



Planning of Soybean Raw Material Inventory Control Using Economic Order Quantity (EOQ) Method, in Corina Factory Kudus, Central Java

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Abstract

Capital market is a market that all prices that occur should be caused because the market mechanism that has been in such a way able to respond to all the information that exists automatically. Such a market is a market that conforms to the concept of an efficient market. In an efficient market, market participants or investors, will not be able to gain an edge over other investors in terms of investment decisions based on the information they get. The market efficiently assumes that the information that is in the market can be accessed by all actors. In fact, many anomalies occur in the market that break through all assumptions built by the concept of an efficient market, one is the phenomenon of price reversal. Price reversal is a phenomenon in which the price of a stock instrument that suddenly experiences a price reversal because there is information that enters the market and is responded to excessively (overreaction) by the market. Research uses quantitative paradigms to prove a particular hypothesis built into research. The data used is secondary data obtained using stock transaction data as well as financial statement data of each sample company.

INTRODUCTION

Indonesia is the country with the most soybean consumption in the world after China. Even so, Indonesia still relies on soybeans from the United States (US) which causes soybean prices to be unstable. According to data from CBOT, the Chicago Board of Trade as of April 1, 2021, it was seen that the provision of world soybean prices in April 2021 was in the range of US \$ 14.33 per bushel, which experienced a price increase of between 3.69% from the Provision of March 2021 which amounted to US \$ 13.82 per bushel. According to kontan.co.id (2021) the results of data from trading economics as of May 1, 2021, the price of soybeans has risen again to US \$ 15.52 per bushel. According to Trade Minister Muhammad Lutfi, predicting an increase in soybean prices could still occur until May 2021. The main cause of the increase in world soybean prices is

due to high demand. Changes in the price of raw materials can be avoided by companies with the existence of supplies so that companies can store raw materials if the price of raw materials in the market is too high so that it can cause high costs for the purpose of purchasing raw materials.

EOQ is an inventory system by determining the quantity of economical orders aimed at minimizing total costs (Hansen & Mowen, 2021). By using the EOQ method, companies can reduce inventory costs by optimizing the purchase of raw materials. Sofian Choi et al., (2018), argues that raw material is a basic material that includes all raw materials used in factory companies, except for physical materials that will be combined with products produced by the factory company, so that the efficiency of inventory in the company can run well. Inventory is goods or materials that are always in the company to be stored with the aim to meet the production process, equipment,

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and machinery in the form of raw materials as auxiliary materials in the production process into finished goods or semi-finished goods. Yamit (2020). With good supplies the company can also reduce the risk of delays in the arrival of raw materials from suppliers..

In controlling inventory management, the company must pay attention to safety supplies. Fithri et al., (2019), argue that safety stock is a safety supply to maintain materials or goods, if the company experiences a shortage of raw materials (stock out) by providing additional supplies to anticipate. To bring raw materials into the warehouse in a timely manner, so that there will be no shortage of raw materials due to excess raw materials in the warehouse or vice versa the delay in the arrival of raw materials, namely because the ordered raw materials come too early. The company must consider the length of the waiting time required in the purchase of such raw materials, with reorder points, Carter (2009), re-order points are the amount of available inventory as well as the amount of inventory that will be used by the company during the waiting time and the amount of safety stock.

Tiga Berlian is the product name of a Corina company engaged in the food industry, namely producing tofu where soybeans as the main raw material. Corina's company was established in 1978 which is a family company of his late father and mother which was passed on by his own son named Mr. Harmoko as the owner of Corina's village located in Glantengan village, Kudus, Central Java as a place for soybean production. The price of soybean raw materials that continued to rise until the peak of 2021 caused the Corina plant to experience a decrease in production from previous years. The Corina plant requires a supply of the main raw material, namely soybeans. Since its establishment until now the Corina factory has not implemented a supply control system. The control of supplies carried out by Mr. Harmoko is traditional in the form of no systematized planning. Therefore, researchers are interested in conducting research. Choi et al., (2018) argues that raw materials are basic materials that include all raw materials used in factory companies, except for physical materials that will be combined with products produced by the factory company.

