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Application of Economic Order Quantity Method in Controlling Raw Material Inventory

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ABSTRACT: The research aims to determine the optimal order quantities of raw materials using Economic Order Quantity (EOQ), the total cost of raw material inventory, reorder point, order frequency, and application of the EOQ method on the CV. XYZ Kupang in an effort to optimize inventory costs.

The data used in this study consisted of primary data and secondary data both qualitatively and quantitatively related to raw material supply. Primary data were obtained through direct observation and interviews with various key respondents at CV. XYZ Kupang. Secondary data were obtained from the documents and reports from Management Company.

The results of this study indicate that the optimal quantity of raw material orders at CV. XYZKupang is 63.80 m3 in 2017, 63.04 m3 in 2018, and 72.80 m3 in 2019. The total cost of the company's raw material supply that issued if EOQ policy appliedRp. 32.267.554 in the year 2017, Rp. 24.507.185 in the year 2018, and Rp. 28.020.251 in the year 2019.CV. XYZ Kupang must perform an order back in the level of inventories of 16.74 m3 in 2017, at 10.08 m3 in 2018, and 9.82 m3 in 2019.6.90 m^3 in 2017, 6.20 m^3 in 2017, and 5.75 m^3 in 2019. CV. XYZ Kupang had to order as many as 9 times in the year 2017, 8 times in the year 2017, and 8 times in the year 2019. Thus the number of all bookings in the year 2017 of 7.09 m3, by the year 2018 of 7.88 m3 and in the year 2019 of 9.1 m3.CV. XYZ Kupang can optimize the cost of supplies, neither order of the cost of storage. If EOQ method applied, there is a saving from the total cost of the inventory in the year 2017 is Rp. 72.523.229, by the year 2018 is Rp. 68.476.912, and in 2019 is Rp. 76.468.558.

KEYWORDS: optimal order quantities (EOQ), the total cost of inventory, point of reorder, frequency of orders, and the EOQ method

INTRODUCTION

Background

Good production process requires a balance between factors of production, which includes raw materials, machine, capital, methods, and human resources. Raw materials are often consideredas an important factor, because the inventory of raw materials is the main support of the smooth production process. To that end, each company must have a planning of raw material needs better and should be aligned with each of the elements in the company without exception (Brasit, 2014; Assauri, 2018).

EOQ method is often used because it is easy to be implemented and able to provide the best solution for the company. This is evidenced by using the EOQ method, it is not only known what amount of inventory is the most efficient for the company, if inventory accumulates too much it affects the quality of goods and if it too little inventory will affect the level of sales. Inventories also make a large contribution to revenue because the efficiency of inventory costs can reduce inventory, but it will also be known that the costs incurred by the company in connection with the inventory of raw materials (calculated as Inventory Cost) and the most appropriate time to make a buyback (calculated by Reorder Point).

Rangkuti (2007) and Siswanto (2007), state that the EOQ is a method used to determine the amount of raw material purchases at each message with the lowest cost. In line with that, (Heizer and Render, 2010; Render, Stair and Hanna) mention EOQ is one of the oldest and most widely recognized inventory control techniques. This inventory control method answers 2 (two) important questions, when to order and how much to order. EOQ aims to minimize the costs incurred by inventory. Costs that are important to this model are storage costs, ordering costs, costs for carrying or maintaining supplies, and inventory placement costs. As for other costs such as the cost of purchasing the inventory itself, it is considered irrelevant for this model because these costs are considered constant.

According to (Kusuma, 2007; Chaze and Aquilano, 2007) supplies are materials, parts provided, and materials in the process contained in the company for the production process, as well as finished goods or products provided to meet the demands

of consumers or customers at any time. Inventory is important for the company, but this does not make the company have as much inventory as possible, having a large inventory does indeed minimize the possibility of inventory being unable to meet consumer needs. Meanwhile, (Ginting, 2010; Assauri (2016), states that inventory control is one of the activities of a sequence of activities that are in close sequence with each other in all of the company's production operations in accordance with what was planned in advance in terms of time, amount, quantity and cost.

