APPLICATION OF EOQ IN A COMPANY FOR THE PROCUREMENT OF WRAPPING PLASTIC AND GLUE IN A CARTON BOX MANUFACTURING COMPANY

Heryanto[1], Agatha Rinta Suhardi[2]

[1]Management Program, Universitas Terbuka, Indoensia
[2] Management Program, Widyatama University, Indonesia

Corresponding author: hery.getup@gmail.com

Abstrack
Inventory management is a crucial aspect of operations in manufacturing companies, including those engaged in carton box production. One of the most effective approaches is to maximize and optimize the management of auxiliary materials, such as wrapping plastic and glue, through the application of the Economic Order Quantity (EOQ) method. This study aims to analyze the application of EOQ in order to determine the optimal purchase quantity and minimize total inventory costs, which include ordering and holding costs. By using data on annual demand, ordering costs, and holding costs, EOQ calculations were conducted for wrapping plastic and glue. The results of the EOQ implementation indicate that the company can reduce the number of orders and suppress operational costs without disrupting the smoothness of the production process. This study provides strategic recommendations for the company in managing raw materials to enhance operational efficiency in supporting the continuity of carton box production.

Keywords*: EOQ, inventory, wrapping plastic, glue, carton box, inventory management.*

INTRODUCTION

In the production activities of a carton box manufacturing company, auxiliary materials such as wrapping plastic and glue play a crucial role in maintaining product quality and packaging efficiency. Poorly managed inventory of these materials can often lead to either overstocking or stockouts, resulting in unnecessary costs or interruptions in the production process. To overcome these challenges, companies can apply the Economic Order Quantity (EOQ) method — a calculation technique used to determine the optimal order quantity in order to minimize total inventory costs. The implementation of EOQ is believed to enhance operational efficiency and reduce both storage and ordering costs.

One of the recurring issues in the procurement of wrapping plastic and glue within carton box companies is the uncertainty in purchase planning, driven by fluctuating demand for carton box orders. In the context of inventory control for auxiliary materials such as wrapping plastic and glue, the following research questions are proposed:

1. How can the EOQ method be applied to determine the optimal order quantity for wrapping plastic and glue to minimize total inventory costs?
2. To what extent can cost efficiency be achieved through the implementation of the EOQ method compared to conventional ordering methods?
3. What is the impact of applying the EOQ method on the continuity and smoothness of the production process in the carton box company?

This study aims to apply the Economic Order Quantity (EOQ) method in managing the inventory of auxiliary materials, specifically wrapping plastic and glue, in a carton box manufacturing company. In detail, the objectives of this research are as follows:

1. To determine the optimal purchase quantity (EOQ) for wrapping plastic and glue in order to minimize inventory costs.
2. To identify an efficient ordering quantity based on the EOQ calculation results.
3. To determine the appropriate reorder point to avoid material shortages during the production process.
4. To provide considerations for the company in making optimal, effective, and well-planned procurement decisions for auxiliary materials.

This study is expected to provide both theoretical and practical benefits as follows:
1. Theoretical Benefits

This research contributes to the development of operations management studies, particularly in inventory management using the Economic Order Quantity (EOQ) approach. The findings of this study are expected to serve as an academic reference for similar research in the future.

2. Practical Benefits

For the carton box company, this study can provide practical information and recommendations regarding:

- The optimal purchase quantity of auxiliary materials, which can reduce total inventory costs.
- More efficient and economical scheduling of material orders.
- Accurate decision-making in the procurement of wrapping plastic and glue, both in terms of timing and alignment with production needs.

The concept of inventory management is essential in the operational activities of a company, particularly in supporting the smoothness of the production process and achieving cost efficiency. Well-managed inventory helps companies maintain continuous production, minimize production costs, and avoid shortages of auxiliary materials during the production process.

