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Application of inventory control using economic order quantity (EOQ) method in increasing inventory cost efficiency

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ABSTRAK

Penelitian ini bertujuan untuk mengetahui apakah metode EOQ dapat meminimalkan biaya persediaan sehingga mendapatkan total biaya persediaan yang lebih efisien. Data yang digunakan dalam penelitian ini adalah data primer yang diperoleh dari catatan perusahaan pada tahun 2023 dan data sekunder. Penelitian ini merupakan penelitian Deskriptif kuantitatif dengan teknik pengumpulan data wawancara dan observasi. Serta teknik analisis data dengan menggunakan metode *Economic Order Quantity (EOQ), reorder point dan total cost.* Hasil penelitian ini menunjukkan bahwa pengendalian persediaan bahan baku kacang kedelai dengan metode EOQ lebih efisien dibandingkan dengan kebijakan perusahaan. Dengan metode EOQ perusahaan dapat menentukan jumlah pemesanan yang optimal dan frekuensi pembelian yang konstan. Total biaya persediaan dengan kebijakan perusahaan adalah sebesar Rp2.852.272 sedangkan dengan metode EOQ diperoleh total biaya persediaan sebesar 1.021.757. Sehingga dengan penerapan metode EOQ Perusahaan dapat melakukan penghematan sebesar Rp1.830.516.

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Keywords:
Inventory control, Economic order quantity (EOQ), Reorder point, Total cost.

ABSTRACT

This research aims to find out whether the EOQ method can minimize inventory costs so as to obtain more efficient total inventory costs. The data used in this research is primary data obtained from company records in 2023 and secondary data. This research is quantitative descriptive research using interview and observation data collection techniques. In addition, data analysis strategies utilizing the total cost, reorder point, and Economic Order Quantity (EOQ) approaches are employed. The study's findings suggest that employing the EOQ method to regulate the supply of soybean raw materials is a more efficient approach than following business policy. With the EOQ method, companies can determine the optimal number of orders and constant purchasing frequency. The total inventory cost using company policy is Rp 2,852,272, while using the EOQ method the total inventory cost is Rp 1,021,757. So by implementing the EOQ method the Company can make savings of Rp 1,830,516.

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INTRODUCTION

Companies operating in the manufacturing sector, be they large companies, medium companies and small companies, of course have supplies of raw materials. Because every business has a varied production scale and output, there is undoubtedly variation in the quantity and type of raw materials supplied to each one.

A company's raw material inventory is a crucial component, and it must be large enough to ensure that production activities proceed without interruption. Neither too little nor too much raw material inventories should be kept on hand. A lack of raw materials might impede production, and production delays will undoubtedly impact sales, making it impossible for businesses to satisfy customer demand. In the end, this has an impact on business earnings and client trust. An overabundance of raw materials will expose the business to a number of risks, including high interest expenses, additional costs for maintaining and storing raw materials in the warehouse, a higher chance of material quality declines and losses due to damage, all of which will lower the company's earnings. Goods kept in inventory are those that will be needed later on to achieve specific objectives.

Good and appropriate control of raw material inventory is so that companies can buy and make products in economical quantities. Raw materials must be planned as well as possible so that the objectives are achieved, namely the right quantity, quality and cost. When a business can predict price changes, provide enough inventory in a given time frame, keep inventory costs low, and maintain a steady level of capital investment in inventory, it is said to be under effective control.

Providing the raw materials required for the production process to ensure that it runs smoothly without shortages or excess inventory is the goal of inventory control, which also aims to minimize inventory expenses. A good production process always pays attention to and prepares the planning and control of raw materials carefully. The type and quantity of raw materials and layout that are not planned properly will result in unexpected costs. In addition, the aim of control is to minimize operational costs to a minimum in order to optimize company performance.

One of the most widely used inventory control models is Economic Order Quantity (EOQ). EOQ is a method that is often used for inventory control. The EOQ method helps companies find out the optimal amount of raw materials needed to order, when to reorder, and how much safety stock the company must provide so that the production process is not hampered and production activities can run well. The EOQ method's goal is to provide a solution for how to calculate the proper amount of inventory for the business, ensuring a smooth manufacturing process while avoiding rising ordering and storage expenses.

