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Economic Order Quantity (EOQ) Application to Raw Material Inventory Control for SME's

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Abstract

The application of the Economic Order Quantity (EOQ) method in managing raw material supplies for Pempek Isti, a micro, small, and medium enterprise (MSME) specializing in Palembang's culinary specialty, Pempek. The study reveals that the current raw material supply management is inefficient, leading to frequent shortages or excess orders, resulting in additional costs and inefficiencies. To tackle this issue, the study proposes the implementation of the EOQ analysis to minimize inventory costs and maximize profits. The research focuses on determining the optimal order quantities for three key raw materials: ikan tenggiri, sago flour, and eggs. After conducting the EOQ analysis, the study identifies the optimal order quantities as 37kg for mackerel fish, 44kg for sago flour, and 7kg for eggs. Furthermore, the study calculates the reorder points for each raw material based on the EOQ method, resulting in 8.36kg for mackerel fish, 8.19kg for sago flour, and 3.23kg for eggs. By implementing the EOQ method, Pempek Isti MSME can accurately estimate the required quantities of raw materials for Pempek production throughout the year. The calculations consider safety stock and lead time, enabling the determination of reorder points and maximum order quantities for each raw material. This information serves as a valuable reference for effectively managing the MSME's raw material supply chain. Overall, the application of the EOQ method is crucial in ensuring an efficient supply chain for Pempek Isti MSME. By implementing proper planning, control, and supervision of raw materials, the company can minimize costs, prevent stockouts, and avoid excessive inventory. This study provides valuable insights into optimizing inventory management, particularly in the context of MSMEs operating in the culinary industry.

Keywords: Economic Order Quantity (EOQ)

1. INTRODUCTION

Currently, the business world is experiencing rapid development and growth, including in Indonesia, so that every company must improve its performance to face future competition. Although every company has the same goal, namely to make a profit, this goal can be achieved in different ways. To achieve the goal of obtaining profits and profits, good planning and systems are essential to maximize the company's potential. This does not only apply to large companies, but also to Micro, Small and Medium Enterprises (MSMEs) that have the same goal. By having good planning and systems, MSMEs can ensure the survival of their businesses and achieve their goals. Micro, Small and Medium Enterprises (MSMEs) are business sectors that operate in various fields and can be run by the community. In Indonesia, the role of MSMEs in poverty reduction has been acknowledged, leading to their regulation through Law Number 20 of 2008. This legislation recognizes MSMEs as a viable and impactful means to alleviate poverty.. As the largest group of economic actors in Indonesia, MSMEs have a significant contribution to national development and provide broad employment opportunities for domestic workers. . Therefore, MSMEs are able to boost the community's economy as well as help reduce the unemployment rate in Indonesia. (Utama, A. K., 2017).

Every company or MSME has the main goal to make a profit or profit. However, to achieve this maximum profit, one of the things that must be considered by SMEs or companies is the production process and how to control raw material supplies. Inventories are goods or raw materials stored for use in future periods. Inventory of raw materials is an important factor in the production process. Lack of raw material inventory can hamper the production process, while excess raw material inventory can increase storage costs and other costs (Evitha, Y, 2019). There are various categories of inventory that require careful management, including raw material inventory, semi-finished goods inventory, and finished goods or merchandise inventory. Raw material inventory is essential during the initial phases of production, whereas finished goods inventory is crucial for meeting market demand. Effective control of raw material inventory is crucial as it directly impacts the costs incurred by the company due to inventory holding.

Consumers not only demand good price and quality of a product, but also good service. The services referred to include the availability of products that are in accordance with consumer needs, both in quantity and quality desired. This information can be used by companies to consider the amount of raw materials needed, because raw materials are an important factor in supporting the smooth production process. The higher the cost of procuring raw materials, the greater the production costs that must be incurred. Inventories consist of several types, such as raw materials, semi-finished materials, and finished goods. Raw material inventories are used for purposes in the production process, while finished goods are used to meet market demand. Inadequate supply of raw materials or insufficient inventory will have a major impact on the production process. If the raw material inventory process does not go well, then the production process will also be disrupted. This can result in the inability of business actors to meet market demand or achieve predetermined production targets. Therefore, problems with the supply of raw materials can hinder the supply of products to consumers and affect the smooth production process (Kosasih, R. A., & Hakim, A., 2023).

