



Analysis of Raw Material Planning Using the EOQ (Economic Order Quantity) Method (Case Study on MSMEs Martabak Binaria)

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ABSTRACT

The study analyzes the method of Economic Order Quantity (EOQ) and Reorder Point (ROP) at Martabak Binaria MSMEs in an effort to improve efficiency in raw material inventory management. Based on sales forecasting and cost comparisons, the study found that the use of EOQ resulted in better cost control compared to previous approaches by companies. In addition, ROP ensures raw material orders are placed on time, avoiding disruptions in the production process. These findings underscore the importance of efficient inventory planning in supporting MSME operations, potentially increasing efficiency, reducing costs, and strengthening their competitiveness in the market. Based on the results of the analysis, it is known that in 2023 Martabak Binaria can generate a sales volume of 999,936,000 and purchase raw materials for production based on the most economical ordering method for each production activity, namely by using the economical ordering amount method or EOQ.

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1. INTRODUCTION

With the advancement of science and technology, competition among companies is getting fiercer. All companies, both services and manufacturing, have the main goal of obtaining maximum profit. However, achieving profit is not easy, mainly due to factors that affect the smooth production and achievement of company profits. One of the main factors is the availability of raw materials.

Improper availability within the company can result in a decrease in profits. Too much inventory can lead to high raw material storage costs, while too small inventory can result in high inventory shortages. Therefore, proper inventory management is needed to ensure the company's operations run smoothly.

Proper inventory management is key for companies, both in the service and manufacturing sectors. Production success and profit achievement depend on the smooth running of the production process, which can be hampered by various constraints, especially related to the availability of raw materials. Therefore, companies need to do good production planning to overcome this problem. (Susanto, Ilhamsah, & Cahyadi, 2023)

One method of raw material planning analysis is the economic order quantity (EOQ) method. This method determines the optimal raw material order quantity and minimizes the total cost of ordering and

storing inventory. The economical order quantity (EOQ) method is an inventory management technique that takes into account inventory costs and order costs. When the total cost is subtracted, the optimal order quantity is obtained. Storage costs are estimated based on the average storage of goods over the course of a year. Using the EOQ method, companies can calculate safety stock, maximum inventory and optimal reorder points to avoid shortages or excess inventory.(Ramadhani, 2018)(Ratningsih, 2021)(Ramadhani, 2018)

The example of the case of MSMEs Martabak and Terang Bulan Binaria in Makassar shows the importance of planning and controlling raw material inventory. As a small business focused on moonlight production, past experience shows that excess inventory can lead to wastage of capital and unused raw materials. Therefore, careful inventory planning can help prevent waste, optimize the use of raw materials, and ensure smooth operations in the production of Martabak and Terang Bulan Binaria.

2. LIBRARY REVIEW

2.1 Raw Material Supplies

Raw material inventory is a form of inventory storage on raw materials for certain purposes. Inventory is indicated on the materials or outputs used in the company to produce and market the goods produced. To produce raw materials, it is necessary to ensure that the raw materials used are sufficient in the production process because it will have an impact on the company's sales to achieve predetermined goals.(Ahmad, 2018) (Simbolon, 2021)

Inventory or raw material inventory is one of the important factors that need to be considered in companies, when raw material inventory is more than forecasted will incur additional costs to store raw material inventory, while if the raw material inventory is too small it can cause product process cessation and loss of opportunities to achieve more profits (Dewi, Herawati, & Wahyuni, 2019).

2.2 Benefits of Setup

The benefits of inventory are something that is fundamental in company operations. This is related to the way the company manages the stock of goods to ensure the smooth production process and meet customer needs. In this context, there are three main functions of inventory as appropriate: (Ahmad, 2018)(Ahmad, 2018)Decoupling, relating to separating production processes; function Economic Lot Sizing, which concerns the determination of the optimal order quantity; and the Anticipation function, which involves responding to fluctuating demand.