Tempe A-Zaki Padangsidimpuan is a business unit engaged in processing soybeans into tempeh products. Soybeans are the main raw material for making tempe products at Tempe A-Zaki Padangsidimpuan. The company's policy in placing orders is not fixed or unstable, the number of orders is made subjectively or makes assumptions based on observations and estimates. The distance between purchases made is also not constant. The time required from ordering until the raw materials arrive at the warehouse takes 4 days.

Below is data on the purchase and use of raw materials carried out by Tempe A-Zaki Padangdisimpuan in 2023. Starting from January to December. The data that has been obtained is as follows:

Table 1. amount of processing and use of soybeans 2023

Month	Purchase (kg)	Usage (kg)	Saldo (kg)
January	16.000	15.600	400
February	16.000	15.800	600
March	18.000	17.700	900
April	20.000	19.800	1.100
May	16.000	16.000	1.100
June	16.000	15.900	1.200
July	20.000	18.400	2.800
August	17.000	17.500	2.300
September	19.000	18.000	3.300

October	20.000	20.900	2.400
November	16.000	15.700	2.700
December	17.000	16.800	2.900
Total	211.000	208.100	

Source: *Tempe A-Zaki Padangsidimpuan*

Soybeans stored in warehouses have a storage time of approximately 1 month. Because this factory once made a repurchase when there was still a lot of inventory in the warehouse, causing a buildup of inventory resulting in a decrease in the quality of the soybeans where there were some soybeans that were damaged and had to be thrown away. This is because companies do not want to take the risk of running out of raw materials.

It is clear from the information gathered that the business has not applied sound inventory management practices. With existing problems, EOQ can determine an economical and constant order quantity, as well as determine how many orders should be made each time an order is ordered in order to get minimum inventory costs. Therefore, this research aims to see whether the EOQ approach has lower inventory costs than those currently used by the company. Based on the background described above, the author conducted research on "Implementation of inventory control using the Economic Order Quantity (EOQ) method in increasing inventory cost efficiency at Tempe A-Zaki Padangsidimpuan."

LITERATURE REVIEW

Inventory

Goods kept in storage for eventual use or sale are referred to as inventory. There are three types of inventory: finished items, semi-finished materials, and raw materials. While finished goods or commodities are stored before they are sold or marketed, raw materials and semi-finished materials are stored before they are used or integrated into the production process (Ristono, 2019).

The inventory needed by the company consists of several types of inventory. To accommodate the inventory function, the company maintains 4 types of inventory, including (Heizer et al., 2017):

1. Raw Material Inventory
2. Work-in-process (WIP) Inventory
3. Maintanance /repair/operating supply (MRO) Inventory
4. Finished-good inventory

The division of inventory based on its purpose consists of (Ristono, 2019):

1. *Safety Stock*
2. Anticipatory inventory
3. *Transit Stock*

Inventory can carry out several functions that increase the flexibility of company operations, including inventory functions(Heizer et al., 2017):

1. To offer a variety of products in order to predict consumer demand and insulate the business from variations in that demand. Such inventory is typically found in retail establishments.
2. It could be necessary to purchase extra inventory to keep the production process and suppliers apart in cases where a company's inventory levels fluctuate and need to be separated.
3. Take advantage of quantity discounts as buying in bigger numbers might lower delivery or product costs.
4. To guard against rising price fluctuations and inflation

Inventory Control

Inventory control is the process of figuring out how much and what kind of merchandise, raw materials, and finished goods a company has on hand in order to safeguard its smoothly running business operations. (Marrono, 2010) in (Sudiyanto et al., 2021).

From the definitions above, the objectives of inventory control are as follows (Ristono, 2019):

1. To be able to promptly fulfill the demands and requests of customers.
2. To ensure that production continues uninterrupted, or to prevent stockouts and the company from ceasing operations.

3. To maintain and if possible increase the company's sales and profits.
4. Ensure that small purchases are avoided, because this can result in large order costs.
5. Watch out for excessive storage in the emplacement, as this will incur high expenses.