MSMEs Pempek Isti is a micro, small and medium enterprise engaged in Palembang's culinary specialty, Pempek to be precise. In carrying out the production process, raw materials must always be available for the smooth running of the production process. Therefore it is necessary to carry out planning and control as well as supervision of raw materials. However, based on initial observations, it turns out that the supply of raw materials at Pempek Isti SMEs has not been planned properly so that when the raw materials run out during the

production process, there is often an excess order of raw materials so that many of these raw materials cannot be used. As well as the lack of a storage place where this will disrupt the operation of taking raw materials. Of course this is very ineffective and efficient which causes additional costs that should not be needed. In this case related to the frequency of purchases and the quantity of raw materials, so as to achieve the target of inventory efficiency in the company. Basically a company or business plans and controls raw materials to minimize costs and maximize profits for the company. In order to minimize the inventory cost, the Economic Order Quantity (EOQ) analysis can be used. To support this, Pempek Isti MSMEs must know how much influence the application of the EOQ method has so that there is no shortage or excess stock of raw material supplies in the storage area.

2. METHOD

The research method used in this study is a quantitative descriptive method. Quantitative research is a research approach that prioritizes the testing of theories by measuring research variables using numerical data and conducting statistical analyses. Descriptive research is a study that describes a particular characteristic or feature of a phenomenon or problem that occurs (Sugiarto, 2022). Inventory calculation for the method EOQ uses POM QM software for windows version 4.0.

To gather the required data for supporting this study, various data collection techniques were employed, as described below: Observation, this technique involved directly observing the study site to collect data. The author observed and recorded information by personally witnessing the activities and processes at UMKM "Isti". Documentation, the author systematically recorded all relevant information related to the study at UMKM "Isti". This could include written records, reports, , and any other documentation that provided valuable insights for the study. And Interview, interviews were conducted at the UMKM "Isti" premises with the business owner as well as the employees. This technique involved engaging in structured conversations to obtain firsthand information, perspectives, and experiences related to the study. The interviews aimed to gather valuable insights and opinions from the key individuals involved in the UMKM's operations. In summary, the data collection techniques used in this study encompassed direct observation, documentation of relevant information, and conducting interviews with the business owner and employees of UMKM "Isti".

Inventory

Inventory is an asset that encompasses company-owned goods prepared for sale within a normal timeframe, as well as goods in the process of production and raw materials awaiting use in production. From this explanation, it is evident that inventory plays a crucial role for companies as it serves to connect interrelated operations in production and ensures the delivery of goods to customers (Vikaliana et al., 2020).

Heizer and Render (2015) stated that in order to perform the functions of inventory, companies need to maintain four types of inventory:

Raw material inventory refers to the collection of materials that are typically acquired through purchase but have not yet been utilized in the production process.

Work in process inventory comprises products or components that have undergone some level of transformation from raw materials but have not yet reached the stage of being considered finished goods.

MRO (Maintenance/Repair/Operating) inventory consists of supplies needed for maintenance, repair, and

operation to ensure the continuous productivity of machines and processes.

Finished goods inventory comprises products that are ready for sale but still remain as assets in the company's accounting records.

Inventory Control

Inventory control is an activity to monitor and maintain the quantity of finished products in stock, with the aim of preventing adverse conditions for the company, such as excessive inventory and inventory shortages (Tannady & Filbert, 2018).

Inventory control is one of the most crucial managerial tasks to determine the optimal level of inventory to be maintained, in order to avoid stockouts or, conversely, excessive inventory (Vikaliana et al., 2020).

