obtained at minimal cost, or is often referred to as the optimal purchase amount. Planning with the EOQ method in a company will be able to minimize out of stock so that it does not interfere with the process in the company and is able to save inventory costs incurred by the company due to the efficiency of raw material inventory in the company concerned [5].

3 Method

Data analysis is done by calculating the economic order quantity (EOQ). EOQ is the amount or quantity of goods purchased at minimal cost or often referred to as the optimal purchase amount. EOQ as the amount or size of orders made should result in costs incurred in the provision being minimal. The method of determining the economic order quantity by deriving it in mathematical formulas can be done by paying attention to the minimum inventory costs, if ordering costs are the same as carrying costs.

In implementing EOQ there are costs that must be considered in determining the amount of purchase or profit, namely Ordering Cost, Storage Cost and Total Inventory

Cost. Ordering costs are costs that will be directly related to the ordering activities carried out by the company. Order costs do not only consist of explicit costs, but also opportunity costs. For example, time lost to process orders, run the administration of the order. Inventory costs (TIC) are the sum of the order costs and storage costs. This minimum TIC will be achieved when the storage costs are equal to the order costs. At the time of the minimum TIC, the number of orders is said to be the most economical amount (EOQ).

$$\text{Formula determines EOQ : } Q^* = \sqrt{\frac{2DS}{H}} \quad (1)$$

$$\text{Formula to determine value TIC : } TIC = \left(\frac{D}{Q}S\right) + \left(\frac{Q}{2}H\right) \quad (2)$$

Where: TIC = Total inventory cost

Q = Number of items per order

D = Annual demand for inventory items (units)

S = Ordering fee for each order

H = Storage cost per unit per year

With this EOQ model, there is actually still a possibility of out of stock or shortage of inventory in production. This possibility can be caused by the use of raw materials in production is greater than previously estimated, and ordering or purchasing raw materials or goods cannot arrive on time (late) this means that the lead time is not right. To anticipate this uncertainty, especially in demand and lead time, a certain amount is provided that will reduce stockouts. Safety stock is additional inventory that will be held to protect or maintain the possibility of stock out. However, by holding safety stock, it will reduce activities caused by stock outs, in addition, safety stock also plays a role in maintaining the continuity of the production process so that it can run according to plan.

$$\text{Safety stock calculation : } SS = Z \times \sigma_d \times \sqrt{\frac{t}{n}} \quad (3)$$

where : SS = Safety stock

L = Lead time

n = Period

σ_d = Standard deviation

$$\text{Standard deviation formula } (\sigma_d) : \sigma_d = \sqrt{\frac{\sum(X-X_i)^2}{n-1}} \quad (4)$$

where : σ_d = Standard deviation

X_i = Average raw material usage

X = Actual raw material requirements

n = A lot of data

To ensure the smooth running of the production process, the company needs to pay attention to the time period between the time of placing an order and the time of receiving the ordered goods and then putting them into the warehouse. The length of

time between the start of ordering materials and the arrival of the ordered materials is called lead time. Raw materials that arrive late will result in a shortage of raw materials. While raw materials that arrive earlier than the specified time will force the company to increase the cost of storing raw materials. Factors that need to be considered in determining the lead time are Stock Out Cost (costs that are forced to be incurred due to the delay in the arrival of raw materials) and Extra Carrying Cost (costs that are forced to be incurred due to the delay in the arrival of raw materials earlier).

The reorder point or level is the level of reordering a point or limit from which the existing inventory at a time of ordering must be re-stocked. The amount of material usage while the ordered materials have not been received is determined by two factors, namely Lead time and average usage level. When reordering (reorder point) can be done in two ways, namely determining the amount of raw materials during the lead time plus a certain percentage, determining the amount of material usage during the lead time plus the safety stock that has been set.

Formula for calculating reorder point: $ROP = d \times L + SS$ (5)

where : ROP = reorder point

SS = safety stock

d = Average usage rate per working day (demand)

L = lead time

4 Results and Discussion

Inventory affects the performance of its production process, so the company tries to manage its inventory as optimally as possible to support the smooth running of the production process. In carrying out its business activities in the building materials component industry, whose main activity is producing furniture (frames, windows, doors) and primary needs consumed by the community, especially in households, offices, hotels, housing, and boarding houses that require raw materials in the form of wood as the main component of its production, especially mahogany wood is the main raw material that is most often used to produce each order, considering that mahogany wood is the most in demand from consumers.

In its production activities, the company has not implemented a policy in the raw material inventory control system, but only relies on intuition or experience from previous periods. Aware that raw material inventory control is a factor that has quite an influence in a production process. The company will reorder raw materials when the inventory looks like it will run out and is not certain in terms of reordering the raw materials. Thus, if there is a large demand and the company does not have a constant inventory, it is not uncommon for the company to experience stockouts. This inventory control is of course based on the product needs of the previous period, so that the company can

make inventory plans for the coming period. There are several costs that arise in controlling the inventory of goods needed to meet consumer needs, including:

- a. Ordering costs include telephone/fax/e-mail costs of IDR 2,716,000, administration costs of IDR 3,120,000, so that the total ordering costs incurred by the company are IDR 5,836,000,-/year. Ordering costs per month = $5,836,000 \text{ IDR} / 12 = \text{IDR } 486,400,-$
- b. Storage costs include warehouse maintenance costs of IDR 1,000,000,-, labor wages of IDR 14,400,000,- per person, electricity costs of IDR 2,575,000,- so that the total storage costs incurred by the company are IDR 17,975,000,-/year. Order frequency per month (Q) = $74,151.86 / 12 = 6,179.3 \text{ m}^3$.
Storage cost (H) = Total storage cost / Demand = $\text{IDR } 17,975,000 / 74,151.86 = \text{IDR } 242.4 / \text{m}^3$.

