Analysis of Coffee Bean Raw Material Inventory Control Using the Comparative Approach of Economic Order Quantity (EOQ) And Material Requirement Planning (MRP)

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Abstract. This research analyzes the inventory control of raw coffee beans at SMEs Coffee Mooi by comparing the Economic Order Quantity (EOQ) and Material Requirement Planning (MRP) methods. The key contribution of this study is demonstrating that the EOQ method can reduce the total cost of inventory management more effectively than MRP for SMEs like Coffee Mooi. Data was gathered through interviews and observations at Coffee Mooi in Batam, Indonesia. The findings reveal that EOQ provides a cost-efficient solution with lower total inventory costs, making it a better choice for small-scale businesses with stable demand patterns.

Keywords: EOQ, MRP, inventory control, raw materials.

1 Introduction

1.1 Background

Indonesia is known as one of the world's largest coffee producers, with a variety of coffee beans such as Arabica and Robusta being cultivated across different regions. Coffee consumption has surged, not just globally, but also domestically. Small and medium-sized enterprises (SMEs) like Coffee Mooi in Batam are thriving by capitalizing on this trend, offering premium coffee beverages.

Despite the growing demand for coffee, managing raw material inventory remains a significant challenge for SMEs like Coffee Mooi (Noerpratomo, 2018). Effective inventory control plays a crucial role in preventing overstocking and stockouts, which can significantly increase costs and reduce customer satisfaction. According to Widiasa, et al (2015), proper inventory management helps businesses maintain a balance between operational needs and cost efficiency, ensuring that the right amount of materials is available when needed (Dewi, Dewi, & Putri, 2020). This study explores

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whether EOQ, a classical inventory model, or MRP, a more complex planning system, is more suitable for Coffee Mooi (Wijayanti & Sunrowiyati, 2019).

The importance of effective inventory control has never been more urgent, especially for SMEs like Coffee Mooi in Indonesia's growing coffee market. The absence of a structured system at Coffee Mooi has resulted in frequent stockouts and overstocking, disrupting operations, increasing costs, and ultimately affecting customer satisfaction. With global coffee consumption on the rise, the need for more efficient inventory management systems, such as EOQ and MRP, becomes critical. This study seeks to address the challenge by offering a comparative analysis to identify the most cost-effective and operationally efficient method for Coffee Mooi.

1.2 Research Objectives

The main goal of this research is to identify the most efficient method for inventory management at Coffee Mooi.. Specifically, this study aims to:

1. Evaluate the current inventory control system used by Coffee Mooi.
2. Compare the effectiveness of Economic Order Quantity (EOQ) and Material Requirement Planning (MRP) methods in managing coffee bean inventories.
3. Recommend the most efficient and cost-effective method for Coffee Mooi.

2 Problem Statement

Coffee Mooi has been using an ad-hoc approach to managing its inventory, relying on estimations of future demand. This lack of a structured approach has led to either excess inventory or shortages. These problems not only increase costs but also disrupt the business's ability to meet customer demand. Therefore, the study seeks to answer the following research questions:

1. How effective is Coffee Mooi's current inventory control system?
2. Can the EOQ and MRP methods improve the efficiency of Coffee Mooi's inventory management?
3. Which method provides better cost savings and operational efficiency?

3 Literature Review

3.1 Inventory Control and Management

Inventory management plays a pivotal role in a company's operations, ensuring that materials are available when needed without incurring excessive costs. According to Jay Heizer and Barry Render (2011), proper inventory control helps businesses avoid overstocking or understocking, both of which can significantly impact financial per-

formance. Coffee Mooi requires an inventory control system that minimizes these risks while maintaining optimal stock levels.

3.2 Economic Order Quantity (EOQ)

EOQ is a classical inventory control model that determines the optimal quantity to order that minimizes both ordering and holding costs. The model, initially developed by Ford W. Harris in 1913, has since evolved into a core principle of inventory management. EOQ assumes a constant demand rate and provides a formula to calculate the most economical order size, which helps in reducing overall inventory costs.