From both definitions, it can be concluded that inventory control is a managerial activity that is important for monitoring and maintaining the quantity of finished product inventory in order to prevent conditions that are detrimental to the company, such as excess inventory or supplies. The main objective of inventory control is to determine optimal inventory levels to avoid stock outs or excess inventory. By implementing effective inventory control, companies can optimize inventory management and reduce the risk of losses associated with unbalanced inventory.

Economic Order Quantity (EOQ)

According to Heizer and Render (2015), the Economic Order Quantity (EOQ) is an inventory control technique designed to minimize the overall cost associated with ordering and holding inventory. While this technique is relatively straightforward to apply, it relies on several assumptions:

The demand quantity is known, fairly constant, and independent.

The lead time, which is the time between ordering and receiving the order, is known and constant.

Inventory is received promptly and in its entirety, meaning that the ordered inventory arrives as a single batch at once.

Quantity discounts are unavailable or not applicable in this context.

The variable costs encompass both the expenses associated with placing or ordering inventory (ordering cost) and the costs incurred for holding inventory over a specific period (holding cost or carrying cost). These cost components have been addressed in the preceding section.

Stockouts, or inventory shortages, can be entirely prevented by placing orders at the appropriate time.

Definition of POM-QM For Windows

POM-QM For Windows is a software application developed to address mathematical problems within the realms of quantitative methods, managerial science, and operations research. This computer program is specifically designed to provide solutions for quantitative analysis and decision-making (Nisa, 2019 as cited in Widodo et al., 2020). Figure 1 displays the POM-QM software designed for Windows operating systems.

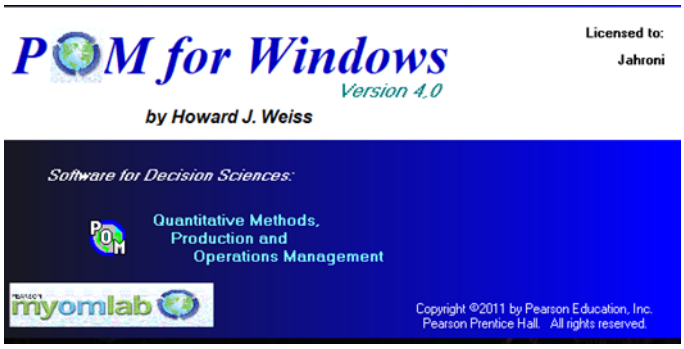

Figure 1. Display POM-QM For Windows Version 4.0

3. RESULT AND DISCUSSION

SMEs Pempek "Isti" currently employs a straightforward approach to control their raw material inventory. The company's raw material procurement system relies on the predetermined production plans as a basis for purchasing the necessary materials. This ensures that SMEs "Isti" can replenish their stock and prevent any potential shortage of raw materials.

To determine the production plan, SMEs "Isti" considers the estimated total number of product requests, which serves as a benchmark for the upcoming production volume. By having this information, the company can accurately calculate the required amount of raw materials needed to meet the production demands for Pempek. Once the calculations are complete, SMEs "Isti" proceeds to place orders for the necessary raw materials.

In the year 2020, SMEs "Isti" relied on the following data to estimate the demand for raw materials. This data allowed them to forecast the quantities needed for the production of Pempek, enabling them to plan their procurement accordingly.

By following this systematic approach to raw material inventory control, SMEs "Isti" can ensure a consistent supply of raw materials, minimizing the risk of production delays or disruptions due to insufficient stock. This proactive approach helps them maintain customer satisfaction by fulfilling product requests in a timely manner.

Raw Material Request

Table 1. Raw Material Request

Periode	Ikan Tenggiri (Kg)	Sago flour (Kg)	Egg (Kg)
January	75	73	2
February	76	74	2
March	80	78	3
April	85	83	4
May	80	79	3
June	75	74	2
July	80	77	3
August	78	75	2
September	79	76	3
October	80	78	3
November	82	80	4
December	84	82	4
Total	954	929	35
Average	79.5	77.41	5

Based on table 1 it is known that the average demand for Ikan Tenggiri every month is 79.5 Kg or we round it up to 80 Kg, the average demand for Sago Flour every month is 77.41 Kg or 78 Kg, and the average demand for eggs every month is 5 Kg.

