

Evaluation of Raw Material Inventory in Socks Home Industry Using Economic Order Quantity (EOQ)

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Abstract

This study aims to evaluate purchasing raw materials and the Home Industry Socks by using the Economic Order Quantity (EOQ) method and the compare to the company's actual method. And to find out whether the EOQ method is effective to be applied to the company. The data used in this study are in the form of notes, reports, and company documentation for the period 2017, 2018, and 2019 provided by the owner through observation, interview, documentation, and literature study. Meanwhile, the usage data, raw material prices, and raw material purchase data are obtained from company records. The analysis technique in this study used EOQ formula, standard deviation, safety stock, Total Holding Cost, Total Ordering Cost, and Total Inventory Cost. The result of this research is that EOQ method is effective to be applied to socks home industry companies to control inventory more efficiently because it can minimize inventory costs.

Key-words: Economic Order Quantity, Safety Stock, Total Ordering Cost, Total Holding Cost, Total Inventory Cost.

1. Introduction

Covid-19, has had a global and local impact on the economy, so that many projects or businesses are not running smoothly, resulting in a sizeable deficit. This happens to large companies, and small companies, including Small and Medium Industries (SMI), for example, textile products, where 80% of companies stop their activities. (<https://mediaindonesia.com>). The influence also occurs in the small textile industry that operates at home or is commonly called the home industry.

One of the SMIs that has been affected by this pandemic is the home industry in the production of socks, which is located in the Bekasi district, south Tambun sub-district. Socks are one of the

products that people need in general and become a product that must be used as a complement to clothing, with a fairly large number of consumers in any segment.

The demand for socks products is decreasing because many activities outside the home are no longer available, where schools, colleges, and office activities use learning methods and work online and work from home. By working from home, the use of socks also decreases, so that the profit of processed socks decreases. This makes it difficult for business actors to estimate the costs of procuring raw materials and the number of raw materials needed because of the limited capital available from profit.

Therefore, this research is focused on the supply of raw materials used in producing socks, namely yarn. The types of yarn used in the production of socks are polyester, rubber, spandex, and PE yarns. These raw materials are the dominant raw materials in the manufacture of socks.

The selection of home industry socks is the object of research because the inventory control system used by the home industry socks is still simple. The owner only orders with traditional estimates, that is, if the amount of raw material availability has started to decrease or runs out, the company immediately orders raw materials again so that the production process does not stop. The calculation method has not yet been implemented in the home industry management, business actors do not know how big the optimal amount of raw materials is in one order. This happens because business actors do not have sufficient knowledge in inventory control and do not have experience in inventory control.

Table 1- Purchase of Raw Materials

No	Product	2017	2018	2019
1	Spandex	1. 346 Kg	1. 485 Kg	1. 590 Kg
2	Polyester	1. 550 Kg	1.723,2 Kg	1.833,4 Kg
3	PE	1.577,6Kg	1.757,1 Kg	1.860,7 Kg
4	Rubber	850,8 Kg	932 Kg	995 Kg

Source: Company data

Data on raw material purchases obtained from company records in the last 3 years has increased, this is due to an increase in finished socks products, with the price per kilogram of raw materials as follows:

Table 2 - Purchase Prices of Raw Materials

No	Product	2017	2018	2019
1	Spandex	Rp. 47.000	Rp.49.000	Rp.51.000
2	Polyester	Rp. 26.000	Rp.28.000	Rp.30.000
3	PE	Rp. 37.000	Rp.39.000	Rp.41.000
4	Rubber	Rp. 62.000	Rp.64.000	Rp.66.000

Source: Company data

It can be seen in the table above the prices for raw materials obtained from records in the home socks industry. Every year the price of raw materials always increases, due to an increase in consumer demand every year.

Table 3 - Use of Raw Materials

Raw material	2017 (kilogram)	2018 (kilogram)	2019 (kilogram)
Spandex	1. 296 Kg	1. 440 Kg	1.540,8 Kg
Polyester	1.497,6 Kg	1.663,2 Kg	1.778,4 Kg
PE	1.497,6 Kg	1.663,2 Kg	1.778,4 Kg
Rubber	820,8 Kg	902,88 Kg	964,8 Kg

Source: Company data

Data on the use of raw materials are obtained from the calculation of the amount of raw material used for every dozen socks products which are then multiplied by the number of sales from each month in one period. The use of raw materials for each dozen has been detailed in table 5. Therefore, it is necessary to use the sales data for the last 3 years that have been processed in table 4 to obtain the use of raw materials as a socks production process.