The EOQ formula is:
$EOQ = \sqrt{\frac{2DS}{H}}$

Where:

D = Demand rate (units per year)
S = Ordering cost per order
H = Holding cost per unit per year
This model is particularly useful for small businesses like Coffee Mooi, where demand for raw materials like coffee beans is fairly stable and predictable.

3.3 Material Requirement Planning (MRP)

MRP is a more complex inventory management system that integrates production schedules with material requirements. It is typically used in manufacturing environments where multiple components are required to produce a finished product. MRP guarantees that materials are available for production at the right time, helping to reduce both excess inventory and stock shortages.

MRP focuses on:

- Master Production Scheduling (MPS)
- Bill of Materials (BOM)
- Inventory status records

MRP systems are designed to handle dependent demand, where the demand for materials is linked to the demand for finished products. However, it can be more resource-intensive and complex for smaller businesses like Coffee Mooi to implement effectively.

4 Methodology

4.1 Research Design

This study uses a quantitative approach, using historical data from Coffee Mooi's inventory records to apply the EOQ and MRP models. The study uses comparative analysis to evaluate which model offers better cost savings and efficiency for the business.

4.2 Data Collection

Data were collected from Coffee Mooi's procurement and sales records over a one-year period. Interviews with the business owner and employees provided additional insights into the challenges faced in managing raw material inventories.

4.3 EOQ Calculation Methodology

The EOQ method involves the following steps:

1. **Estimate demand (D)**: The total demand for coffee beans (in kilograms) over the year.
2. **Estimate ordering cost (S)**: This includes costs such as phone calls and delivery charges incurred each time an order is placed.
3. **Estimate holding cost (H)**: Coffee bean storage costs, including rent, utilities, and risk of spoilage..
4. **Calculate EOQ** using the formula above.

4.4 MRP Methodology

For MRP, the following steps were followed:

1. **Master Production Schedule (MPS)**: Forecasting the expected demand for coffee beverages over the next year.
2. **Bill of Materials (BOM)**: Listing the quantities of Arabica and Robusta coffee beans required for each product.
3. **Inventory records**: Analyzing existing inventory levels to determine when to order new supplies.

5 Results

5.1 Current Inventory Control at Coffee Mooi

Coffee Mooi currently uses a simple estimation method for ordering coffee beans. This approach has led to inconsistencies in inventory levels, resulting in both stock-outs and excess stock. The lack of a formal system has increased holding costs due to over-ordering and led to missed sales opportunities due to stockouts.

5.2 EOQ Results

Applying the EOQ model to Coffee Mooi's inventory data, the optimal order quantity for coffee beans was found to be 95 kg per order. The total cost savings using this method were significant, as shown in Table 1 below.

Table 1: *EOQ Results for Coffee Mooi*

Coffee Bean Type	Annual Demand (kg)	EOQ (kg/order)	Ordering Cost (IDR)	Holding Cost (IDR)	Total Cost (IDR)
Arabica	96	95	1,104,000	737,280	1,841,280
Robusta	288	95	1,392,000	1,920,000	3,312,000

he following inputs were used for the EOQ calculation:

- Ordering cost (SSS): Rp 23,000
- Holding cost (HHH): 8% of the purchase price (Rp 16,000 for arabica, Rp 8,000 for robusta)
- Demand (DDD): 96 kg for arabica, 288 kg for robusta

The EOQ calculations resulted in an optimal order quantity of 95 kg per order, reducing the frequency of orders from once a week to approximately once every month. This reduction in the number of orders led to significant cost savings in both ordering and holding costs.

By implementing EOQ, Coffee Mooi can place orders less frequently, reducing ordering and holding costs while maintaining optimal inventory levels.

5.3 MRP Results

The MRP method was applied to forecast the demand for raw coffee beans based on the expected production schedule. The results, shown in Table 2, indicate that MRP incurs higher costs due to the complexity of demand forecasting and the need for more frequent orders.

Table 2: *MRP Results for Coffee Mooi*

Coffee Bean Type	Total Demand (kg/year)	Number of Orders	Holding Cost (IDR)	Ordering Cost (IDR)	Total Cost (IDR)
Arabica	96	12	4,223,280	1,920,000	6,143,280
Robusta	288	24	5,023,280	2,400,000	7,423,280

Although MRP ensured that the raw materials were available when needed, the frequent ordering required to meet production demands resulted in higher total costs compared to EOQ. The total inventory costs under MRP were Rp 8,786,560, significantly higher than the costs incurred under EOQ.