Order Fee

Table 2. Order Fee

No	Ordered items	Fee type	Cost
1	Ikan Tenggiri	Telephone Cost	Rp. 2000
		Shipping Cost	Rp. 100.000
	Total Cost		Rp. 102.000
2	Sago flour	Telephone Cost	Rp. 2000
		Shipping Cost	Rp. 100.000
	Total Cost		Rp. 102.000
3	Egg	Telephone Cost	Rp. 2000
		Shipping Cost	Rp. 100.000
	Total Cost		Rp. 102.000

Table 2 presents two distinct types of costs that impact the process of making bookings: telephone charges and delivery fees.

Storage fee

Table 3. Storage Fee

No	Ordered	Raw Material	Fee/month	Total Cost/year
1	Electricity cost	Ikan Tenggiri	Rp. 12.000	Rp. 144.000
2		Sago flour	Rp. 10.000	Rp. 100.000
3		Egg	Rp. 12.000	Rp. 144.000

Based on table 3, the saving cost is the cost of electricity for one year on Tenggiri raw materials of Rp. 144,000, sago flour Rp. 100,000, and eggs for Rp. 144,000.

Inventory Control EOQ Method

The EOQ (Economic Order Quantity) method is utilized to determine the ideal number of orders with minimal costs for controlling raw materials. EOQ aims to minimize the total cost of procuring raw materials or, in other words, optimize the purchasing process. To efficiently manage and keep track of raw material inventory, the POM-QM software for Windows is employed. This software assists in solving problems related to production and operations management by calculating the optimal number and frequency of orders.

Calculation of EOQ on Raw Materials Ikan Tengiri

Parameter	Value		Parameter	Value
Demand rate(D)	954		Optimal order quantity (Q*)	36,76
Setup/Ordering cost(S)	102000		Maximum Inventory Level (Imax)	36,76
Holding cost(H)	144000		Average inventory	18,38
Unit cost	55000		Orders per period(year)	25,95
Days per year (D/d)	300		Annual Setup cost	2646918,0
Daily demand rate	3,18		Annual Holding cost	2646918,0
Lead time (in days)	2		Annual Holding (safety stock)	288000
Safety stock	2		Unit costs (PD)	52470000
			Total Cost	58051840
			Reorder point	8,36 units

Figure 2. EOQ calculations Ikan Tenggiri
(**Source**: Output POM-QM for Windows Version 4.0)

Based on Figure 2, the recommended order quantity, denoted as Q*, for Ikan Tenggiri is 36.76 kg, rounded up to 37 kg. The average inventory value of the raw material is calculated to be 18.38 kg. The frequency of orders per period is indicated as 25.95 or approximately 26 orders per year. The total cost of storage and ordering amounts to Rp. 2,646,918 annually. Considering the unit price of IDR 52,470,000, the optimal total cost for Ikan Tenggiri raw materials is IDR 58,051,840. The reorder point is determined to be 8.36 kg. Therefore, "Isti" needs to place a new order with the main raw material supplier. The balance point for Ikan Tenggiri raw materials can be seen in Figure 2 below.

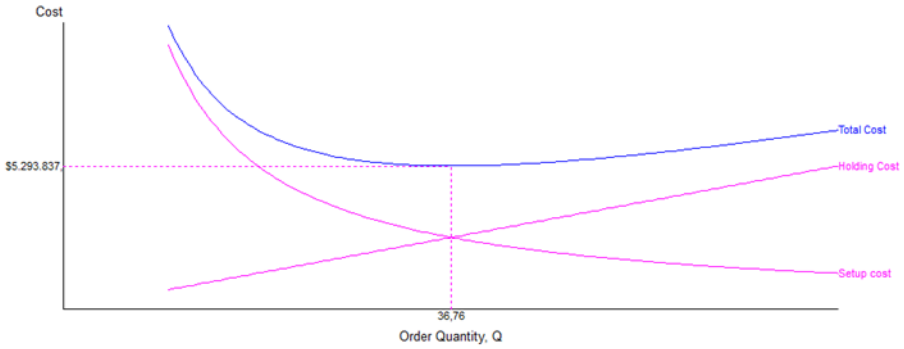

Figure 3. The balance point Ikan Tenggiri
(Source: Output POM-QM for Windows Version 4.0)