Stevenson (2015), said that inventory is one of the production processes by storing goods or materials so that they can be resold as reserves from equipment or machines owned by the

company. Function inventory according to Yamit (2008) said that the inventory function has four factors, which include (1) the time factor, which is related to the time needed in the production and distribution process, it takes time to make a schedule so it is necessary to stock up to meet the lead time, namely the need for waiting time, (2) the arrival uncertainty factor is that the company requires inventory so as not to hamper production or delay delivery to consumers, (3) use uncertainty factor, to anticipate forecasting uncertainty where the use from within the company is an error in demand forecasting, (4) the economic factor is the purchase in large quantities, there is a possibility that the company will get a discount according to the agreement.

Guo et al., (2018) state there are several elements used in calculating EOQ, (1) ordering costs are costs incurred by companies related to orders and are not affected by the number of items ordered, (2) carrying cost is a storage cost where this cost depends on the amount of inventory stored, if the company stores finished goods or materials inventory, (3) total cost or Total Annual Cost (TOC) is the sum of the total ordering costs or Total Ordering Cost (TOC) and storage costs or Total Carrying Cost (TCC).

Fithri (2019) argue that safety stock is a safety stock to maintain materials or goods, if the company experiences a material shortage (stock out) by providing additional inventory to anticipate. Stevenson (2015) argue safety stock is the minimum stock in anticipation if the company experiences a shortage of materials or delays in materials purchased by the company to facilitate the production process. According to Stevenson (2015) The reorder point (ROP) arises when the quantity includes the estimated demand during waiting time or extra inventory. This amount has been predetermined which serves to reduce the probability of stock outs occurring during the waiting time. Stevenson (2015) says that in determining the re-order point there are things that must be considered. (1) use of materials during lead times. Lead time is the waiting time when placing an order for materials which is determined by the distance between the company and the source of the material using different transformation tools, the waiting time varies from one item to another, (2) safety stock is the minimum inventory carried out by the company in anticipation if the company experiences a shortage or runs out of inventory or delays in materials ordered by the company (out of stock).

METHOD

Researchers used quantitative descriptive research with a case study approach. The types of data used are primary and secondary data (1) Primary Data : Interview, The researcher obtained primary data by conducting direct interviews with the owner of the Corina factory, regarding the company's data in 2019-2021, Company operational data, which includes: (a) Sales data (b) Production data (c) Raw material purchase data (d) Raw material inventory data (h) Raw material storage cost data (2) Secondary Data : Researchers obtain secondary data through literature such as operations management books related to raw material inventory and several other journals and articles that can help solve the problems that underlie the research. Data collection used by researchers includes interviews, documentation, and literature study. In this study the authors set the following variables: (1) product demand, (2) raw material demand (3) inventory cost, (4) ordering cost, (5) raw material purchase cost. Researchers collect data by study operations management books related to raw material inventory and several other journals and articles that can help solve the problems that underlie the research. The author uses a descriptive method, namely by seeking control of soybean raw material inventory according to company policy which consists of the number and frequency of soybean raw material production and raw material inventory costs, where the inventory costs incurred by the company are obtained through information obtained directly from the Corina factory. The data analysis technique used in this research is the calculation using the economic order quantity (EOQ) method. (1) analysis of economic order quantity, (2) ordering cost a year, (3) inventory cost a year, (4) optimal raw material order quantity, (5) Optimal amount of soybeans every order, (6) total inventory cost, (7) safety stock, (8) reorder points.

RESULT AND DISCUSSION

Tiga Berlian is the product name of a Corina company engaged in the food industry, namely producing tofu where soybeans as the main raw material. Corina's company was established in 1978 which is a family company of the late father and mother which was passed on by her own son named Mr. Harmoko as the owner of Corina's village located in Glantengan village, Kudus, Central Java as a soybean production place that has 10 factory employees including 9 tofu

production workers, factory finance manager 1 person. Every month Corina can produce tofu flowers as much as 4,600 - 5,200 packs every year.

Inventory Management Analysis Using the EOQ Method.