2.3 Control of Baku Material Preparation

Control of raw material inventory is an effort to control the most optimal inventory at the lowest cost and the main objective of control is to obtain the quantity and quality of raw materials appropriately at the lowest price, maintain inventory so that stocks do not run out, and to meet the satisfaction of consumers.(Simbolon, 2021).

Based on the explanation above, the author suggests that control of raw material inventory is important to implement because it plays an important role in business continuity. Inventory management must be able to maintain raw material stocks in optimal conditions so as not to cause excessive losses in inventory costs and storage costs.

2.4 Production Planning or Mapping

Production planning is a planning process that involves setting production quantities, production schedules, and resource allocation to meet market demand. In the context of raw material planning, production planning is very important because raw materials are the main component in the production process. By taking into account market demand, raw material ordering lead time, and production capacity, companies can plan production efficiently. (Efendi, 2019)

In the context of production planning, companies need to consider factors such as market demand, raw material ordering lead time, production capacity, and inventory policy. By paying attention to these factors, companies can optimize production planning and raw material inventory so as to achieve operational efficiency and reduce inventory costs.(Ismaya, 2022)

2.5 EOQ (Economic Order Quantity)

The EOQ model is an approach that is expected to assist management in making decisions about the number of units that should be ordered, with the aim of avoiding excessive investment and preventing inventory shortages that can disrupt the production process.(Dewi, Herawati, & Wahyuni, 2019).

In the EOQ method, there are several assumptions used, including constant demand for goods, constant ordering costs, constant storage costs per unit of inventory, and the absence of purchase discounts. Using a mathematical formula, EOQ calculates the optimal order quantity that will result in a total minimal inventory cost.(Gian Eka Alynardina, 2018).

In its implementation, this model considers operational and financial costs, and determines the number of orders that can minimize the total cost of material inventory. This is expected to have a positive impact on the profits of Micro, Small and Medium Enterprises (MSMEs), especially from the sale of Martabak Binaria and optimization of inventory costs.

3. METHODOLOGY

The research methods used here are quantitative, descriptive and general approaches. The collection, interpretation and presentation of data and results is part of quantitative descriptive research whose end goal is an objective description or description of a situation. (Tannady & Pratama, 2019).

3.1 Research Steps

The stages of this research activity are as follows:

3.1.1. Library research

This research was conducted by seeking information from various sources such as academic journals, to obtain research-related information that can assist companies in providing forecast data for raw material planning.

3.1.2. Observations

This section describes live tracking of Martabak and Terang Bulan binary sales. The following activities include, among others, the collection of sales data necessary to achieve research objectives.

3.1.3. Needs analysis

At this stage, the needs analysis stage will be carried out, where the estimated needs of Martabak and Terang Bulan Binaria raw materials planning will be studied. At this stage the company's sales data is collected using the results of the analysis.

3.1.4. Design and testing

At this stage the system is planned and tested based on sales data obtained through trend projection methods and tested using the Microsoft Excel application.

3.2. Trend projection method

The trend forecasting method consists of attaching a trendline to a set of historical data points and then projecting those lines into a future with a medium to long time horizon. This research projection method examines the tendency in straight lines (linear). The proper approach to linear trends is the least squares method. The least squares method finds the line that best fits the pattern of the resulting data. The main goal of this method is to minimize the sum of squared errors of linear regression equations with the entire real data. (Khairani, 2023). The mathematical formula for finding forecast results by the trend projection method is as follows:

$$Y = a + bX$$

Information: Y = calculated value of the prediction variable

price A = Y when x = 0 (Standard price)

b = coefficient indicating the slope of the line. If (+) the line direction is up, if (-) the line direction is down.

x = subject to independent variable.