Based on Figure 3, the optimal intersection point between holding cost and setup cost occurs at the value of 36.76. This point represents the lowest cost incurred by SMEs “Isti” for the procurement of Ikan Tenggiri raw materials.

Calculation of EOQ on Raw Materials Sago Flour

Parameter	Value		Parameter	Value
Demand rate(D)	929		Optimal order quantity (Q*)	43,53
Setup/Ordering cost(S)	102000		Maximum Inventory Level (Imax)	43,53
Holding cost(H)	100000		Average inventory	21,77
Unit cost	10000		Orders per period(year)	21,34
Days per year (D/d)	300		Annual Setup cost	2176672,0
Daily demand rate	3,1		Annual Holding cost	2176672,0
Lead time (in days)	2		Annual Holding (safety stock)	200000
Safety stock	2		Unit costs (PD)	9290000
			Total Cost	13843340
			Reorder point	8,19 units

Figure 4. EOQ calculations Sago Flour

(**Source**: Output POM-QM for Windows Version 4.0)

Figure 4 shows that the optimal optimal order quantity Q* is 43,53 kg if rounded to 44kg, the average raw material inventory value is 21,77 kg. The frequency of orders for one period shows as much as 21,34 or the same as 22 orders a year. And the total cost of storage and ordering is Rp. 2.176.672 in a year. With units of IDR 9.290.000, the optimal total cost for Sago Flour raw materials is IDR 13.843.340 and the reoder point is 8.19 kg. "Isti" is required to order again from the main raw material supplier. The balance point for egg raw materials can be seen in Figure 4 below.

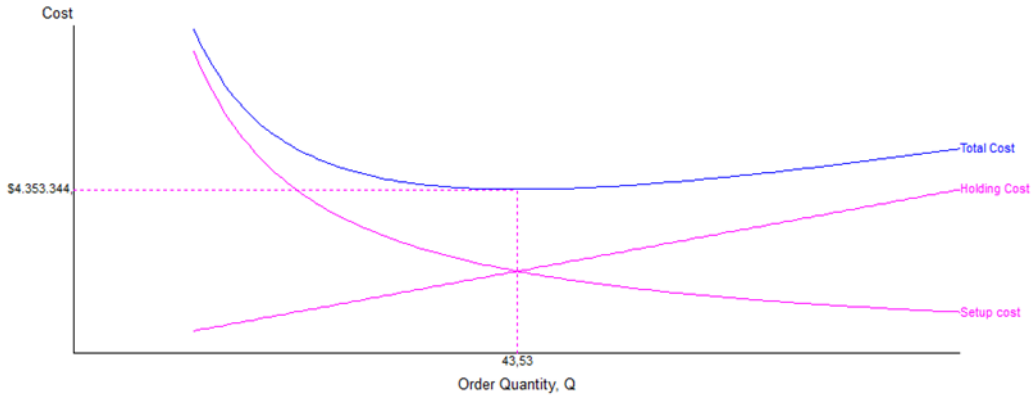

Figure 5. The balance point Sago Flour

(**Source**: Output POM-QM for Windows Version 4.0)

Figure 5 shows that the optimal meeting point between holding cost and setup cost is at point 43.53, that point shows that the smallest cost incurred by SMEs “Isti” for Sago Flour raw materials.