Based on journal reviews, the following insights are highlighted:

Sari & Rahayu (2021): Effective inventory management is crucial to reducing operational costs. The implementation of the EOQ method has proven effective in determining optimal order quantities and reducing total inventory costs. Firmansyah (2022): Applying the EOQ system in small and medium enterprises (SMEs) positively impacts the efficiency of raw material procurement. Structured order planning enables companies to minimize order frequency and storage costs. Soares et al. (2021): Modern inventory management requires a strategic approach that goes beyond traditional methods like EOQ. It emphasizes integrating information technology to enhance demand forecasting and inventory control accuracy. Sholeha (2021): Inventory management challenges in SMEs often stem from limited capital and the absence of a control system. EOQ is seen as a simple solution that helps companies control inventory costs efficiently. Lutfhi et al. (2020): The EOQ method is an effective tool for achieving inventory management efficiency. Research shows significant cost savings when EOQ is consistently applied based on actual data.

Based on book references, the following explanations are provided:

Heizer, J., Render, B., & Munson, C. (2020), *Operations Management* (13th ed.): The EOQ method allows carton box companies to manage the procurement of wrapping plastic and glue efficiently, reduce operational costs, and ensure a smooth production and packaging process through optimal raw material availability. Fahmi (2016): EOQ supports efficient procurement and inventory control, especially for supporting materials, by providing a structured and cost-saving approach. Wisner, J. D., Tan, K. C., & Leong, G. K. (2016), *Principles of Supply Chain Management: A Balanced Approach* (4th ed.): EOQ helps carton box companies optimally manage the inventory of wrapping plastic and glue, reducing costs and maintaining production flow through improved control over ordering and holding costs. Jacobs, F. R., & Chase, R. B. (2018), *Operations and Supply Chain Management* (15th ed.): EOQ enables efficient procurement of wrapping plastic and glue, decreases inventory costs, and ensures production continuity by enhancing inventory control. Nasution, M. N. (2018), *Manajemen Operasi (Revisi)*: EOQ application provides cost-efficiency benefits in managing inventory and ensures the availability of raw materials at the right time and in optimal quantities. Rusdin, A. (2017), *Manajemen Persediaan*: Implementing EOQ in the procurement of wrapping plastic and glue helps optimize inventory management, reduce total inventory costs, ensure stable raw material availability, and improve overall operational efficiency.

The application of the Economic Order Quantity (EOQ) method in purchasing wrapping plastic and glue for a carton box company is a way to optimize inventory management in order to minimize costs, which consist of ordering costs and holding (storage) costs.

Steps in applying the EOQ method are as follows:

1. Determine the Required Cost Components

To calculate EOQ, several cost components must be identified:

o Ordering Cost (S)

The cost incurred each time an order is placed, such as transportation and administrative costs.

o Holding Cost (H)

The cost of storing one unit of inventory per year, including warehouse space and potential damage during storage.

o Annual Demand (D)

The total quantity of wrapping plastic and glue needed annually to meet production requirements.

2. Use the EOQ Formula

The basic formula to calculate EOQ is:

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

Where:

- D = Annual demand (in units)

- S = Ordering cost per order
- H = Holding cost per unit per year

3. Example of EOQ Calculation for Wrapping Plastic and Glue:

For example, a carton box company needs wrapping plastic and glue with the following data:

- Annual demand (D): 10,000 units
- Ordering cost (S): Rp 50,000 per order
- Holding cost (H): Rp 10,000 per unit per year

Using the EOQ formula:

$$EOQ = \sqrt{\frac{2 \times 10.000 \times 50.000}{10.000}} = \frac{1.000.000.000}{10.000} = \sqrt{100.000} = 316,23$$

So, the EOQ obtained is approximately 316 units, meaning the company should order 316 units of wrapping plastic or glue each time to minimize total inventory costs.

4. Benefits of Implementing EOQ

- Reduces Total Inventory Costs

  EOQ helps companies avoid placing orders too frequently (which increases ordering costs) or ordering in large quantities (which increases holding costs).

- Ensures Smooth Production

  With regular and accurate ordering based on calculations, companies can ensure a stable supply of raw materials and avoid shortages that may disrupt production.

- Improves Operational Cost Efficiency

  EOQ helps companies achieve overall cost efficiency—from procurement to better stock management.