Table 4 - Socks Sales

Product	Per -Semester	2017	2018	2019
Office	January– June	1.200Ls	1.380Ls	1.500Ls
	July - December	1.200Ls	1.380Ls	1.500Ls
	January– June	4.200Ls	4.500Ls	4.800 Ls
MK Man	July - December	4.200Ls	4.500Ls	4.800 Ls
MK Male	January– June	4.200Ls	4.800Ls	5.100 Ls
	July - December	4.200Ls	4.800Ls	5.100 Ls
TOTAL		19.200	21.360	22.800

Source: Company data

Sales data taken on a semester basis above are obtained based on the average sales of socks each month in 2017 sales of 200 dozen office socks, 700 dozen MK men and 700 dozen MK ladies for the next period 2018 for office socks 230 dozen, socks 750 dozen MK men and 800 dozen MK ladies and in the 2019 period sales of 250 dozen office socks, 800 dozen MK men and 850 dozen MK ladies. If you look at sales in the last 3 years, the company's sales of finished socks look good because sales every year always experience a fairly large increase.

Table 5 - Uses per Dozen

Socks Type	Poly	Span	PE	Rubber
office socks	120 g	120 g	120 g	48 g
MK adult male	84 g	72 g	84 g	60 g
MK adult ladies	60 g	48 g	60 g	24 g
TOTAL	264 g	240 g	264 g	132 g

Source: Data processed

There are 3 types of socks produced, namely office socks, male adult ankle socks, and female adult ankle socks. It can be seen in table 5 that each product of one dozen socks requires different raw materials. This study aims to determine the number of economic orders at each time ordering raw materials, look for Safety Stock, Re-Order Point and determine storage costs, ordering, find out the frequency of economical orders and determine the total cost to obtain an efficient level of raw material supply. and determine the value-added tax of 10%.

From the description above, researchers are motivated to want to use the EOQ method in controlling inventory, because this method is better known and more often applied in various companies. In addition, researchers choose the Economic Order Quantity method because this method can answer questions about conditions that often occur in companies, namely determining the amount of inventory under the needs of the company.

2. Literature Review

Inventory management is part of an inventory system to achieve minimum costs. (Panday et al.).

The related things are the amount of order, reorder time, the number of items to be ordered, average inventory level. Inventory management aims to service the customers, in anticipation of meeting demand, maximizing the efficiency of purchasing, minimizing stock cost, and maximizing

profits. Too much inventory will cause increased inventory costs, while too little inventory will result in increased ordering costs and excessive ordering frequency. (Panday et al.)

Type of inventory according to (Heizer, J., & Render) (Hillier and Lieberman) (Blumenfeld)) as raw material inventory, work-in-process inventory, maintenance repair operating, finish-good inventory.

According to (Heizer, J., & Render) (Hillier and Lieberman) (Blumenfeld)), There are three types of costs in inventory, among others:

1. Holding cost.
2. Ordering cost.
3. Setup cost.

EOQ (Economic Order Quantity)

EOQ is one of the oldest and most widely known inventory management models, to determine the number of goods / raw materials with minimal costs (Heizer, J., & Render) (Hillier and Lieberman) (Blumenfeld) (Kalaiarasi). The goal of the EOQ method is the efficiency of inventory levels in terms of low cost and optimal needs. The EOQ method has been used in several studies by (Yuliana et al.) (Yopan Maulana) (Saragi and Setyorini) (Fahmi Sulaiman).

The EOQ must meet the following assumptions (Maisuriya and Bhathawala) (Heizer, J., & Render) (Hillier and Lieberman):

1. Needs in one year are known to be constant
2. The lead time is constant.
3. Supplies are immediately received and complete in full.
4. Quantity discounts are not available.
5. The cost of ordering and the cost of holding inventory is fixed.
6. Out of stock can be completely avoided if the order is made promptly.