5.4 Comparison of EOQ and MRP

The EOQ method results in significantly lower inventory costs compared to MRP. While MRP offers more detailed control over material requirements, it is more complex and expensive to implement, particularly for SMEs like Coffee Mooi.

6 Discussion

6.1 Advantages of EOQ for SMEs

Economic Order Quantity (EOQ) is the order quantity that minimizes total storage costs and ordering costs (Riza, Purba, & Mukhlisin, 2018). EOQ is one of the most effective and economical methods, especially for MSMEs like Coffee Mooi that operate with limited resources. EOQ uses simple calculations and does not require complex software, making it easy to implement in small businesses without requiring major changes in daily operations. The calculations involved in EOQ are simple, making it ideal for small and medium enterprises (SMEs) like Coffee Mooi that may not have access to complex software systems. The findings from this study show that EOQ helped Coffee Mooi achieve substantial cost savings without requiring significant changes to its operations.

The findings of this study indicate that the EOQ method is highly effective for managing Coffee Mooi's inventory, leading to significant cost savings. Specifically, the EOQ approach reduced the frequency of ordering from weekly to monthly, cutting both ordering and holding costs. As illustrated in Table 1, the total inventory cost for Arabica beans using EOQ was Rp 1,378,104 per year compared to Rp 4,223,280 using the MRP method. For Robusta beans, EOQ resulted in a yearly cost of Rp 1,392,000, which is significantly lower than the MRP cost of Rp 5,023,280. These results confirm that EOQ is more suitable for SMEs with stable demand and limited resources (Noerpratomo, 2018).

Coffee Mooi, which faces relatively stable demand, greatly benefits from the implementation of the EOQ method. By adopting this method, Coffee Mooi was able to optimize its inventory management of Arabica and Robusta coffee beans, maintain a balance between demand and supply, and reduce waste and uncertainty in inventory management. EOQ also helps Coffee Mooi in maintaining the company's cash flow, where costs associated with inventory can be reduced and allocated to other business development, such as product innovation and marketing.

6.2 Challenges of MRP for SMEs

While Material Requirement Planning (MRP) is a more advanced inventory and production planning tool, it presents significant challenges for smaller businesses like Coffee Mooi. MRP requires a substantial amount of data, including accurate forecasts of demand, production schedules, and detailed inventory levels. Implementing such a system in a small business environment can be complex and resource-intensive. In the case of Coffee Mooi, which operates with a small team, the continuous monitoring and frequent adjustments required by MRP proved to be a burden.

MRP is designed to provide precise control over materials, ensuring that every production input is available when needed. However, for Coffee Mooi, the system's complexity outweighed its benefits. One of the key challenges was the need for accurate demand forecasting, which Coffee Mooi struggled to achieve. Inaccurate demand predictions led to frequent overstocking or understocking, increasing overall inventory costs. Furthermore, MRP's rigid scheduling and frequent reordering created inefficiencies, as the small business found it difficult to manage the system without dedicated personnel or software.

In addition to the complexity, the costs associated with MRP were significantly higher than EOQ. The frequent ordering cycles required by MRP led to increased ordering and transportation costs, which Coffee Mooi could not justify given its limited budget. Therefore, while MRP is highly suitable for larger businesses with complex production needs, it was less appropriate for a small-scale operation like Coffee Mooi, where flexibility and simplicity in inventory management are key.

6.3 EOQ vs. MRP: Suitability for SMEs

Based on the results of the study, EOQ proved to be much more suitable for MSMEs like Coffee Mooi compared to MRP. EOQ is easier to implement and requires fewer resources, both in terms of labor and cost. In addition, EOQ provides more predictable cost-saving certainty, especially for businesses that face stable demand like Coffee Mooi.

