Efficiency, Effectiveness, and Profitability: The ABC-EOQ Formula for Success in Mineral Water Inventory Management

Valencio Rafferty Sidharta[1], Diah Ayu Septi Fauji[2]

[1,2] Management Department, Universitas Nusantara PGRI Kediri

INFO ARTIKEL	Abstract

This paper attempts to offer improvements to the problems faced by the inventory management of mineral water agent retail businesses in Kediri by providing solutions to the main causes of excess inventory. Several popular inventory management techniques such as ABC classification and EOQ to reduce excess stock in warehouses have proven to be quite efficient so they can help in managing inventory effectively and can increase the fluency of business cash flow. This combination of techniques could open the way for new research topics and expand the literature on this subject. This research uses quantitative descriptive methods. Data was obtained from interviews and inventory data. The results of this research also show that for products with the highest demand and consuming 66.31% of capital, inventory can be controlled with EOQ. The calculation results using a combination of the two methods proved to be more efficient. This can be seen by comparing the company's policy with the number of goods ordered in one order of 350 gallons with a frequency of ordering 8 times a year with a total cost of Rp.44,254,740,- while the EOQ method produces a total order of goods of 1,208 gallons with a frequency of ordering 2 times in a year and with total costs incurred amounting to Rp.39,033,490,-.

✉ Authors
(*) Corresponding Author

Email:
sidhartavalencio@gmail.com[1],
septifauji@unpkediri.ac.id[2*]

Introduction

In the business world, inventory has an important role in the operational activities of a business (Rambitan *et al.*, 2018). The general definition of inventory management is a process or continuous activity that involves organizing, planning, and controlling inventory (AL-Dulaime and Emar, 2020). Inventory management plays a role in determining the balance between inventory investment and customer service. A balanced investment in inventory and customer service can determine a company's long-term competitive advantage (Sanjaya and Purnawati, 2021). Correct inventory management can also prevent a company from various possibilities that could hamper the running of a company's operational activities. Inventory management is closely related to warehouse capacity. Inventory management also means monitoring company assets in the form of inventory (Gunawan and Setiawan, 2022). Inventory of goods or stock is the most dynamic and important capital for companies that have material value (Prayogi *et al.*, 2022). The greater the amount of inventory, the greater the company's investment. When the availability of goods is maintained and can be managed well, it will also have a good impact on managerial decision-making such as marketing and financial

decisions. Apart from that, inventory control is also one of the most important factors that contributes to reducing costs incurred by the company (Dhaiban, 2017).

In general, all companies require inventory control planning with the aim of minimizing costs and optimizing profits (Elmas, 2017). Therefore, correct inventory management is needed. Excessive goods stored in the warehouse will increase the risk of goods being damaged due to unsold goods (Abbas *et al.*, 2021). Apart from that, inventory that is too large also indicates that capital investment in the form of goods is not circulating smoothly (Iqbal *et al.*, 2017). However, if too few goods are stored in storage, it will disrupt the operations of a company and can result in market demand that cannot be met. (Mayasari and Supriyanto, 2022). Therefore, shortages or even running out of inventory can result in the company losing opportunities to gain profits (Fithri *et al.*, 2019). This shows that the continuity of operational activities will not run smoothly if there is a shortage or excess of inventory (Guslan and Saputra, 2020). Meanwhile, one of the common problems faced by companies is how companies can provide inventory appropriately, without shortages or excesses (Hastari *et al.*, 2020). Thus, inventory management aims to find a balance point between customer service and the value of the company's investment in inventory (Monica and Setiawan, 2019).

A quantity of inventory that is too large will not only affect storage capacity but will also cause large costs. With good inventory management, companies can optimize the profits they obtain by minimizing losses caused by inventory that is less effective and efficient (Sulaiman and Nanda, 2015). This could mean that failure to control inventory will fail to optimize company profits (Saragi and Setyorini, 2014). Many costs are not detected by inventory managers which can reduce a company's profits. Some inventory costs that are often not realized but can have a significant impact include inventory costs, storage costs, ordering costs, material shortage costs, and goods preparation costs. (Sanjaya and Purnawati, 2021). Apart from that, inventory management is also related to things such as the number of items needed in one order, when is the right time to place an order, and so on (Putra and Purnawati, 2018). Business actors or entrepreneurs must be able to know the optimal ordering of goods for their company so that costs remain efficient (Sukosyah *et al.*, 2023). If inventory can be managed well, effectively, and efficiently, then these costs can be said to have been managed to become economic costs and not burden the company. However, vice versa, if these costs cannot be managed well by the company, it will result in quite significant costs and will reduce the company's profits. Therefore, one of the company's efforts to achieve efficiency is by controlling inventory (Wahyudi, 2015).