According to (Heizer, J., & Render) (Hillier and Lieberman) (Blumenfeld) (Onawumi, Oluleye) (Birbil, Bulbnul, J.B.G.Frenk) (Tibrewala and Kleinstein) to determine the amount of economic order, use the following formulas:

Table 6 - The formula of Economic Order Quantity

$\text{EOQ atau } \bar{Q} = \sqrt{\frac{2DS}{H}}$	EOQ or \bar{Q} : Optimal order amount (in units) D: Number of demands per year (in units). S: Ordering cost.
$N = \frac{D}{Q^*}$	H: Holding cost per unit. N: Frequency of orders for one year
$\text{TCC} = \frac{Q}{2} H$	TCC: total holding cost TOC: total ordering cost
$\text{TOC} = \frac{D}{Q} S$	Q: EOQ H: ordering cost D: demand S: holding cost
$\text{TC} = \text{TOC} + \text{TCC}$	TC: Total cost
$\text{ROP} = (L \times d) + \text{SS}$	ROP: Reorder point L: Lead time d: rate of need per day SS: safety stock
$\text{Standart Deviasi} = \sqrt{\frac{\sum(x - \bar{x})^2}{n}}$	X: The number of goods needed \bar{x} : Average amount of goods needed n: Amount of data
$\text{SS} = Sd \times Z \text{ or } \text{SS} = Sd \times 1,65$	SD: Standard deviation Z: Safety factor

Value Added Tax (VAT)

Definition of Value Added Tax (VAT) is a tax imposed on any increase in the value of a good or service in its circulation from producer to consumer (www.kemenku.go.id). Then Daud, Sabijono, & Pangerapan, (2018) added Value Added Tax (VAT) is a tax imposed on any added value of goods or services in circulation from producers to consumers. In other words, the tax bearer (the final consumer) does not directly deposit the insured tax.

Prior Research

Research using EOQ to optimize inventory and costs has been used in research (Wahyudi) to sandals inventory at Samarinda's New Era store, (Nurhasanah) conducting Solar Inventory Analysis Using the Economic Order Quantity Method (EOQ) at PT. Anugrah Bara Kaltim, (Fahmi Sulaiman) use the EOQ Method in a furniture company, (Gede Agus Darmawan, Wayan Cipta) apply the EOQ in flour raw material inventories at the Pia, (Asrori) on Sengon wood raw material inventory at PT. Abhirama Kresna, and (Indrayati) analyzed raw material inventory control at PT. Tipota Furnishings Jepara. (Rorim Panday; Hernawati) use EOQ in the inventory of raw materials for Akadril cough syrup.

From the previous research above it can be concluded that the studies are still in line with the research conducted by the author.

3. Method

This research is a quantitative study, conducted at Tambun Selatan, Bekasi, dilakukan pada bulan September 2020 hingga Januari 2021. The calculation method uses Economic Order Quantity. The data needed is inventory data which includes sales data, ordering costs, holding costs, and product ordering data. After collecting all data, a calculation is made using the Economic Order Quantity formula. Then a comparative analysis is carried out on the implementation of inventory management.

4. Result and Discussion

Before doing the calculation, EOQ will calculate the storage and ordering costs per unit. Home Socks Industry purchases yarn raw materials independently using their private car once a month, purchasing raw materials in the Bandung Regency area has a fairly far reach from Bekasi Regency. costs incurred by the company, namely the cost of gasoline of Rp. 300,000, the entrance fee for travel via TOLL is Rp. 150,000 for one trip, and consumption on the trip is Rp. 50,000 when the total costs are Rp. 500,000 x 12 months than in one period of Rp. 6,000,000.

Total Order cost/ Frequency Ordering

$$\frac{6.000.000}{12} = 500.000 : 4 = 125.000$$

The value of 4 is the number of types of raw materials ordered so that it is found that the ordering costs incurred are Rp. 125,000 in one order.

For storage costs, there are two costs incurred, namely electricity costs of Rp. 720,000 and warehouse rental costs Rp. 6,000,000 for the period 2017, 2018 and 2019.

Total Holding cost/Capacity storage

$$\frac{6.720.000}{500 \text{ kg}} = \text{Rp. } 13.440/\text{KG (Spandex, Polyester, PE \& Rubber)}$$

For the storage cost of Spandex, Polyester, PE, and Rubber raw materials in the previous 3 years period are still the same, namely Rp. 13,440 per kilogram.

After knowing the cost of ordering in one order and the number of storage costs per unit, then the calculation of EOQ, frequency of orders, safety stock, reorder points, total ordering costs, total storage costs, total inventory costs, and taxes are known.