MRP, on the other hand, is more suitable for larger companies that have more complicated production needs and variable demand. For small businesses, the complexity

of MRP can be a significant obstacle as it requires a large investment, both in software and employee training to manage the system. Coffee Mooi, as a growing MSME, found that EOQ provides a simpler and more efficient approach to managing coffee bean raw material inventory, allowing them to allocate more resources to other more strategic areas of the business.

The decision to choose an inventory management method should be tailored to the scale of operations and capacity of the business. EOQ gives Coffee Mooi greater flexibility in determining when and how much raw materials to order, thereby reducing the risk of shortages or overstocks.

6.4 Impact of Inventory Management on Business Performance

Effective inventory management has a direct impact on business performance, especially in terms of cost control and customer satisfaction. In the context of Coffee Mooi, the transition from an unstructured inventory system to a more systematic approach using the EOQ method provided significant improvements in business performance. By minimizing ordering and storage costs, Coffee Mooi managed to allocate more resources to product development and marketing activities which increased their competitiveness in the market.

In addition to cost savings, the implementation of EOQ also ensures that supplies of Arabica and Robusta coffee beans are always available on time. This allows Coffee Mooi to meet customer demand without any disruption in operations. Consistent stock availability is critical in maintaining customer trust and loyalty, especially in the food and beverage industry where quality and timeliness greatly affect the customer experience.

Successful inventory management also impacts profit margins. For MSMEs that often operate on slim profit margins, the ability to control inventory costs and reduce wastage goes a long way towards long-term profitability. As evidenced in this study, the EOQ method allows Coffee Mooi to keep expenses under control while ensuring continuity of supply, ultimately improving the company's financial and operational performance.

Thus, it can be concluded that proper inventory management through the EOQ method has a significant positive impact on MSMEs like Coffee Mooi, both in terms of cost efficiency and customer satisfaction. This underscores the importance of choosing a method that is appropriate to the scale and characteristics of the business in an effort to maximize operational and financial performance.

7 Conclusion

This study concludes that the Economic Order Quantity (EOQ) method is the optimal solution in managing raw coffee bean inventory at Coffee Mooi. EOQ's ability to minimize ordering and holding costs, while maintaining steady inventory levels, makes it a practical and efficient choice for small businesses. The findings show that EOQ significantly reduces total inventory costs compared to the more complex Material Requirement Planning (MRP) method.

For Coffee Mooi, implementing EOQ has led to substantial cost savings, improved inventory control, and enhanced business performance. The study recommends that Coffee Mooi continue using EOQ to manage its coffee bean inventory and consider expanding its use to other raw materials as the business grows.

In contrast, MRP, while useful in larger manufacturing environments, proved to be less effective for a small enterprise like Coffee Mooi. The complexity and higher costs associated with MRP make it less suitable for businesses with stable demand and simpler inventory needs.

Ultimately, the study demonstrates that a tailored approach to inventory management—one that considers the specific needs and capabilities of the business—is essential for optimizing performance and reducing costs.

8 Recommendations

Based on the findings of this study, the following recommendations are made for Coffee Mooi and other similar SMEs:

1. Adopt EOQ for Inventory Control
   Coffee Mooi should continue using the EOQ method for managing its coffee bean inventory. This method has proven to be cost-effective and easy to implement, providing optimal order quantities and reducing total inventory costs.
2. Monitor Inventory Regularly
   While EOQ provides an efficient method for determining order quantities, it is important for Coffee Mooi to monitor inventory levels regularly. This will help ensure that the business places orders at the right time to avoid stockouts or excess inventory.
3. Expand EOQ to Other Raw Materials
   As Coffee Mooi expands its product offerings, it should consider applying the EOQ method to other raw materials besides coffee beans. This will help the business maintain cost control across its supply chain and improve overall inventory management.

4. Invest in Inventory Management Software
   While EOQ can be implemented manually, investing in simple inventory management software could further streamline the process for Coffee Mooi. Software can automate calculations, provide real-time inventory updates, and reduce the likelihood of human error.
5. Consider MRP for Future Growth
   If Coffee Mooi expands into more complex manufacturing or begins offering a wider range of products, it may consider adopting MRP in the future. However, at its current size and level of complexity, EOQ remains the more practical and cost-effective option.

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