5. Application in the Supply Chain

By using EOQ, carton box companies can integrate their ordering systems with supply chain management. This ensures that auxiliary materials like wrapping plastic and glue are available at the right time and in optimal quantities, supporting smooth production processes. The application of EOQ for the procurement of wrapping plastic and glue in carton box companies allows for efficient inventory management, cost reduction, and uninterrupted production. By calculating the optimal order quantity, the company can balance ordering and holding costs while ensuring the availability of raw materials according to production needs.

Theoretical framework:

1. Inventory Management

Inventory management is the process of planning, organizing, and controlling the quantity and types of raw materials and finished goods stored by a company. According to Rusdin (2017), the purpose of inventory management is to ensure smooth production and reduce costs arising from either excess or shortage of inventory. In the context of a carton box company, auxiliary materials such as wrapping plastic and glue are important components of supporting inventory.Economic Order Quantity (EOQ)

2. Economic Order Quantity (EOQ)

EOQ is a method used to calculate the most economical order quantity that minimizes the total inventory cost. According to Heizer & Render (2016), EOQ is used to determine the optimal order quantity based on the frequency of material usage, ordering costs, and holding costs.

Formula $EOQ = \sqrt{\frac{2DS}{H}}$

Where:

- D = Annual demand (units)
- S = Ordering cost per order
- H = Holding cost per unit per year

The implementation of EOQ helps carton box companies avoid overstocking of wrapping plastic and glue, and reduce inefficient order frequencies.

3. Inventory Costs

In the EOQ model, there are three main components of inventory costs:

- Ordering Cost

  Costs incurred every time the company places an order (e.g., transportation, administration).

- Holding Cost

  Costs to store goods in a warehouse (e.g., warehouse rental, security, damage).

- Stockout Cost

  Costs caused by stock shortages, such as halted production.

  According to Nasution (2018), companies must balance these three costs to achieve minimum inventory costs, and EOQ is one of the planning tools that can assist in achieving this goal.

4. EOQ Application in Supply Chain Management
Wisner et al. (2016) emphasize that good inventory management is a key part of an efficient supply chain. EOQ not only affects warehouse operations but also influences the smooth flow of materials from suppliers to the production process. In the case of carton box companies, EOQ helps ensure that supplies of wrapping plastic and glue are available on time, supporting productivity and customer satisfaction.

5. Benefits of EOQ in the Manufacturing Industry
Jacobs & Chase (2018) explain that EOQ can:
- Lower logistics costs
- Reduce material obsolescence risks
- Accelerate production cycles
- Improve procurement efficiency

In the carton box industry, EOQ helps companies manage supporting materials such as wrapping plastic and glue efficiently and measurably.

This theoretical framework explains that the implementation of EOQ in carton box companies aims to optimize the procurement of auxiliary materials (wrapping plastic and glue) through efficient inventory management. EOQ is a crucial tool in reducing costs, increasing operational efficiency, and ensuring production continuity.

RESEARCH METHODS

This research is a descriptive quantitative study because it aims to systematically describe the application of the EOQ (Economic Order Quantity) method based on quantitative data such as order quantity, ordering cost, holding cost, and annual raw material requirements. The research approach used is a case study, as this study is conducted in-depth on a single carton box company as the research object.

Object and subject of the research:
1. The object of the research is the application of the EOQ method for procuring wrapping plastic and glue as auxiliary materials in the production process of a carton box company.
2. The subject of the research is the staff involved in inventory management and procurement, such as warehouse receiving staff, warehouse shipping staff, purchasing, and production departments.

The methods used in this research are:
1. Interview
Conducted with warehouse or logistics staff to obtain information about ordering patterns, ordering costs, and the frequency of material needs.
2. Observation
The researcher directly observes the inventory management process of wrapping plastic and glue.
3. Documentation
Collecting secondary data from company documents such as purchase records, ordering costs, holding costs, and annual usage volume.