The procurement of safety stock by companies is intended to reduce losses incurred due to the occurrence of stock out, but also at that time to maintain the carrying cost at lowest level possible. Furthermore, the Reorder Point can be calculated by adding up the raw material requirements during the Lead Time plus the amount of safety stock.

CV. XYZ Kupangrealizes that competition in raw material inventory is increasing very significantly. Therefore, the right strategy is needed to face the competition. One strategy used by the company to win in competition is to reduce costs to a minimum level possible. To fulfill the consumer demand, companies need a supply of raw materials that are not small in number. For this reason, mature planning is needed so that inventory costs are spent as efficiently as possible and do not become a problem that can drain a large cost.

RESEARCH METHODS

Types and sources of data

The types of data in this study are quantitative and qualitative data obtained from CV. XYZ Kupangon periode of June until July 2020.

Analysis Methods

Determine EOQ

EOQis the order amount that can minimize the total cost of inventory, so the cost calculation is only based on costs that affect orders and purchases, namely the total cost of the order and the total cost of storage. By using the following formula:

$$Q^* = \sqrt{2DS / H}$$

Description:
Q* = Quantity of goods at each order.
D = Number of requests for raw material needs per year.
S = Cost per each order
H = Storage fee per unit per year.

Determining Total Inventory Cost

Total inventory cost is the sum of the cost of storing and ordering costs.

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

Description:
TC = Total Inventory Cost
Q = Number of items per order
D = Annual demand for inventory, in units.
S = Order cost for each order.
H = Storage cost per unit per year.

Determine Safety Stock

Determination the cost of security supplies using statistical analysis, which is by considering deviations that have occurred between the estimated use of raw materials with actual usage, so that the standard deviation is known

$$SD = \sqrt{\frac{\sum (x-x)^2}{N}}$$

Description:
SD = Standard Deviation
X = Real use

X_{bar}= Estimated usage
N = Amount of Data

Assuming that the company uses 5% deviation and uses one side of the normal curve (values can be seen in the standard table = 1.65), the calculation Safety Stock is as follows:

$$SS = SD \times 1.6$$

Description:
SS=Safety Stock
SD = Standard Deviation

ReOrder Points

ReOrder Points can be calculated with adding up raw material needs during Lead Time plus the amount supply security (safety stock).So, ReOrder Points can be calculated with the formula (Heizer and Render, 2010):

$$ROP = dL + SS$$

Description:
ROP=ReOrder Point
D = Level of need per period
L = Lead Time
SS =Safety Stock

RESEARCH RESULTS AND DISCUSSION

Metode EOQ

The EOQ method allows companies to determine the most economical quantity of raw material orders with constant demand and lead time. The calculation of the optimal quantity of wood raw material orders during 2017-2019 can be seen in detail in Table 1 below.

Table 1. Usage, Ordering Fee and Annual Storage Fee

Year	Usage (D)			Order Cost (S) (Rp)	Storage Cost (H) (Rp)
	Total (m^3)	Price / m^3 (Rp)	Total (Rp)		
2017	598.16	7,250,000,-	4,336,660,000,-	1,755,755, -	516,168,-
2018	511.00	7,300,000,-	3,730,300,000 -	1,522,011,-	391,215,-
2019	610.55	7,500,000,-	4,579,125,000 -	1,710,027,-	393,957,-