Inventory management analysis using the model EOQ method, starting from the Demand stage. The production capacity of the Corina plant reached an average of 2019-2021 per year, which was 4,898 units

Table 1. Production Rate Data

Year	Production Rate	Unit Product
2019	58,000 kg	5.220
2020	53,500 kg	4.815
2021	51,753 kg	4.658
Average	54,471 kg	4.898

In table 1, it can be concluded that the use of raw materials for the Corina factory at the beginning of the year has decreased, this is due to an increase in the price of raw materials at the peak of 2021. The frequency of purchases during 2019-2021 is every month 2 times. For the average purchase of soybeans during 2019-2021 is 54,471 kg.

Table 2. Data on level of sales goods

Year	Sales Rate Tofu Flowers	Unit Product
2019	58,000 kg	5.220
2020	53,500 kg	4.815
2021	51,753 kg	4.658
Average	54,471 kg	4.898

In table 2 above that the amount where each Corina factory produces, will be directly sent to the supplier of tofu flowers, where the Corina factory will produce according to the level of demand.

Table 3. Levels of Beginning and Ending Finished Goods Inventory

Year	Initial Inventory	Final Inventory
2019	0	0
2020	0	0
2021	0	0

The next data used in this study is the initial and final inventory level of goods so 2019-2021. It can be seen that table 3 that in 2019-2021 for initial and finally inventory.

Table 4. Initial and final inventory data for raw materials

Year	Initial Inventory	Final Inventory
2019	116,000 kg	2,320 kg
2020	107,320 kg	3,005 kg
2021	103,505 kg	4,140 kg

According to the information provided by the owner of the corina factory to researchers regarding the initial inventory and final supply of soybean raw materials in 2019-2021. In 2019 the initial provision of finished goods amounted to 116,000 kg, the final supply was 2,320 kg. In 2020 the initial inventory was 107,320 kg and the final inventory was 3,005 kg. In 2021 the initial supply of raw materials amounted to 103,505 kg and the final supply of soybean raw materials amounted to 4,140 kg.

Table 5. Ordering Cost

Cost Component	Ordering Cost 2021
Phone fees	Rp. 8,500
Administrative costs	Rp. 6,000
Shipping Costs	Rp. 1,046.873
Average	Rp. 1.061.373

Ordering Cost on the table 6 issued by the company for order is Rp. 1,061,373 . While the duration of delivery of raw materials from suppliers to corina factories for one day.

Table 6. Inventory Cost

Cost Component	Ordering Cost 2021
Warehouse electricity costs	Rp. 1.200.000
Warehouse tax charges	Rp. 2.400.000
Supervisor's Salary Costs	Rp. 4.123.800
Damage costs	Rp. 18.504.060
Average	Rp. 26.227.860

In table 3, the storage cost used by the Corina factory is Rp. 26,227,860

Economic Order Quantity (EOQ)

$$EOQ = \sqrt{\frac{2DS}{h}}$$

Soybean raw materials is the most economical for the year 20 22 with using the Economic

Order Quantity (EOQ) method are:

Description :

D = material usage time period

S = ordering cost for one order

h = Inventory cost for one unit a year

$$EOQ = \sqrt{\frac{2DS}{h}}$$

$$EOQ = \sqrt{\frac{2 \times 90.092 \times 1.319.817}{192}} = 35.193 \text{ Kg}$$

Frequency of purchasing raw materials in a year:

$$\frac{139.775}{35.193} = 3,9 \text{ or } 4$$

The data obtained from the results of the study, namely the amount of raw materials needed for one year is 90.092 kg, the cost of ordering each time is 1.319.817 The storage cost is Rp. 192. So the most economical order quantity for the Corina factory for ordering soybean raw materials per year is 35.193 kg for each order. Meanwhile, the frequency of ordering soybeans is 4 times a year.

This analysis can be done using the following formula :

$$TIC = TOC + TCC$$

Description :