Comparison of Actual Procedures and EOQ

The results of the computation have been carried out previously and then the results of the two methods are compared to be a decisive choice for the home industry company socks which method is the most effective and efficient. The results of the comparison can be seen in the table below:

Table 7 - Calculations based on Company Procedures

Product	Component	Actual		
		2017	2018	2019
		112,16 kg	123,75 Kg	132,5Kg
	Frequency	12	12	12
	Ordering cost	IDR. 1.500.000	IDR. 1.500.000	IDR. 1.500.000
Spandex	Holding cost	IDR. 1.507.520	IDR. 1.663.200	IDR. 1.780.800
	Inventory cost	IDR. 3.007.520	IDR. 3.163.200	IDR. 3.280.800
	Tax 10%	IDR. 300.752	IDR. 316.320	IDR. 328.080
	Component	2017	2018	2019
		129,16 kg	143,6 Kg	152,78 Kg
	Frequency	12	12	12
	Ordering cost	IDR. 1.500.000	IDR. 1.500.000	IDR. 1.500.000
Polyster	Holding cost	IDR. 1.736.000	IDR. 1.929.984	IDR. 2.053.408
	Inventory cost	IDR. 3.236.000	IDR. 3.429.984	IDR. 3.553.408
	Tax 10%	IDR. 323.600	IDR. 342.998,4	IDR. 355.340,8
	Component	2017	2018	2019
		131,46 Kg	146,42 Kg	155,05 Kg
	Frequency	12	12	12
	Ordering cost	IDR. 1.500.000	IDR. 1.500.000	IDR. 1.500.000
PE	Holding cost	IDR. 1.766.912	IDR. 1.929.984	IDR. 2.083.648
	Inventory cost	IDR. 3.266.912	IDR. 3.429.984	IDR. 3.583.648
	Tax 10%	IDR. 326.691,2	IDR. 342.998,4	IDR. 358.364,8
	Component	2017	2018	2019
		70,9 kg	77,66 Kg	82,91 Kg
	Frequency	12	12	12
	Ordering cost	IDR. 1.500.000	IDR. 1.500.000	IDR. 1.500.000
Rubber	Holding cost	IDR. 952.896	IDR. 1.043.840	IDR. 1.114.400
	Inventory cost	IDR. 2.452.896	IDR. 2.543.840	IDR. 2.614.400
	Tax 10%	IDR. 245.289,6	IDR. 254.384	IDR. 261.440

Source: Company data

Obtaining the results of the method before the Economic Order Quantity in the socks home industry company does not have a safety stock and the reorder point then the inventory control in the home industry of socks have not been effective and the resulting of inventory cost is greater when compared to using the Economic Order Quantity method as follows:

Table 8 - Calculation Results Using the EOQ Procedure

		EOQ		
Product	Component	2017	2018	2019
	EOQ	156 kg	164 kg	170 kg
	Frequency	9 kali	9 kali	10 kali
	Ordering cost	IDR.1.037.500	IDR.1.097.500	IDR.1.132.500
Spandex	Holding cost	IDR.1.048.320	IDR.1.102.080	IDR.1.142.400
	Inventory cost	IDR.2.085.820	IDR.2.199.580	IDR.2.274.900
	Tax 10%	IDR.208.582	IDR. 219.958	IDR. 227.490
	<i>Safety Stock</i>	6,43 kg	10,97 kg	12,12 kg
	ROP	10,54 kg	15,54 kg	17,01 kg
	Komponen	2017	2018	2019
	EOQ	167 kg	176 kg	182 kg
	Frequency	9 kali	10 kali	10 kali
	Ordering cost	IDR.1.120.000	IDR.1.181.250	IDR.1.221.250
Polyster	Holding cost	IDR.1.122.240	IDR.1.182.720	IDR.1.223.040
	Inventory cost	IDR. 2.242.240	IDR. 2.363.970	IDR. 2.444.290
	Tax 10%	IDR. 224.224	IDR. 236.397	IDR. 244.429
	<i>Safety Stock</i>	6,43 kg	12,75 kg	16,13 kg
	ROP	11,18 kg	18,03 kg	21,77 kg
	Component	2017	2018	2019
	EOQ	176 kg	176 kg	182 kg
	Frequency	9 kali	10 kali	10 kali
	Ordering cost	IDR.1.120.000	IDR.1.181.250	IDR.1.221.250
PE	Holding cost	IDR.1.122.240	IDR.1.182.720	IDR.1.223.040
	Inventory cost	IDR. 2.242.240	IDR. 2.363.970	IDR. 2.444.290
	Tax 10%	IDR. 224.224	IDR. 236.397	IDR. 244.429
	<i>Safety Stock</i>	6,27 kg	11,99 kg	14,94 kg
	ROP	11,02 kg	17,27 kg	20,58 kg
	Component	2017	2018	2019
	EOQ	124 kg	130 kg	134 kg
	Frequency	7 kali	7 kali	7 kali
	Ordering cost	IDR. 826. 250	IDR. 867. 500	IDR. 900.000
Rubber	Holding cost	IDR. 833. 280	IDR. 873. 600	IDR. 900.480
	Inventory cost	IDR.1.659.530	IDR. 1.741.000	IDR. 1.800.480
	Tax 10%	IDR.165.953	IDR. 174.100	IDR. 180.048
	<i>Safety Stock</i>	5,28 kg	7,32 kg	10,37
	ROP	7,88 kg	10,18 kg	13,43 kg