The total inventory cost that must be borne by the company is IDR 6,585,751.7.

The problems that arise in the company are high shipping costs due to repeated ordering of raw materials with quite high shipping costs, the frequency of orders reaches 12 times a year which causes the ordering costs to be high and the next problem is the absence of a Reorder Point, which is the minimum stock amount where a reorder must be made. The company does not know the amount of ROP which will result in the company not knowing when the remaining stock amount must reorder its raw materials, there is a possibility that the company runs out of raw material stock when production takes place at a certain time so that this will have an impact on the unfulfilled consumer demand which causes the company to immediately reorder the raw materials needed from the supplier as a result there will be additional costs outside the plan that will be determined.

The amount of raw material purchases each time an order is made using the EOQ method is $17,251 \text{ m}^3$. The frequency of orders at an economical order quantity is obtained as many as 4 times. The amount of inventory that can be reserved as a safeguard for the continuity of fulfilling consumer demand from the risk of running out of wood raw material inventory is $1,540.67 \text{ m}^3$. Reorder point is the point at which a company must reorder raw material inventory before the inventory in the warehouse reaches zero. The amount of inventory in the warehouse must be able to meet consumer demand during the lead time. Lead time itself means the time required between the time of ordering and the arrival of the ordered product. The company has a lead time in ordering raw materials of 10 days with an average working day of 308 days per year. The reorder point for wood raw materials is when the remaining inventory is $3,950.67 \text{ m}^3$ and the company must immediately reorder $17,251 \text{ m}^3$ of raw materials. In accordance with the previous Economic Order Quantity calculation, the raw materials that have been ordered will arrive when the inventory reaches the safety stock point of $1,540.67 \text{ m}^3$.

Table 3 Comparison Between Company Method And EOQ Method

Description	Company Method	EOQ Method	Difference
Quantity	6,179.3 m ³	17,251 m ³	11,071.7 m ³
Frequency	12 times	4 times	8 times
Total Inventory Cost	IDR 6,585,751.7,-	IDR 4,181,567.52,-	IDR 2,404,181.18,-
Safety Stock	Not specified	1,540.67 m ³	-
Reorder Point	Not specified	3,950.67 m ³	-

From table 3, it can be seen that the quantity of wood raw material purchases based on company policy averages 6,179.3 m³. While using the EOQ method is 17,251 m³. The total inventory cost incurred based on company policy is IDR 6,585,751.7,-. If using the EOQ method, the total cost of raw material inventory is IDR 4,181,567.52,- So that it can save inventory costs of IDR 2,404,181.18,-.

In addition, from table 3 it is known that the inventory control policy carried out by the company is still less effective and efficient. The factor that causes the company's inventory control policy to be less effective and efficient is the frequency of ordering raw materials carried out by the company too much, reaching 12 times a year, this results in very large ordering costs compared to using the EOQ method only ordering 4 times a year. Then, in addition to the ordering frequency factor, the company has not been able to determine how much inventory to use as safety stock so that there is no shortage of raw materials when there is a sudden increase in product demand. In addition, the company has not determined the raw material reorder point how much inventory is left when the company will reorder raw materials, considering that there is a lead time that causes the ordered raw materials to not be able to reach the company immediately. When compared to using the EOQ method, the company will be able to find out how much safety stock the company must have. From table 3 above, it can be seen that by using the EOQ method, the company must provide raw materials as safety stock of 1,540.67 m³ and ROP where the reorder point carried out by the company when the remaining inventory is 3,950.67 m³, this amount has taken into account the lead time of 10 days and the company's operating hours in a year of 308 days.

Thus, this can prove that the inventory control policy carried out by the company is not optimal. Proven from the calculation of the total cost of inventory between company policy and the EOQ method. Where the inventory cost of the company's policy is greater than the calculation of the EOQ method. Therefore, the company needs to control inventory to prevent excess or shortage of inventory that will affect inventory costs. The use of the EOQ method by the company will get an opportunity cost for the company because with the EOQ method the company will be able to save more inventory costs.

5 Conclusion

Based on the results of the research and data analysis, it can be concluded that the raw material inventory procurement policy carried out by the company so far has not been optimal and has not shown minimum costs in the sense that the inventory costs are still greater than if the company implemented raw material inventory control with the EOQ method. The implementation of raw material inventory carried out by the company so far has only been based on intuition, habits and experience in determining its policies. With reorder points and safety stock not being taken into account.

The company should know how much inventory is left if it wants to make a reorder in order to maintain the fulfillment of consumer demand and avoid additional costs outside the predetermined plan. The frequency of orders made by the company during one period is 12 times. This will have an impact on the amount of ordering costs. The problem faced by the company in controlling wood raw material inventory is that the company does not know when the remaining stock must reorder its raw materials, there is a possibility that the company will run out of raw material stock when production takes place at a certain time so that this will have an impact on not meeting consumer demand which causes the company to immediately reorder the products needed from the supplier as a result there will be additional costs outside the plan that will be determined. This problem is solved by implementing the EOQ method in the company, so that the purchase of raw materials each time an order is 17,251 m³ with a frequency of 4 orders during one period, with a difference of 8 times.

The EOQ method is more effective than the inventory method that has been used by the company to control inventory. The quantity of safety stock needed by the company with the EOQ method is 1,540.67 m³, while according to company policy there is none and the right reorder point according to EOQ is when the stock of raw materials in the warehouse is 3,950.67 m³. While according to company policy there is no exact reorder point.

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