Source: CV. XYZ Kupang (processed), 2020

Tahun 2017

$$EOQ = \frac{\sqrt{2 \times 598.16 \times Rp.1,755,755}}{Rp.\ 516,168}$$

$$= \sqrt{4,069.30} = 63.80\ m^3$$

Tahun 2018

$$EOQ = \frac{\sqrt{2 \times 511.00 \times Rp.1,522,011}}{Rp.\ 391,215}$$

$$= \sqrt{3,976,06} = 63.05\ m^3$$

Tahun 2019

$$EOQ = \frac{\sqrt{2 \times 610.55 \times Rp.\ 1,710,027}}{Rp.\ 393,957}$$

$$= \sqrt{5,300.36} = 72.80\ m^3$$

Based on the data from the EOQ calculation above, it is known that the optimal quantity of raw material orders is 63.80 m3 in 2017, 63.05 m3 in 2018, and 72.80 m3 in 2019 for each order. The calculation above shows that there is a significant difference between the EOQ values each year. EOQ is gradually experiencing a downward trend. The decrease was due to differences in the level of inventory and costs attached to these inventories, especially at the level of demand for raw materials each year. In 2019, the EOQ increased quite significant.

Optimal Order Frequency

After knowing the optimal quantity of raw material orders, the frequency of new orders can be calculated. The total order frequency is calculated from the division between the demand during the year concerned with the optimal quantity of orders for raw materials or by the formula: D / EOQ. The calculation of the frequency of orders / purchases of raw materials is presented as follows:

Year 2017

Order Frequency = Requests for a year / EOQ
598.16 m3 / 63.80 m3 = 9.377 times (9 times)
For one order quantity = EOQ volume / frequency
63.80 m3 / 9 times = 7.09 m3

Year 2018

Order Frequency = Requests for a year / EOQ
511.00 m3 / 63.05 m3 = 8.104 times (8 times)
For one order quantity = EOQ volume / frequency = 63.05 m3 / 8 times = 7.88 m3

Year 2019

Order Frequency = Requests for a year / EOQ
610.55 m3 / 72.80 m3 = 8.386 times (8 times)
For one order quantity = EOQ volume / frequency = 72.80 m3 / 8 times = 9.1 m3

CV. XYZ is principally involved in processing and selling sawn timber of various sizes in Kupang. Marketing and distribution of its wood products to meet various consumer and development needs. It is in this connection that various costs occur as listed in Table 2.

Table 2. Various costs incurred in CV XYZ Kupang 2017 – 2019 in Rupiah

Year	Storage Cost	Order Cost	Total Inventory Cost
2017	16,465,759	15,801,795	32,267,554
2018	12,331,097	12,176,088	24,507,185
2019	14,340,035	13,680,216	28,020,251

Source: CV. XYZ Kupang, 2020 (processed).

Furthermore, the data in Table 2 shows that the components of the cost of raw material inventory that cause storage costs are 16,465,759. In 2018 and 2019 it was Rp. 12,331,097, - and Rp. 14,340,035, - The total cost of raw material inventory based on the EOQ method in 2017 was 32,267,554, - in 2018 amounting to Rp. 24,507,185, - and in 2019 amounting to Rp. 28,020,251, -

Safety Stock

Safety stockis inventory additions are held to maintain the continuity of production from possible shortages of raw materials.The resulting standard deviation in Table 3 is 5.17 m^3 in 2017, 9.50 m^3 in 2018 and 0.88 m^3 in 2019, resulting in a safety stock of 8.53 m^3 in 2017, 3.08 m^3 in 2018 and 1.46 m^3 in 2019.

Table 3. Safety stock during 2017-2019

Year	Deviation	Standard Irregularities	Safety stock
2017	5.17 m^3	1.65	8.53m^3
2018	9.50 m^3	1.65	3.08m^3
2019	0.88m^3	1.65	1.46m^3

Source: CV. XYZ, 2020 (processed).

Reorder Point

Reorder Points the limit ofthe amount of inventory in the warehouse when the order has to be held back.The average usage is obtained from the results for the level of usage for a year, namely 360 days (see Table 4). The number of working days is assumed to be equal to 360 working days.