(Source: Data processed 2020)

It can be seen carefully in the company procedure table with the EOQ procedure that the EOQ method produces a larger optimal order quantity while the warehouse capacity is only 500 kg which exceeds the warehouse capacity. Therefore the company must increase the capacity of the existing warehouse so that the EOQ method can be implemented.

The company can have a safety stock and an order point when the company must reorder. The results obtained by the EOQ method of ordering frequency are reduced in one period and the total cost of inventory becomes more economical and the value-added tax also decreases. With the EOQ method, the company can save costs of Rp. 3,733,498, 2018 period Rp. 3,898,388 and the 2019 period of Rp. 4,068,296.

5. Conclusions

Based on the results obtained by using the economic order quantity (EOQ) method at the home socks industry company, the following conclusions can be drawn:

1. There has been a decrease in the order frequency, where the company usually makes 12 orders with the purchase of raw materials. By using Economic Order Quantity gets 7 to 9 orders for the period 2017, 7 to 10 orders for the period 2018, and 8 to 10 orders for the period 2019.
2. The optimal order unit for raw materials at Home Industry of Socks using EOQ, for 2017 are: 156 kg Spandex, 167 kg Polyester, 176 kg PE, and 124 kg Rubber. For period 2018: 164 kg Spandex, 176 kg Polyester, 176 kg PE, and 130 kg Rubber. And for the 2019 period: 170 kg Spandex, 182 kg Polyester, 182 kg PE, and 134 kg Rubber.
3. Safety Stock obtained were 6.43 kg for each Spandex and Polyester, 6.27 kg PE, and 5.28 kg Rubber in period of 2017; for period 2018 as many as 10.97 kg Spandex, 12.75 kg Polyester, 11.99 Kg PE, and 7.32 Kg rubber. The next period of 2019 were 12.12 kg Spandex, 16.13 kg Polyester, 14.94 kg PE, and 10.37 kg Rubber. For ROP were: 10.54 kg Spandex, 11.18 kg Polyester, 11.02 PE, and 7.88 Rubber for the period 2017, and the next period 2018 were 15.54 kg Spandex, 18.03 kg Polyester, 17.27 kg PE, and 10.18 kg Rubber and for the period 2019 were 17.01 kg Spandex, 21.77 kg Polyester 20.58 kg PE, and 13.43 kg Rubber.
4. Inventory cost raw materials per period with EOQ: for period 2017 as much IDR. 8229,830, for period 2018 as much IDR. 8,668,620, and for period 2019 as much IDR. 8,963,960. Inventory cost by company procedure have result as follow: for period of 2017 as IDR. 11,963,328, for period 2018 as IDR. 12,567,008, and for period 2019 as IDR. 13,032,256. This means, by using the EOQ method the company can save costs in the period 2017 as much IDR. 3,733,498, in the period 2018 as IDR. 3,898,388, and in the period 2019 as IDR. 4,068,296.
5. The acquisition of value-added tax for all raw materials per period with company procedure: for period 2017 as much Rp. 1,196,332.8, for period 2018 as much Rp. 1,256,700.8 and for

period 2019 as much Rp. 1,303,225.6. There is a decrease in tax by using EOQ as follow: for period 2017 become as Rp. 822,983, for period 2018 become as Rp. 866,852, and for period 2019 become as Rp. 896,396.

6. Recommendations

1. For the company, it would be nice to review the raw material inventory policy carefully. Because the results of the study found that the methods or policies used by the company were less effective and efficient in controlling inventory and minimizing inventory costs.
2. The company should increase the inventory capacity because the optimal number of orders obtained exceeds the existing inventory capacity to get maximum profit and continuity production.
3. Companies should apply the Economic Order Quantity method because the results of the total costs are more efficient than the total costs incurred by the company.
4. Companies should evaluate and consider the use of the Economic Order Quantity (EOQ) method in purchasing raw material supplies of spandex, polyester, PE, and rubber as materials in the manufacture of socks.

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