Calculation of EOQ on Raw Materials Egg

Parameter	Value		Parameter	Value
Demand rate(D)	35		Optimal order quantity (Q*)	7,04
Setup/Ordering cost(S)	102000		Maximum Inventory Level (Imax)	7,04
Holding cost(H)	144000		Average inventory	3,52
Unit cost	2000		Orders per period(year)	4,97
Days per year (D/d)	300		Annual Setup cost	506991,1
Daily demand rate	,12		Annual Holding cost	506991,1
Lead time (in days)	2		Annual Holding (safety stock)	432000
Safety stock	3		Unit costs (PD)	70000
			Total Cost	1515982,0
			Reorder point	3,23 units

Figure 6. EOQ calculations Egg

(**Source**: Output POM-QM for Windows Version 4.0)

Figure 6 shows that the optimal optimal order quantity Q* is 7,04 kg if rounded to 7kg, the average raw material inventory value is 3,52 kg. The frequency of orders for one period shows as much as 4,97 or the same as 5 orders a year. And the total cost of storage and ordering is Rp. 506.991 in a year. With units of IDR 432.000, the optimal total cost for Egg raw materials is IDR 70.000 and the reoder point is 3,23 kg. "Isti" is required to order again from the main raw material supplier. The balance point for egg raw materials can be seen in Figure 4 below.

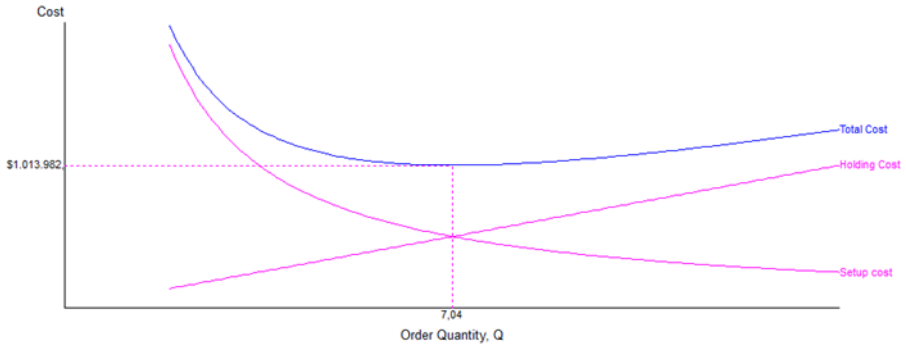

Figure 7. The balance point Egg

(**Source**: Output POM-QM for Windows Version 4.0)

Figure 7 shows that the optimal meeting point between holding cost and setup cost is at point 7,04, that point shows that the smallest cost incurred by SMEs “Isti” for Egg raw materials.

The findings of this study corroborate the findings of previous research conducted by Jiroyah and Sumarsono (2021) titled " Analisis Pengendalian Persediaan Bahan Baku Di Ukm Batik Sekar Jati Star Dengan Menggunakan Metode Abc Analysis Dan Economic Order Quantity (EOQ)" The results of their study indicated that utilizing the EOQ method can result in significantly higher efficiency. The quantity and frequency of raw material purchases are reduced while still considering safety stock and reorder point, ensuring that the production process remains uninterrupted. Moreover, inventory costs are minimized, leading to inventory cost efficiency.

4. CONCLUSION

Based on the calculation of the EOQ method using the POM QM software for Windows Version 4.0, the results obtained are economical order quantities for each material supplied to UKM "Isti", namely 37kg of

mackerel, 44kg of sago flour, and 7kg of eggs. The calculated reorder point levels for the respective raw materials are as follows: for mackerel, it is 8.36 kg or 8 kg; for sago flour, it is 8.19 kg or 8 kg; and for eggs, it is 3.23 kg or 3 kg. These quantities indicate the threshold at which it is necessary to reorder the respective raw materials.

It can be concluded that the economic order quantity (EOQ) method can be implemented to calculate the inventory of raw materials needed in the Pempek "Isti" SME production information system. So that it can be known the number of raw material requirements for the production of Pempek in one year. The raw materials for making pempek consist of: Mackerel Fish, Sago Flour, and Eggs. By knowing the amount of safety stock, lead time, we can find out the reorder point, as well as the maximum order for each of the above raw materials. The data from the calculation above can be used as a reference in managing MSMEs.

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