Inventory Cost

For companies that carry out production activities, the size of the inventory they hold really depends on company policy, and this is determined by certain considerations, one of which is the cost factor. What is included in inventory costs include (Ristono, 2019):

1. Purchace Cost

Purchase costs refer to the price per unit if the goods are purchased externally, or the production costs per unit if the goods are produced in-house. Purchase costs can also be said to be all costs incurred in purchasing spare parts.

2. Order Cost/Set Up Cost

Ordering Costs are costs incurred in connection with ordering goods from suppliers. It can be interpreted as ordering costs, namely the costs required to order goods every time the goods are brought in, ordering costs include:

a) Telephone costs or costs for contacting suppliers
b) Issuance of correspondence
c) loading and unloading costs
d) Good goods receipt report
e) Goods inspection costs or checking costs
f) Cost of sending orders to the warehouse
g) Payment processing costs, such as costs for making checks, sending checks or transfer costs to supplier banks and so on.

3. *Carrying cost/Holding cost/Storage cost*

Storage costs can also be defined as all expenses incurred as a result of storing materials and goods, including costs for storage facilities, warehouse rental, obsolescence, insurance, taxes, and other expenses. Alternatively, storage costs can be defined as expenses incurred in relation to storing materials and goods in a warehouse. Costs associated with storage include:

a) Cost of renting or using the warehouse
b) The price of sustaining items
c) Heating or cooling costs, if heating or cooling factors are needed to maintain the durability of the good.
d) Costs of counting and weighing goods, and so on

4. Stockout cost

Inventory shortage costs are the economic consequences of shortages from outside or within the company. External shortages occur when consumer orders cannot be fulfilled. The costs arising from this inventory shortage are as follows:

a) Loss of income
b) Difference in component prices
c) Depends on the operation

Inventory Level

There are three inventory models that answer two important questions: when to order and how much to order. This independent demand model is (Heizer et al., 2017):

1. *Basic economic order quantity (EOQ)*

Heizer et al. (2017) state that the order-out quantity (EOQ) approach is an inventory control technique that addresses the two critical problems of when and how much to order. One of the most popular methods for inventory control is the EOQ model. Although this method is quite simple to apply, it is predicated on a few ideas:

a) An item's demand is well-established, largely stable, and independent of choices made about other things.
b) Lead time, or the amount of time that elapses between placing and receiving an order, is predictable and steady.
c) Inventory is immediately and fully received. Stated differently, inventory is delivered in batches from an order.
d) Cannot receive a quantity discount.

e) The only variable expenses are those associated with ordering, preparing, and occasionally storing merchandise.
f) Stock outs (shortages) can be completely avoided if orders are placed at the right time.
The EOQ formula is as follows (Heizer et al., 2017):

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

2. Production order quantity model

It was anticipated that every inventory order was received all at once in the prior eoq inventory model. On the other hand, a business may occasionally get its inventory over a predetermined length of time. Situations such as these call for the use of an alternative model—one that does not presuppose quick acceptance. This model can be used in two scenarios: (1) when units are created and sold at the same moment, or (2) when inventory flows or grows over time following an order. The following is a statement of the poq formula (Heizer et al., 2017).

$$Q_P^* = \sqrt{\frac{2DS}{H[1-(d/p)]}}$$

3. Quantity discount model

For at least part of the goods they purchase or sell, the majority of businesses give or accept quantity discounts. Simply put, a quantity discount is a price (P) reduction for an item when bigger quantities are ordered. When thinking about quantity discounts, the primary trade-off is between raising carrying costs and lowering product costs. The following formula may be used to determine the overall yearly inventory cost when product costs are taken into account (Heizer et al., 2017):

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

RESEARCH MODELS AND HYPOTHESES

By controlling raw material inventories, factories can estimate the number of orders well so that there are no shortages or excesses of inventory and can minimize inventory costs. One way that can be done to make this happen is by using the EOQ method.
Based on previous research studies, theoretical foundations and problems that have been previously identified, the following is a conceptual framework model for this research:

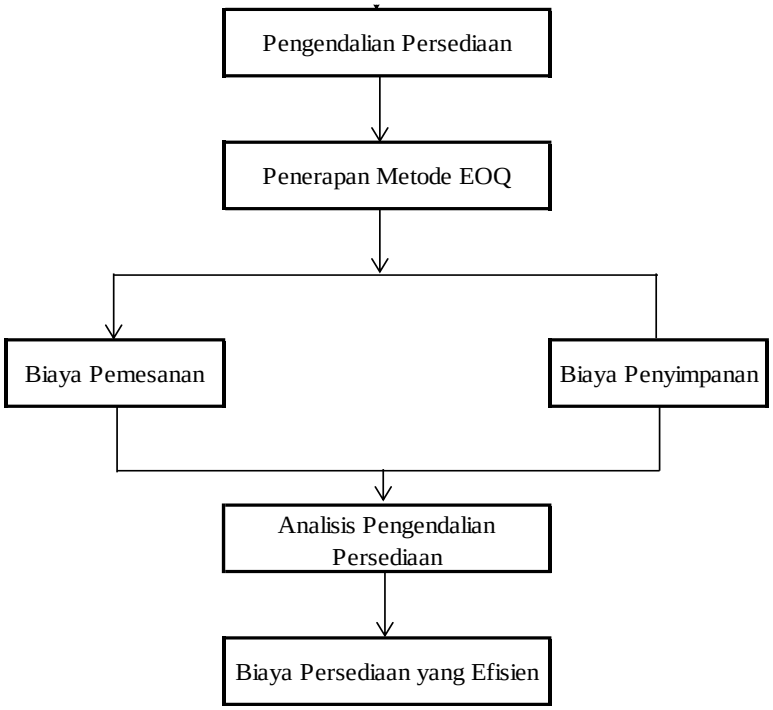

Figure 1. Conceptual Framework

METHOD

This study employed a quantitative descriptive research design. A systematic, factual, and accurate picture of the facts and relationships between the phenomena under investigation is intended to be created by the descriptive method of research, which is structured to provide a systematic description of scientific information originating from the object of research (Fitriyah, 2018). The quantitative method is processing data into mathematical formulas (Nurriyah, 2022). This Quantitative Descriptive Method is a method that describes the actual situation regarding a research object (Karyawati, 2018). The following is a table of defense research operations.

Table 2. Table of Operational Variable

Research variable	Dimensions	Indicator
The goal of inventory control is to keep an eye on and ascertain the ideal level of material composition to facilitate seamless, productive, and efficient business operations (Ristono, 2019).	Economic order quantity	1. Annual request 2. Ordering fees 3. Stotage cost $\boldsymbol{Q^* = \sqrt{\frac{2DS}{H}}}$
	Reorder point	1. Requests per day 2. Waiting time for ordering (Lead time) $\boldsymbol{ROP = d \times L}$
	Total inventory costs	1. Ordering fees 2. Storage cost $TC = \frac{Q}{2}\boldsymbol{H} + \frac{D}{Q}\boldsymbol{S}$

The research data that has been obtained will be processed and analyzed, as follows:

1. Inventory expenses are calculated in accordance with corporate policy:

At Tempe A-Zaki Padangsidimpuan, raw material inventory is still calculated using traditional techniques for figuring out raw material costs. Since the founding of Tempe A-Zaki Padangsidimpuan, this approach has been

followed. The conventional method is carried out by collecting each receipt for purchasing raw materials every month. Then a calculation is made of all the purchase receipt amounts.

2. EOQ Method (Heizer et al., 2017):
   a) EOQ
      $Q^* = \sqrt{\frac{2DS}{H}}$
   b) Frequency of orders
      $N = \frac{D}{Q^*}$
   c) Distance between orders
      $T = \frac{Jumlah\ hari\ kerja\ dalam\ satu\ tahun}{N}$
   d) Total inventory costs
      TC = $\frac{Q}{2}H + \frac{D}{Q}S$
3. Reorder Point
   $ROP = d \times L$
4. The calculation results are compared in tabular form

RESULTS AND DISCUSSION

The computation outcomes of the two approaches can then be determined after computing inventory costs using the EOQ method and the company's policies. The following table shows the comparison of inventory costs based on business policy and the EOQ approach.:

Table 3. Comparison of inventory control according to company policy with the EOQ method

No	Information	Actual method	EOQ Method
1	Order Quantity per order (Zak)	160-200	204
2	Frequency of orders	27	20
3	Distance between orders (day)		17
4	Reorder point (Zak)	60	48
5	Ordering cost (Rp)	675.000	510.878
6	Storage cost (Rp)	2.177.273	510.878
7	Total inventory cost (Rp)	2.852.273	1.021.757

Results of inventory cost calculations using company policy

The total inventory cost obtained by company policy is Rp 2,852,273. Where the company places orders 27 times in one period with a quantity of 160-200 zak. The reorder point or Reorder Point is 60 zak. Rp 675,000 was spent on ordering, while Rp 2,177,273 was spent on storage by the company.

Based on the data analyzed, inventory control at Tempe A-Zaku Padangsidimpuan is not effective enough because it does not have a constant number of orders which results in frequent orders resulting in a buildup of soybean raw materials which results in a decrease in the quality of soybean raw materials and increases the cost of ordering bean raw materials soya bean.

Results of inventory cost calculations using EOQ

After carrying out calculations using the EOQ method, the total inventory cost in one period was Rp 1,021,757. The frequency of orders can be made up to 20 times with an order quantity of 204 zak. The ordering cost according to the EOQ method is Rp 510,878 and the holding cost obtained is Rp 510,878.

Making use of the EOQ technique, the ordering costs incurred by the company during one period are greater than using the EOQ method because by using the ordering frequency it is reduced so that the ordering costs fall. The number of order frequencies made by company policy is more frequent, namely 27 times, whereas with the EOQ method it is only 20 times in one period. This is because the company does not want to take the risk of running out of inventory. Using the EOQ approach, the business can determine the optimal number of orders and when to reorder because the distance between orders has been obtained, namely 17 days.

From the results of calculations using the EOQ method, it shows that with EOQ there is a reduction in storage costs. In line with research by Kusuma Ningrat & Gunawan (2023) where there was a decrease in raw material storage costs in Nusa Sari Cracker MSMEs. However, one of the weaknesses in this research is that the company does not have data on storage costs per unit per year, where this research uses the assumption of total storage costs in one period divided by the average amount of inventory available in one year.

Results of comparing inventory costs using company policy with EOQ

The research results show that the total inventory costs using the EOQ method are smaller compared to company policy. In other words, utilizing the EOQ technique, the overall inventory costs incurred by Tempe A-Zaki Padangsidimpuan can be minimized. by using the EOQ method the company can make savings of Rp 1,830,516. The results of this research are relevant to previous research conducted by Sutrisna et al (2021) where companies obtained inventory cost savings by using the EOQ method. Therefore, it may be concluded that the EOQ method of inventory control is more effective than business policy. According to research (Aprilianti & Ishak, 2023) the difference in total inventory costs incurred by the company using the EOQ method—which can be found by comparing the two cost values—indicates the cost efficiency of implementing inventory control using the EOQ method.

DISCUSSION

Several inferences are drawn from the research's findings, which include the following::

1. Tempe A-Zaki Padangsidimpuan still uses conventional methods or based on estimates and experience to control its raw material supplies. This makes inventory control of soybean raw materials unstable and results in high inventory costs.
2. The quantity ordered for soybean raw materials according to the EOQ method is much greater than the company policy, this is because the frequency of orders according to company policy is more frequent than with EOQ. However, inventory costs incurred can be minimized.
3. Using the EOQ approach to control raw material inventories reduces inventory expenses when compared to maintenance policies. where consumers can save 1,830,516 in expenses.

CONCLUSION

Researchers can offer Tempe A-Zaki Padangsidimpuan recommendations based on the preceding conclusions that can be taken into consideration, such as:

1. Tempe A-Zaki Padangsidimpuan should examine the policies it has put in place for the supply of soybean raw materials so that inventory expenses don't get out of control.
2. Tempe A-Zaki Padangsidimpuan can try to apply the EOQ method to determine the economical order quantity and minimize inventory costs.
3. In order for research on EOQ to be sharper, it is recommended that companies be able to present and identify data that is more recorded, precise and better.

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