TIC = Total inventory cost for one period

TOC = Total cost of order

TCC = Total carrying cost

Based on the 2022 Economic Order Quantity (EOQ) method

$$TOC = \frac{R}{Q} S$$

$$TOC = \frac{90.092}{31.948} \times 1.319.817 = \text{Rp.} 3.721.828$$

$$TCC = \frac{Q}{2} C$$

$$TCC = \frac{31.948}{2} \times 192 = \text{Rp.} 3.067.008$$

$$TIC = 3.721.828 + 3.721.942 = \text{Rp.} 6.788.836$$

So , the total cost of inventory in 2022 is Rp. 6.788.836

Total Inventory Analysis Company Policy method

Total costs that do not use the Economic Order Quantity (EOQ) method, the company determines the frequency of purchasing raw materi-

als 72 times in 3 years, So for the year 2019-2021, one purchase is 321.500 kg : 72 = 4.465 kg . It is assumed that the purchase frequency in 2022 is the same as the average purchase frequency for 2019-2021, namely (72/3 = 24 times). Then total ordering cost and total inventory cost in 2022 as follows:

$$TOC = 1.319.817 \times 24 = 31.675.608$$

$$TCC = \frac{4.465}{2} \times 192 = 428.640$$

$$TIC = 31.675.608 + 520.173 \\ = RP.32.104.248$$

So the total inventory cost according to company policy in 2022 is IDR 32.104,248

Tabel 7. comparison of company policy method with EOQ method

Description	Company Method 2021	Company Method 2021	EOQ Method 2021	EOQ Method 2022
Frequency/year	24 times	24 times	3 times	4 times
TOC	Rp. 25.472.952	Rp. 31.675.608	Rp. 3.644.152	Rp. 3.721.828
TCC	Rp. 521.157	Rp. 428.640	Rp. 3.644.240	Rp. 3.067.008
TIC	Rp. 25.994.109	Rp. 32.104.248	Rp. 7.308.392	Rp. 6.788.836

The conclusion from table 7 is that the EOQ method is more effective than the company policy method It is proven that there is a decrease in inventory costs (order costs and storage costs) of Rp. 25,315,412 with a purchase frequency of 4 times a year. Meanwhile, the raw material control carried out by the Corina factory before using the Economic Order Quantity (EOQ) method was Rp. 31,675,608 for ordering costs and Rp 428,640 for holding costs , so the total inventory cost before using the Economic Order Quantity (EOQ) method was Rp 32,104. 248.

Safety Stock Analysis

$$\text{Safety Stock} = Z \times \sigma d \times \sqrt{L}$$

Description :

Z = Standard deviation value associated with the level of service possibility

σd = Standard deviation

\sqrt{L} = lead time

Standard Deviation for 2019-2021 is

$$\sigma d = \sqrt{\frac{\sum (X - x)^2}{n}}$$

$$\sigma d = \sqrt{\frac{220.491.568}{36}} = 2.475 \text{ kg}$$

After the standard deviation is known, the next step is to calculate the safety stock, in this discussion using a 95% confidence level. The 95% confidence level can be calculated by the formula:

$$Z = 95\% (1.65)$$

$$SS = Z \times \sigma \times \sqrt{L}$$

$$SS = 1,65 \times 2.475 \sqrt{1} \\ = 4.083,453 \text{ atau } 4.083 \text{ kg}$$

So the amount of safety stock for raw materials in 20-22 is 4.083 kg

Re-Order Point Analysis (Reorder Rate)

The lead time that has been set by the company is 1 day, working days for one year are 365 days, the analysis of the Re Order Point calculation is as follows:

$$ROP = dL + Z\sigma d\sqrt{L}$$

Description :

ROP = Reorder Point

d = Demand per day

L = Waiting time

Z = Standard deviation value associated with the level of service possibility

σd = Standard deviation

\sqrt{L} = lead time

$$d = 869 = 290 \\ 3$$

$$ROP = (290 \times 1) + 4.083 = 4.373 \text{ kg}$$

When the inventory of soybean raw materials in the warehouse has reached 4,373 kg , the company must place an order for raw materials again so that the company does not experience a shortage of raw material inventory for use in the production process.