Table 4. ReOrder Point during 2017 - 2017

Year	Time Waiting(days)	Average usage / day / m^3	dL	SS	ROP (dL+ SS)
2017	4	0.80	3.20	3.70	6.90
2018	4	0.84	3.36	2.84	6.20
2019	4	0.86	3.44	2.31	5.75

Source: CV. XYZ Kupang (processed), 2020

The average usage is obtained from the quotient of the level of usage for a year with 365 days working days for a year. The number of working days is assumed to be the same as the number of days in a year. In accordance with the above data, the company must immediately place an order again when the inventory in the warehouse is 8.53 m^3 in 2017,3.08 m^3 in 2018, and 1.46 m^3 in 2019.

Comparison of Raw Material Inventory Costs

The method has been carried out by CV. XYZ Kupang can actually be compared with theEOQ method.The data in Table 5 shows that the EOQ method provides benefits to the company through the savings that occur, both in terms of storage costs and order costs.

Table 5. Raw Material Inventory Cost comparation actual and using EOQ Method

	2017		
Description	Actual (IDR)	EOQ (IDR)	Saver(IDR)
Storage Cost	27,537,563	16,465,759	11,071,804,-
Order Cost	77,253,220	15,801,795	61,451,425,-
Inventory Costs	104,790,783	32,267,554	72,523,229,-
	2018		
Description	Actual (IDR)	EOQ (IDR)	Saver(IDR)
Storage Cost	27,537,624	12,331,097	15,206,527,-
Order Cost	65,446,473	12,176,088	53,270,385,-
Inventory Costs	92,984,097	24,507,185	68,476,912,-
	2019		
Description	Actual (IDR)	EOQ (IDR)	Saver(IDR)
Storage Cost	27,537,594	14,340,035	13,197,559,-
Order Cost	76,951,215	13,680,216	63,270,999,-
Inventory Costs	104,488,809	28,020,251	76,468,558,-

Total: 152,937,116

Source: CV. XYZ Kupang (processed), 2020

Savings that occurred in storage costs amounted to Rp. 11,071,804, - in 2017, Rp. 15,206,527, - in 2018, and Rp. 13,197,559, - in 2018. Meanwhile, the savings incurred in order costs amounted to Rp. 61,451,425, - in 2017, Rp. 53,270,385, - in 2018, and Rp. 63,270,999, - in 2019. The total savings in inventory costs amounted to Rp. 72,523,229, - in 2017, Rp. 68,476,912, - in 2018, and Rp. 76,468,558, - in 2019.

CONCLUSION

Based on the analysis and calculation results that have been obtained, then the conclusions can be drawn on theapplication of the EOQ model at CV. XYZ Kupangare:

1. The optimal number of raw material ordersat CV. XYZ Kupang was 63.80 m^3 in 2017,-63,05 m^3 in 2018, and 72.80 m^3 in 2019.
2. The total cost of raw material inventory issued by the company if implementing EOQ policy are Rp. 32,267,554 in 2017, Rp. 24,507,185 in 2018, Rp.28,020,251 in 2019.
3. Thecompany must place an order again at the level inventory of 16.74m^3 in 2017, 10.08 m^3 in2018, 9.82 m^3 in 2019. Thus the number of actual inventory was in 2017at 22.30m^3.In 2018 it was 15.64 m^3. In 2019 it was 10.92 m^3.
4. The company must place an order9 times in 2017, 8 times in 2018, and 8 times in 2019.
5. If the EOQ method is applied, there will be a total cost savings in inventory, 2017of Rp. 72,523,229,- in 2018of Rp. 68,476,912,- and in 2019of Rp. 76,468,558.-

SUGGESTION

Based on the results of the research and analysis, the authors submit suggestions to the CV. XYZ Kupang which can be taken into consideration of the inventory policy. The suggestions proposed are as follows:

1. Companies should carry out inventory control processes which that can obstruct the production process addressed immediately.
2. Companies should use the EOQ method to make inventory costs more optimal.
3. Companies must also pay attention to two components of inventory costs, namely storage costs and order costs. These two cost components are the company's main references in determining its inventory control policy.
4. The company should pay attention to the number of times it is ordered so that it is optimal
5. Thecompany must also control the total cost of inventory in order to be optimal

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