The current purchasing practice for wrapping plastic and glue by the company is based on average past purchases and reducing transportation costs. The application of EOQ in purchasing wrapping plastic and glue by the company follows these steps:
1. Identifying the required variables:
   o Annual demand (D)
   o Ordering cost per order (S)
   o Holding cost per unit per year (H)
2. Using the EOQ formula:
$$\text{EOQ} = \sqrt{\frac{2DS}{H}}$$
3. Analyzing the EOQ Result:
The EOQ result is compared with the company's current actual ordering quantity to evaluate the effectiveness of EOQ implementation.
4. Calculating Total Inventory Cost (TIC):
$$\text{TC} = \left(\frac{D}{Q} \times s\right) + \left(\frac{Q}{2} \times H\right)$$

Where:
- Q   = EOQ (jumlah pemesanan optimal)
- D/Q   = jumlah pemesanan per tahun
- Q/2   = rata-rata-persediaan

RESULTS AND DISCUSSION

PT. Asia Paperindo Perkasa is a manufacturing company engaged in the production of packaging made from paper-based materials, especially carton boxes. The company has been operating since 2004 and is located in Tunas Industrial Estate Block 5G, serving various industrial sectors such as electronics and consumer goods.

In its production process, PT. Asia Paperindo Perkasa uses main raw materials such as kraft paper (commonly referred to as sheet corrugated) and supporting materials such as wrapping plastic and glue. Wrapping plastic is used to protect finished products during shipping, while glue is used to bond parts of the carton during assembly. These two materials are essential in maintaining product quality and production efficiency.

Currently, the company faces challenges in managing inventory for these supporting materials. Inaccurate determination of order quantity and timing often leads to overstocking or stockouts, which may disrupt production flow and increase operational costs.

In practice, inventory decisions are still based on rough estimation in determining the required amount of wrapping plastic and glue for production.

To address this issue, this study examines the application of the Economic Order Quantity (EOQ) method as an approach in procurement decision-making for supporting materials. It is expected that EOQ can assist PT. Asia Paperindo Perkasa in optimizing the purchase of wrapping plastic and glue, resulting in more efficient inventory costs and smoother production operations.

In PT. Asia Paperindo Perkasa's operations, wrapping plastic and glue are crucial supporting materials used regularly in the final packaging process of carton box products. To ensure smooth production, an accurate needs analysis is necessary to avoid both excess and shortages of materials.

Annual Demand Identification:

The first step in applying the EOQ method is to determine the annual demand for wrapping plastic and glue. This data is derived from usage records over 12 months:

Table 1 Usage Data of Plastic Wrapping and Glue Over 12 Months

Parameter	Wrapping Plastic	Glue
Annual Demand (D)	87.000 roll	1.500 kg
Ordering Cost (S)	Rp 250.000/order	Rp 200.000/kg
Holding Cost (H)	Rp 1.500/roll	Rp 1.000/kg
Working Days per Year	300 days	300 days
Lead time (L)	5 days	5 days

Pre EOQ Calculation:
Wrapping Plastic Calculation
100 rolls × 30 days = 3,000 rolls per order → overstock
Glue Calculation:
12 kg × 180 days = 2,160 kg per order → overstock

EOQ and Reorder Point (ROP) Calculations:
1. EOQ Calculations: $EOQ = \sqrt{\frac{2DS}{H}}$
   - EOQ Plastik Wrapping:
     $EOQ = \sqrt{\frac{2 \times 87.000 \times 250.000}{1.500}} = \sqrt{\frac{4.350.000.000}{1.500}}$
     $= \sqrt{2.900.000} = 1.702,94 = 1.703$ roll/order
   - EOQ Lem :
     $EOQ = \sqrt{\frac{2 \times 1.500 \times 200.000}{1000}} = \sqrt{\frac{600.000.000}{1000}} = \sqrt{600.000} = 774,60 = 775$ kg/order
2. Reorder Point (ROP)
   ROP is the minimum inventory level at which a new order must be placed to avoid stockouts before the next delivery arrives.
   ReOrder Point (ROP) = Leadtime (days) x Average daily Usage
   - Wrapping Plastic:
     87,000 rolls / 300 days = 290 rolls/day
     ROP = 290 × 5 = 1,450 rolls
   - Glue:
     1,500 kg / 300 days = 5 kg/day
     ROP = 5 × 5 = 25 kg
   Conclusion of EOQ & ROP Application:

- Wrapping plastic is ordered when the inventory reaches 1,450 rolls, with an order size of 1,703 rolls per order.
- Glue is ordered when inventory reaches 25 kg, with an order size of 775 kg per order.
  This method helps the company reduce total inventory costs, maintain availability of materials, and prevent stockouts or excess stock.