3.3 The most Economical Order Method (EOQ)

The most economical way of troubleshooting with booking (*EOQ*) is a mathematical approach used in inventory management to find the ideal order total to minimize the total budget on inventory. Manner(Cahyani, 2019) It minimizes the budget on inventory by considering the storage budget of the goods and the costs associated with the order. The budget includes consumption levels, unit storage budgets, as well as order budgets. *EOQ* Aim to strike a balance between high storage costs for excess inventory and high ordering costs for insufficient inventory. By determining the optimal order quantity, businesses can improve inventory management and reduce costs.(Mayasari & Supriyanto, 2022)

$$EOQ = \sqrt{\frac{(2 \times D \times S)}{H}}$$

Where:

EOQ = Optimal quantity purchased economically.

D = Consumption / Estimated demand per time period.

S = Booking cost.

H = Storage budget per year

Storage cost or budget = 10% x price per unit on raw materials.

Booking frequency is as follows:

$$I = \frac{R}{EOQ}$$

Where:

I = booking frequency

R = amount of raw materials required

EOQ = economically optimal amount to purchase

4. RESULTS AND DISCUSSION

4.1 Trend Projection Methods

The trend projection method is a method carried out to determine sales forecasting in 1 year for MSMEs Martabak and Terang Bulan Binaria in 2023.

Table 1. Sales Data of MSMEs Martabak and Terang Bulan Binaria in 2020-2022

Year	Sales Volume (Y)
2020	838656000 Unit
2021	806400000 Unit
2022	967680000 Unit

Source : UMKM Martabak and Terang Bulan Binaria

To calculate the trend projection method, it requires a time variable (x) = 0 and uses the least square method because it uses odd data.

Table 2. Sales Table of MSMEs Martabak and Terang Bulan Binaria After Being Weighted

Year	Sales Volume (Y)	X	XY	X ²
2020	838656000	-1	-838656000	1
2021	806400000	0	0	0
2022	967680000	1	967680000	1
Sum	2612736000	0	129024000	2

To calculate the time variable (x), you can use the formula:

$$Y = a + bX$$

To calculate the values of a and b , namely:

$$a = \frac{\sum y}{n}, \text{ maka } a = \frac{2612736000}{3} = 870912000$$

$$b = \frac{\sum(xy)}{\sum x^2}, \text{ maka } b = \frac{129024000}{2} = 64512000$$

$$Y = 870912000 + (64512000 \times 2)$$

$$Y = 999936000$$

So, based on the calculation results using the trend projection method, resulting in a sales forecast in 2023 of units 999936000 .

4.2 Use of Raw Materials

The raw materials used in the production process of martabak and terang bulan Binaria require 7 (seven) types of raw materials and can be seen in the table as follows:

Table 3. The Use of Raw Materials in MSMEs Martabak and Terang Bulan Binaria in 2023

Moon	Use of Raw Materials (kg)
January	756,36
February	556,36
Maret	617,18
April	700,24
From	660,36
June	724,55
July	800,36
Agustus	770,85
September	750,36
October	866,85
November	936,43
December	936,42
Total	9.076,32
Average/Month	756,36
Average/Day	31,515

Source : UMKM Martabak and Terang Bulan Binaria in 2023

$$\text{Total Kebutuhan Bahan Baku} = \frac{\text{Kebutuhan bahan baku}}{\text{Frekuensi pemesanan perusahaan}}$$

$$\text{Total Kebutuhan Bahan Baku} = \frac{9.076,32}{288}$$

$$\text{Total Kebutuhan Bahan Baku} = 31.515 \text{ Kg atau } 32 \text{ Kg}$$

4.3 Purchase of Raw Materials

MSMEs Martabak and Terang Bulan Binaria purchase raw materials to carry out their production process. The amount of raw materials needed varies from year to year. The purchase of raw materials can be seen in the table as follows:

Table 4. Purchasing Raw Materials at MSMEs Martabak and Terang Bulan Binaria in 2023

Moon	Purchase of Raw Materials (Rp)
January	75.636.000
February	55.636.000
Maret	61.718.000
April	70.024.000
From	66.036.000
June	72.445.000
July	80.036.000
Agustus	77.085.000
September	75.036.000
October	86.685.000
November	93.643.000
December	93.642.000
Total	907.632.000
Average/Month	75.636.000
Average/Day	3.151.500

Source : UMKM Martabak and Terang Bulan Binaria in 2023

4.4 Lead Time for Raw Material Procurement

Lead time or waiting time in the procurement of raw materials is the period of time needed when bakkku materials are ordered until the raw materials arrive at the company. Based on information obtained from owners of MSMEs Martabak and Terang Bulan Binaria, the lead time required for 7 (seven) raw materials used is 1 (one) day.