One company that requires effective inventory control is the Flow Kediri mineral water agent. Flow Kediri mineral water agent is a company engaged in the distribution of mineral water in Kediri City, East Java. Mineral water is one of the basic human needs and companies have an important role in managing the distribution of mineral water so that it can meet the needs of consumers. Therefore, this company needs good inventory management so that the company's operational activities can run smoothly. The main problem at the Flow Kediri mineral water agent is that there is no inventory control planning which causes distribution activities to not run smoothly. Based on the results of interviews with Flow Kediri managers, orders for goods are only made if stock starts to run low. Thus, it can be said that Flow Kediri does not yet have a reorder point. This results in empty inventory if the ordered goods do not arrive. With an empty stock of goods, Flow Kediri carries out goods distribution activities using other brands to maintain customer loyalty. However, this results in additional costs because the price of competitors' products is higher than Flow Kediri's selling price. These problems will also have an impact on total inventory costs which are uncontrolled. Uncontrolled inventory costs will have a direct impact on company profits.

Rossi (2021) conveyed at least three main reasons for the importance of controlling inventory, namely time, uncertainty, and economies of scale. The word "time" here means that there is a waiting time after an order for goods is made, it is hoped that controlled inventory can be used as collateral for the continuity of operational activities during the waiting time. After that, the word "uncertainty" relates to the uncertainty of waiting times and market demand. Furthermore, economies of scale, economies of scale are expected to be achieved if inventory can be controlled appropriately. Therefore, improvements are needed in inventory management so that companies can carry out operational activities smoothly to obtain optimal profits. In general, the inventory management process begins with inventory planning, then inventory control, and ends with inventory monitoring (Rusdiana, 2014). For this reason, this problem can be handled using the ABC classification and EOQ method. According to Heizer *et al.*, (2017), ABC analysis divides inventory into three categories based on annual investment volume. In line with Heizer's statement Purnomo, (2017) also states that ABC analysis is a classification of a group of goods arranged based on costs in a certain period. ABC classification will help to classify goods according to the largest investment value in a period of goods sales. Goods classified into group A are goods that have the greatest investment value among others. Items that fall into this category require more intense attention because they have a greater investment value. If goods that fall into this category have not been controlled properly, then it can be ascertained that the resulting inventory costs will have a significant influence on optimizing company profits. To minimize inventory costs, the EOQ method is the right method to overcome this problem. According to (Heizer *et al.*, 2017), The EOQ method is an inventory control technique by minimizes total ordering costs and storage costs. With the EOQ method, companies can find out how many items need to be ordered in one order and how frequently they need to order. After that, the company needs to think about when is the right time to order goods. This problem can be solved by calculating the Reorder Point. Heizer *et al.*, (2017) explain Reorder Point is the inventory level at which the company needs to order goods so as not to experience a situation of inventory shortage. With the combination of ABC classification and EOQ and Reorder point methods, it is hoped that it can solve the problems experienced by the Flow Kediri mineral water agent, namely being able to streamline operational activities by controlling existing inventory effectively to provide efficiency to the company in the form of minimizing costs incurred and optimizing company profits.

RESEARCH METHOD

This research uses quantitative descriptive methods. Data sources were obtained from primary data in the form of direct interviews and secondary data in the form of goods ordering documents. The data collection techniques used in this research were observation and interviews. The data analysis technique is carried out by combining the ABC classification and the EOQ method with the following stages: making a list of items to be analyzed, this list contains the name of the item, price, and quantity requested in one period. After that, look for items that have the greatest investment value by carrying out ABC classification using the POM QM application. Items that have the greatest investment value will be analyzed further using the EOQ and Reorder Point methods. Before carrying out analysis using the EOQ method, researchers collected data related to the number of requests for these goods in one period, the frequency of ordering these goods in one period, and the total inventory costs in one period consisting of ordering costs and storage costs. This is done as a comparison with the calculation results using the recommended EOQ method. According to Heizer *et al.*, (2017), Total inventory costs can be calculated using the following formula:

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

with the following information: TC is the total cost in one period, D is the number of requests in one period, Q is the number of units of goods per order, S is the total ordering cost per order, and H is the total storage cost in one period.