The application of the EOQ method in managing wrapping plastic and glue inventory brings significant positive impacts to the carton box production process, including:

1. Better Material Availability
   EOQ enables the company to determine accurate order quantities and reorder points, reducing the risk of stockouts that may disrupt production flow.
2. More Consistent and Scheduled Production
   The availability of materials according to schedule allows production to run continuously without delays due to material shortages, improving time efficiency and labor utilization.

3. Reduction in Overtime and Downtime Costs
   Previously, material shortages often resulted in production halts or overtime once supplies arrived. EOQ helps prevent such situations, reducing both overtime and idle time costs.
4. Warehouse Space Optimization
   By ordering the right quantities, the company avoids overstocking, improving warehouse layout and reducing the risk of material damage due to long-term storage.
5. Improved Customer Service Quality
   Smooth production processes lead to timely delivery of finished goods, increasing customer satisfaction and strengthening the company's reputation in terms of reliability and punctuality.

CONCLUSION AND SUGGESTION

Based on the analysis of the application of the Economic Order Quantity (EOQ) method in the procurement of wrapping plastic and glue at PT. Asia Paperindo Perkasa, the following conclusions can be drawn:

1. The EOQ method is more effective in reducing total inventory costs, including both ordering and holding costs.
2. The frequency of ordering becomes more efficient, where the number of orders placed annually is optimized and adjusted to actual needs, thus avoiding both shortages and excess inventory.
3. The positive impact on the production process is highly significant, including smoother production schedules, reduced stockout risk, and optimized warehouse space—ultimately supporting the company's overall operational performance.
   For further development and optimization, the author provides suggestions:
1. The implementation of the EOQ method should be conducted consistently and reviewed periodically, especially when there are significant changes in demand, ordering costs, or holding costs.
2. The company should integrate an accurate inventory information system, so that data related to demand and procurement cycles can be monitored in real-time to support more responsive decision-making.
3. The use of the EOQ method should be extended beyond wrapping plastic and glue to other supporting and raw materials that play a crucial role in the carton box production process.
4. Training should be provided to warehouse and procurement staff on the use of the EOQ method and the importance of efficient inventory management to ensure the method is implemented effectively and sustainably.

REFERENCES

Sari, W. P., & Rahayu, M. (2023). *Application of the Economic Order Quantity (EOQ) Method for Inventory Control of Screen Printing Raw Materials*. UNISTEK Journal, 10(1), 25–30.

Firmansyah, F., & Sutrisno, S. (2022). *Application of the Economic Order Quantity (EOQ) Method in Raw Material Inventory Control at the Tofu Industry XYZ*.

Soares, T. A., Montolalu, C. E., & Manurung, T. (2021). *Carton Inventory Analysis Using the Economic Order Quantity (EOQ) Method* (Case Study: PT Asegar Murni Jaya, North Minahasa). Scientific Journal of Science, 21(2), 170–175.

Sholeha, R. (2021). *Application of the Economic Order Quantity (EOQ) Method to Improve the Efficiency of Raw Material Inventory Control* at CV Syahdika Perspective Journal, 19(2), 158–164.

Luthfi, W., Santoso, E. B., & Dhiana, P. (2018). *Analysis of Raw Material Inventory Control Using the Economic Order Quantity (EOQ) Method* to Achieve Production Continuity (Case Study at CV Cynthia Box Kudus). Accounting and Business Research Journal, 18(1), 40–46.

Heizer, J., Render, B., & Munson, C. (2020). *Operations Management* (13th ed.). Pearson Education.

Wisner, J. D., Tan, K. C., & Leong, G. K. (2016). *Principles of Supply Chain Management: A Balanced Approach* (4th ed.). Cengage Learning.

Jacobs, F. R., & Chase, R. B. (2018). *Operations and Supply Chain Management* (15th ed.). McGraw-Hill Education.

Nasution, M. N. (2018). *Operations Management* (Revised Edition). Ghalia Indonesia.

Rusdin, A. (2017). *Inventory Management*. Mitra Wacana Media.