4.5 Raw Material Inventory Cost

The total cost of raw material inventory is generally divided into 2 (two), namely ordering costs and storage costs.

Booking Fee, Booking fees at MSMEs Martabak and Terang Bulan Binaria can be seen in the following table:

Table 5. Order Fees for MSMEs Martabak and Terang Bulan Binaria in 2023

Types of Fees	Details	Amount in 1 Year
one charges	. 4.500,- x 288 times	₹ 1,296,000
ministration &; General Fees	. 15.000,- x 12 times	₹ 180,000
ading and Unloading Cost	₹ 125.000,- x 288 times	₹ 36,000,000
TOTAL		₹ 37,476,000
ter - letter/the day		₹ 3,123,000

$$\begin{aligned} \text{Biaya Pemesanan} &= \frac{\text{Total biaya pemesanan}}{\text{Frekuensi pemesanan}} \\ \text{Biaya Pemesanan} &= \frac{37.476.000}{288} \\ \text{Biaya Pemesanan} &= \text{Rp. } 130.125 \end{aligned}$$

Storage Cost, The amount of storage costs for raw materials for MSMEs Martabak and Terang Bulan Binaria is 10% of per kg. The amount of storage costs for raw materials for MSMEs Martabak and Terang Bulan Binaria can be seen in the following table:

Table 6. Storage Costs for MSMEs Martabak and Terang Bulan Binaria in 2023

% Saving Cost	Price/kg	Storage Cost/Year
10 %	IDR 100,000	IDR 3,456,000

$$\begin{aligned} \text{Biaya Penyimpanan} &= \frac{\text{Total biaya penyimpanan}}{\text{Jumlah Kebutuhan Bahan Baku}} \\ \text{Biaya Penyimpanan} &= \frac{3.456.000}{9.076,32} \\ \text{Biaya Penyimpanan} &= \text{Rp. } 380,7710614 \text{ atau Rp. } 381/\text{Kg} \end{aligned}$$

Total Inventory Cost (TIC)

$$\begin{aligned} \text{TIC} &= H \frac{Q}{2} + S \frac{D}{Q} \\ \text{TIC} &= 381 \frac{130.125}{2} + 3.123.000 \frac{9.076,32}{130.125} \\ \text{TIC} &= 24.788.813 + 217.832 \\ \text{TIC} &= \text{Rp. } 25.006.644 \end{aligned}$$

Inventory Analysis with Economic Order Quantity (EOQ) Method

Table 7. Calculation of the optimal amount of raw materials for MSMEs Martabak and Terang Bulan Binaria in 2023

Use	Order Fees	Storage Cost
Sum 9.076,32 Price/pcs 100.000 Total IDR 907,632,000	IDR 37,476,000	IDR 3,456,000

$$\begin{aligned} \text{EOQ} &= \sqrt{\frac{2 \times D \times OC}{CC}} \\ \text{EOQ} &= \sqrt{\frac{2 \times 9.076,32 \times 37.476.000}{3.456.000}} \\ \text{EOQ} &= \sqrt{196.842.69} \\ \text{EOQ} &= 443,6695729932 \text{ Kg or } 444 \text{ Kg} \end{aligned}$$

Based on the EOQ calculation that has been obtained, the most optimal amount of raw materials is 443.6695729932 kg. With a value of D is the amount of inventory needed in one year, which is 9,076.32 kg. Then OC is a number of ordering costs for raw material inventory, which is Rp. 37,476,000. And CC is the

total storage cost of raw materials, which is Rp. 3,456,000.