CONCLUSION AND RECOMMENDATION

Based on the results of calculations using the Economic Order Quantity (EOQ) method, it shows that the purchase of raw materials made by the Corina factory is not optimal. Meanwhile,

if the Corina factory uses the Economic Order Quantity (EOQ) method, it can obtain optimal and economical raw material purchases. Based on company policy in 2021, the purchase of raw materials for one order made by the company is 4,186 kg taken from the average purchase of raw materials during the 2019-2021 time period, while using the Economic Order Quantity (EOQ) method of purchasing raw materials for one order. in 2021 by 29.271 Kg. The frequency of purchases based on the policy of the Corina factory company is 24 times, while using the Economic Order Quantity (EOQ) method the purchase frequency is 3 times a year. Based on the company's policy in 2022, the purchase of raw materials for one order made by the company is 4.465 kg, it is assumed that the purchase frequency in 2022 is the same as the average purchase frequency for 2019-2021. Meanwhile, using the Economic Order Quantity (EOQ) method, the purchase of raw materials for one order in 2022 is 35.193 kg. The frequency of purchases based on the Corina factory policy is an average of 24 times, while using the Economic Order Quantity (EOQ) method the purchase frequency is 4 times a year. It can be seen that using the Economic Order Quantity (EOQ) method in purchasing raw materials will be more effective in terms of purchasing frequency per year and more efficient in terms of purchasing raw materials for a single purchase. The Corina factory in carrying out production activities does not stipulate a safety stock. The company will immediately buy raw materials again if the raw materials are seen to be low. This policy will be a problem for the company if there is a delay or unavailability of soybean ingredients to be purchased by the company. The Corina factory must consider the existence of a safety stock, so things that are not desirable can be controlled, so in this study the researchers presented an analysis of the safety stock of 4.083 kg with a 95% confidence level and a standard deviation of 2.475 kg and a lead time of 1 day. Reorder point at the Corina factory in this analysis is 4.373 kg, the results of the analysis carried out by the author will be a guide for companies to reorder if the supply of soybean raw materials is close to that result. So the optimal amount of raw material inventory in one period at the Corina Factory is 4 times a year with the purchase of soybean raw materials of 35.193 kg per order to reach the optimum point

The total cost of raw material inventory for the Corina 2021 factory based on company policy is Rp 25.994.109 (Total Ordering Costs Rp.25.472.95 and Total Carrying Costs Rp.521.157). while the total inventory method

used by the company when calculated using the Economic Order Quantity (EOQ) method. Total Inventory Cost is Rp.7.308.392 consisting of (Total Order Cost Rp.3.644.152 and Total Carrying Cost Rp.3.644.240). In total inventory that does not use the Economic Order Quantity (EOQ) method, the Total Inventory Cost is Rp. 32.104.248 consisting of (Total Ordering Costs Rp. 31.675.608 and Total Carrying Costs Rp. 428.640). while the total inventory method used by the company when calculated using the Economic Order Quantity (EOQ) method is the Total Inventory Cost of Rp. 6.788.836 which consists of (Total Ordering Costs Rp.3.721.828 and Total Carrying Costs Rp.3.067.008). Based on the results of the author's calculations, the EOQ is more effective with the total inventory cost in the 2022 forecast of Rp.6.788.836 while the total inventory cost at the Corina factory policy is Rp.32.104.248

Comparison of the amount of raw material inventory based on company policy using the Economic Order Quantity (EOQ) method. by using the company's policy of raw material inventory of 4.465 kg, while by using the Economic Order Quantity (EOQ) method of raw material inventory 29.271 Kg. Costs incurred by the Corina factory in 2022 that do not use the Economic Order Quantity (EOQ) method and use the Economic Order Quantity (EOQ) method. The total cost of inventory that does not use the Economic Order Quantity (EOQ) method is Rp. 32.104.248. Meanwhile, by using the Economic Order Quantity (EOQ) method, the total cost incurred by the Corina factory during the period 2021 for soybean raw materials is Rp. 6.788.836. This shows that the EOQ model is efficient than the company's current policy

Based on the results of the research from the analysis above, the authors propose suggestions to the management of Corina that can be taken into consideration in inventory policy. The suggestions put forward are as follows: (1) The company should carry out the inventory control process so that things that can hinder the production process can be addressed immediately. (2) Companies should use the Economic Order Quantity (EOQ) method because using the Economic Order Quantity (EOQ) method can minimize the total inventory costs incurred. (3) Companies must also pay attention to two components of inventory costs, namely ordering costs and holding costs. These two cost components become the company's main reference in determining the company's inventory control policies.

Limitations of the Research is the current

research still has shortcomings and limitations. The analysis tool used is not appropriate with the type of EOQ inventory, because in this study the right one is dependent demand, not independent demand. So the right method in this research is MRP (Material Requirement Planning).

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