After obtaining data in the form of total inventory costs which consist of the total costs of ordering and storing goods, the EOQ and Reorder Point calculations can be carried out. EOQ and Reorder Point calculations are carried out using the POM QM application and reinforced by calculations using mathematical formulas according to Heizer *et al.*, (2017) as follows:

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

with the following information: Q is the optimal number of orders per order, D is the number of requests in one period, S is the total cost of ordering goods per order, and H is the total cost of storing goods per period. The next step is to find the reorder point using a formula Heizer *et al.*, (2017) as follows:

$$ROP = d \times L$$

with the following information: ROP is the reorder point, d is the number of requests per day, and L is the waiting time after ordering goods until the goods arrive (in days). The final stage is to carry out a comparison between the policies in force in the company and the results of calculations using the EOQ method. The data to be compared includes the optimal number of ordering frequencies, the optimal number of units per order, and the total inventory costs incurred by the company in one period with the total inventory costs recommended by the EOQ method.

RESULT

Research results based on observations and interviews show that this company has several item variants, namely 120ml mini cup, 220ml standard cup, 200ml mini bottle, 550ml standard bottle, 1500ml large bottle, and 19L gallon. From this data, ABC classification was carried out to divide it into 3 categories. The following are the results of the ABC classification:

Table 1. Result for ABC Classification

Item name	demand	price	volume	Percent of vol	category
Galon 19L	2958	Rp11.167	Rp33.031.990	66,31	A
Cup 120ml	720	Rp14.000	Rp10.080.000	20,23	A
Botol 200ml	220	Rp16.200	Rp3.564.000	7,15	B
Cup 220ml	150	Rp15.000	Rp2.250.000	4,52	C
Botol 550ml	20	Rp29.000	Rp580.000	1,16	C
Botol 1500ml	10	Rp31.000	Rp310.000	0,62	C
TOTAL	4078		Rp49.815.980		

By obtaining these classification results, the item that will be analyzed further using the EOQ and Reorder Point methods is the 19L gallon item. According to the results of interviews and supported by goods ordering documents, the number of orders for 19L gallon items is 350 gallons per order. In processing data using the EOQ and Reorder Point methods, some additional data is needed. This data is data on the number of requests in one period, ordering costs per order frequency, storage costs per unit, price per unit, productive days, and waiting time or lead time.

From the results of the research carried out, it is known that the total demand in one period was 2958 units for IDR 11,167 per unit. Then, ordering costs are known to be IDR 1,225,000 per order, and storage costs are IDR 4,970 per unit. Storage costs include employee salaries, electricity costs, and contribution costs. Meanwhile, ordering costs include transportation costs. The total productive days in one period are known to be 246 days and the waiting time or lead time is 7 days. From these data, the following EOQ and Reorder Point calculation results are obtained:

Table 2. Result for EOQ model and Reorder Point

Parameter	Value
Optimal order quantity (Q*)	1.207,55
Maximum Inventory Level (Imax)	1.207,55
Average inventory	603,77
Orders per period(year)	2,45
Annual Setup cost	3.000.754,00
Annual Holding cost	3.000.754,00
Total Inventory (Holding + Setup) Cost	6.001.507
Unit costs (PD)	33.031.990
Total Cost (including units)	39.033.490
Reorder point	84,17 units

Data obtained from the calculation results of the EOQ and Reorder Point methods will be compared with data obtained from the results of company policy, namely the number of goods in one order is 350 gallons. The following are the results of a comparison of the data from the EOQ and Reorder Point calculation methods when compared with the data obtained by the company's applicable policies:

Table 3. Comparison of Result Using EOQ and Result Using Company's Policy

Parameter	Results using EOQ	Results using 350
Optimal order quantity (Q*)	1.207,55	
Maximum Inventory Level (Imax)	1.207,55	350
Average inventory	603,77	175
Orders per period(year)	2,45	8,45
Annual Setup cost	3.000.754,00	10.353.000
Annual Holding cost	3.000.754,00	869.750
Total Inventory (Holding + Setup) Cost	6.001.507	11.222.750
Unit costs (PD)	33.031.990	33.031.990
Total Cost (including units)	39.033.490	44.254.740
Reorder point	84,17 units	