4.6 Optimal Number of Booking Frequencies

To determine the optimal order frequency amount, it can be calculated using the required inventory data in one year / EOQ.

$$\text{Frekuensi Pemesanan} = \frac{9.076,32}{443,6695729932}$$

$$\text{Frekuensi Pemesanan} = 20,457386651 \text{ atau } 20 \text{ kali}$$

The actual order frequency at Martabak and Terang Bulan Binaria MSMEs is 288 times in one year. However, by using the results of calculating the optimal booking frequency with the EOQ method, the order frequency can be made as many as 20 times. The smaller the frequency of bookings made, the smaller the booking costs incurred but storage costs will increase.

4.7 Total Cost of Optimal Raw Material Inventory (TIC)

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

$$\text{TIC} = 381 \frac{444}{2} + 130.125 \frac{9.076,32}{444}$$

$$\text{TIC} = 84.468 + 2.662.017$$

$$\text{TIC} = \text{Rp. } 2.746.486$$

4.8 Comparative Analysis of Total Inventory Cost (TIC) with Company Method and Total Inventory Cost (TIC) with EOQ Method.

Based on the results of calculations that have been carried out, the total inventory cost with the company's method in 2023 is Rp. 25,066,644 and the total inventory cost with the EOQ method in 2023 is Rp. 2,746,486. Comparison of TIC in the company method and the EOQ method can be seen in the following table:

Table 8. Comparison of TIC on enterprise method and EOQ method

Year	TIC	TIC*	Cost Savings
2023	IDR 25,066,644	IDR 2,746,486	IDR 22,260,158

The comparison results in the table above show cost savings by using Economic Order Quantity (EOQ) of Rp. 22,260,158. So it can be concluded that using the EOQ method is more efficient than using the Company's method.

4.9 Reorder Point (ROP) Analysis

a. Safety Stock

$$\text{Safety Stock} = Z \times d \times l$$

$$d = \frac{\text{Total Kebutuhan Bahan Baku}}{\text{jangka Waktu Kerja Satu Tahun}}$$

$$d = \frac{9.076,32}{288}$$

$$d = 31,515 \text{ atau } 32 \text{ Kg}$$

So, the amount of safety stock can be calculated:

$$\text{Safety Stock} = 1,64 \times 32 \times 288$$

$$\text{Safety Stock} = 151.114 \text{ Kg}$$

b. Reorder Point

$$\text{ROP} = (d \cdot L) + \text{Safety Stock}$$

$$\text{ROP} = (32 \times 288) + 151.114$$

$$\text{ROP} = 24.330 \text{ Kg}$$

Based on the results of calculations that have been carried out, Reorder Points can be carried out if raw materials can be as much as 24,330 Kg in 2023. And the maximum raw material inventory using safety stock is 151,114 Kg in 2023

The following comparison of control on raw materials based on the results of company policies and EOQ methods can be seen in the table as follows:

Table 9. Comparison of Company Policy Results and EOQ Method

Information	Company Policy	EOQ Method
Purchase of Raw Materials	32 Kg	444 Kg
Booking Frequency	288 times	20 times

Total Inventory Cost	25.006.644	2.746.486
Safety Stock	-	151.114 kg
Reorder Point	-	24.330 kg

5. CONCLUSION

Efficient production planning and controlling the availability of effective raw materials are useful for maintaining smooth business operations, especially in the era of a crowded economy. The following study aims to apply the EOQ method to Martabak Binaria MSMEs to optimize raw material inventory management.

MSMEs Martabak Binaria focus on producing moonlight and using various raw materials. However, the company faced the problem of lack of adequate inventory planning, which resulted in hampered production processes due to scarcity of raw materials. Thus, the following research was formed to analyze the problem using sales forecasting methods, EOQ analysis, and inventory control cost comparison between EOQ methods and company concepts.