DISCUSSION

Based on the research results after carrying out the ABC classification, the 19L gallon item is an item that is included in category A with the largest volume percentage among other items. This item has the largest contribution to the total inventory of goods with a total of 2958 units out of 4078 total inventories. This means that the 19L gallon item has a percentage of total inventory of 72.53%. The research results also show that the 19L gallon item has a large contribution to the company's inventory with the largest investment value percentage among the others, namely 66.31%. The results of this classification show that the 19L gallon item is an item that requires intense planning and supervision and is prioritized because if inventory control for this item cannot run well, it will have a direct effect on the costs incurred by the company which in the end will have an impact on optimizing profits.

Because the 19L gallon item has the greatest investment value among other items, calculations using the EOQ and Reorder Point methods are important. With the EOQ method, companies can find out the exact frequency of orders in one period, companies can find out the number of units that need to be ordered in one order, and with Reorder Point the company can know when is the right time to order goods. The results of calculations using the EOQ method show that the company's optimal order frequency is 2 times in one period with units per order of 1,208 gallons. By using the recommended EOQ calculation method, the value of goods ordering costs and storage costs is balanced, namely IDR 3,000,754 so that the total inventory cost is IDR 6,001,507. The results of the EOQ method calculation also show that the total unit cost is IDR 33,031,990, and if the total unit cost is added to the total inventory cost, the total cost in one period is IDR 39,033,490. The reorder point was found to be 84 units. This shows that the company needs to order goods when inventory remains at 84 units. This is done so that the amount of inventory can be optimal, there is no shortage or excess.

Table 3 shows the comparison results using EOQ and company policy. The comparison of order frequency in one period looks quite significant. The policy implemented by the company requires 8 times the delivery frequency, while the results of the EOQ method show that orders only need to be made 2 times in one period. This has an impact on the order units in one frequency of ordering goods. The EOQ method recommends ordering units in one order frequency of 1,208 units or around 4 times more than the company policy of 350 units in one order. The results of calculations using company policy show that the total cost of ordering

and storing goods is not balanced with ordering costs of IDR 10,353,000 and storage costs of IDR 869,750 in one period. If the two costs are added up, it will result in a total inventory cost of IDR 11,222,750. This means that the total costs incurred by the company in one period when added up to the total unit costs are IDR 44,254,740. When compared with the calculation results using the EOQ method, there is a difference of IDR 5,221,250.

CONCLUSION

Based on the results of the research and data analysis that has been carried out, the conclusions that can be drawn are as follows: 1) by the results of the ABC classification, the 19L gallon item is an item that is included in category A. This means that the 19L gallon item is an item with the investment value is the largest compared to other items so the 19L gallon item needs to be prioritized and controlled properly. 2) according to the calculation results of the EOQ method, the optimal ordering frequency for 19L gallon items is 2 times with a total of 1,208 units per ordering frequency. 3) The company's Reorder Point is at 84 units, this number indicates that the company needs to order goods when inventory has reached this number. This is done so that inventory can be optimal and efficient, meaning there is no shortage or excess of inventory. 4) the total inventory cost using company policy is IDR 39,033,490, while the total inventory cost using the EOQ method is IDR 44,254,740. Thus, calculations using the EOQ method succeeded in implementing efficiency by reducing inventory costs so that company profits could be optimized by IDR 5,221,250.

Based on the conclusions that have been obtained, there are several suggestions that can be put forward by researchers. It is recommended that related company should implement and improve their inventory management by reconsidering using recommendations resulting from a combination of the ABC classification and EOQ methods. This combination has been proven to be able to streamline the company's operational activities by knowing which categories of items need to be prioritized, and most importantly, it can have an impact on the company's cost efficiency. With cost efficiency, company profits can be optimized. This research is limited to a combination of the ABC classification and the EOQ method which only focuses on inventory control by reducing the costs incurred by the company. Further research can be carried out by combining the ABC classification, EOQ method, and other analysis tools which can further refine the results of this study.

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