Research shows that the most economical ordering method (Eoq) can save budget on inventory significantly compared to the concept of organization. And this research provides a comprehensive picture of the importance of production planning and inventory control to maintain smooth business operations, especially for MSMEs. By applying the right EOQ method, companies can improve operational efficiency and reduce costs, which will ultimately increase their profits and competitiveness in a competitive market.

6. REFERENCES

- Ahmad, N. G. (2018). *Operations Management*. Jakarta: Earth of Characters.
- Dewi, D. C., Herawati, N. T., & Wahyuni, M. A. (2019). ANALYSIS OF INVENTORY CONTROL USING THE ECONOMIC ORDER QUANTITY (EOQ) METHOD FOR OPTIMIZING THE INVENTORY OF RAW MATERIALS FOR MINERAL WATER PACKAGING. *Accounting Professions*, 54-65.
- Gian Eka Alynardina, M. S. (2018). ANALYSIS OF RAW MATERIAL INVENTORY PLANNING USING ECONOMIC ORDER QUANTITY (EOQ) METHOD (Case study at PT. Semen Indonesia (Persero) Tbk Tuban Factory). *Journal of Business Administration (JAB)*, 17-25.
- Ida Ayu Chintia Cahyani, d. (2019). Analysis of Raw Material Inventory for the Effectiveness and Cost Efficiency of Raw Material Inventory on the Smooth Production Process in the Murnisingaraja Forging Industry Business in Badung Regency. *Economic Discourse (Journal of Economics, Business and Accounting)*, 117-118.
- Jainuril Efendi, d. (2019). Analysis of Inventory Control of Raw Potato and Curly Potato Crackers Using the Economic Order Quantity (EOQ) Method. *Scientific Media of Industrial Engineering*, 125-134.
- Khairani, P. (2023). Implementation of Trend Projection Method in LPG Gas Inventory Forecasting at PT. Sintora Putra Gasindo. *Journal of Information Systems Management*, 61-65.
- Mayasari, D., & Supriyanto. (2022). ANALYSIS OF RAW MATERIAL INVENTORY CONTROL USING EOQ (ECONOMIC ORDER QUANTITY) METHOD AT PT. SURYA MAS LESTARI PRIMA. *Journal of Business Administration*, 44-50.
- Puspita, K. (2023). Implementation of Trend Projection Method in LPG Gas Inventory Problems at PT. Sintora Putra Gasindo. *Journal of Information Systems Management*, 61-65.
- Ramadhani, S. (2018). ANALYSIS OF RAW MATERIAL INVENTORY USING THE ECONOMIC ORDER QUANTITY METHOD IN THE PIA MIRAH HOUSEHOLD INDUSTRY.
- Ratningsih. (2021). Application of Economic Order Quantity (EOQ) Method to Improve Efficiency of Raw Material Inventory Control on CV Syahdika. *Journal of Economics & Management, Bima Sarana Informatika University*, 158-160.
- Symbolon, L. (2021). Setup Handling. *Asjawa Youth Forum*.
- Susanto, H. D., Ilhamsah, H. A., & Cahyadi, I. (2023). PLANNING AND CONTROL OF RAW MATERIALS USING PROBABILISTIC EOQ (ECONOMIC ORDER QUANTITY) METHOD AND MONTE CARLO SIMULATION AT BK NGADIREJO TOFU FACTORY. *Journal of Industrial Engineering*, 24-25.
- Tannady, H., & Primary, D. Y. (2019). Analysis of raw material inventory planning using the Economic Order Quantity method with stockout cost considerations (Case Study of PT. Multi Precision Metal). *Industrial Spectrum*, 93-97.
- Yudha Bambang Ismaya, S. (2022). Analysis of Sweet Potato Raw Material Pwngendalian Using Economic Order Quantity (EOQ) and H-Sin Methods of PT. Aesthetic Pretext. *Journal of Applied Industrial Technology and Management (JTMIT)*, 123-130.