Control of Raw Material Inventory at Cireng and Cimol Nella Businesses Using EOQ Method (Economic Order Quantity)

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ABSTRACT	ARTICLE INFO

This research is research in the field of culinary business where raw materials if stored for too long can cause damage as well as losses to the business owner. The businesses chosen were those of Cireng and Cimol Nella which had problems in supplying raw materials, namely flour. This research also aims to enable business actors to carry out an inventory of raw materials so that product quality is better maintained so that it does not change the taste of the product and the condition of the product is even better. From the existing problems, the method used is to use the application of the EOQ (Economic Order Quantity) formula because using this method is considered appropriate for calculating the number of times the right order is made in 1 month. Then the determination of the reorder point was made by the company when the stock of tapioca flour in the company was 77.87 kg. Economic Order Quantity, Safety Stock and Reorder Point are interrelated things to be able to find out the most optimal order quantity. Advice for business owners to always take into account when placing an order so that raw materials do not become wasteful or wasted due to damage.

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1. Introduction

Every business must carry out the production process how the formation of an item, a good production process. Nowadays, there are a lot of establishments of a business or business or what is commonly referred to as MSMEs. Coupled with the existance of a pandemic where everyone has switched to running a business or business, many of them are in the form of culinary businesses. Culinary business is an easy business to run. However, every business must have a calculation for the inventory of raw materials.

Inventory is the most important asset in a company, because inventory is an asset that is quite large in value. The existence of inventory in a company contains implications seen from the presence or absence of inventory. If the available inventory is large enough, then the impact is also the cost required to maintain inventory is also large. Conversely, if inventory is not available, the implications for the production and sales process will be disrupted. (Lestari, Subagyo, & Limantara, 2019). Inventories must also always have good control so that the raw materials obtained and will be used have good quality and are suitable for use.

Inventory control is all actions taken to ensure the availability of materials (inventory) in a certain amount at a certain point in time (Pardede, 2010). If the control of raw material inventory is good, the final product that can be run by the entrepreneur will also have maximum results.

The problem of controlling orders in micro or medium businesses is something that very often occurs because many factors have an influence, one of which is that the control process has not been implemented properly and correctly. The use of the EOQ method is widely used by factories and SMEs, because it is the easiest to implement and the most efficient.(Mahendra, Jufriyanto, & Rizqi, (2022).

The SMEs chosen for this research are Cireng and Cimol Nella. These businesses also include businesses that are easy to run and their products are often sought after by consumers as daily snacks. However, for the manufacture of products the quantity is not clear per day. Where the business has constraints in the form of inventory control. Due to being in a pandemic period, business owners are still confused about ordering the right raw materials so they don't meet with suppliers too often, but if they buy too many raw materials, it is feared that it will change the quality of the raw materials.

2. Literature Review

Economic Order Quantity (EOQ)

Economic Order Quantity (EOQ) or the basic economic order quantity this method is often used in raw material inventory where EOQ plays an important role in minimizing the cost of an inventory, according to Heizer and Render (2015: 561) EOQ is one of the most frequently used inventory control techniques.

Safety Stock (SS)

According to Heizer and Render (2015: 567) Safety Stock is an additional supply that allows the occurrence of demand inequality, a buffer.

Reorder Point (ROP)

The Reorder Point formula according to Heizer and Render (2015: 567) is the reorder point or reorder point (ROP) which is the inventory level where when the inventory level has reached that level.

3. Method, Data, and Analysis

The research method is a way of how research is carried out. The method used is descriptive quantitative. According to Sugiyono (2013:13) qualitative research methods can be interpreted as research methods based on the philosophy of positivism, used to examine certain populations or samples, sampling techniques are generally carried out randomly, data collection using research instruments, data analysis is quantitative/ statistics with the aim of testing the late established hypothesis.

Data collection technique

According to Sugiyono (2017, 194) the method or technique of data collection can be done by interview (interview), questionnaire (questionnaire), observation (observation), and a combination of the three. And what the researchers did are as follows:

1. Interview

   According to Sugiyono (2017, 194) Interviews are used as a data collection technique if the researcher wants to carry out a preliminary study to find the problems to be studied, and if the researcher also wants to know things from respondents who are more in-depth and the number of respondents is small.

2. Observation

   According to Sugiyono (2017, 203) Observation is a data collection technique that has specific characteristics when compared to other techniques. Observations are made by looking directly at the field, for example the condition of the work space and work environment that can be used to determine the appropriate factors supported by interviews and questionnaires regarding job analysis.

Data Analysis Design

The design of data analysis is an integral part of the research process stated either in written form or not. According to Sugiyono (2017: 244), data analysis is the process of systematically searching and compiling data obtained from interviews, field notes, and other materials, so that they can be easily understood, and the findings can be informed to others. In this research, data has an important position.

From the results of documentation and observations, the author will apply several methods to answer the problems that exist in the formulation of the second problem. Here are the steps used:

a. Calculating economical raw material orders (EOQ)

b. Calculating safety stock

c. Reorder Points (ROP)

4. Result and Discussion

Based on the results of interviews and data analysis, after that three calculations were carried out to find out the order quantity using Economic Order Quantity (EOQ), safety stock and reorder point.

To determine the order with the optimal quantity, the Economic Order Quantity (EOQ) method is used which requires the following calculations:

a. **Annual Demand (D)**

Based on data obtained from companies that have been calculated previously, the demand for raw materials for cireng and cimol nella, especially the main raw material, namely tapioca flour in 2020-2021 is as follows:

Table 1 Use of Tapioca Flour Raw Materials in 2020-2021

Month	Request
April 2020	250
Mei 2020	240
Juni 2020	300
Juli 2020	250
Agustus 2020	240
September 2020	300
Oktober 2020	270
November 2020	240
Desember 2020	320

Januari 2021	300
Februari 2021	300
Maret 2021	220
Total	3230
Average	269,2

Source : Cireng dan Cimol Nella 2021

It can be seen in table 1 that the use of tapioca flour raw materials during 2020-2021 fluctuated so that each use of raw materials from April 2020 to March 2021 was different. So far, Cireng and Cimol Nella have purchased raw materials almost every month, the reason being that the company buys raw materials every month as inventory in the production process and to anticipate an increase in raw material prices and delays in delivery. Thus, the company pays less attention to the number of economical purchases.

From the total use of raw materials from April 2020 to March 2021, it can be seen that the average use of tapioca flour raw materials is 269.2 kg.

b. **Ordering Cost (S)**

Results of interviews with cireng and cimol owners. nella for the cost of ordering via Whatsapp messages, the transportation costs are around Rp. 50,000 per month and each time an order, then for each year is Rp. 600,000 which can be obtained from the result of the booking fee per month multiplied by 12 months.

c. **Holding Cost (H)**

Based on interviews with business owners, storage costs are assumed to increase by 5% from the previous year, due to the increase in electricity and fuel prices. For storage of raw materials can be seen as follows:

Table 2 Cost of Storage of Tapioca Flour Raw Materials

Cost Component	Storage Cost
Damage Cost	11.000
Electricity Cost	100.000
Total per month	111.000
Total per year	1.332.000

Source : Result of interview with owner

Based on Table 2, the results of interviews with business owners regarding the cost of storing raw materials issued by the company every month. The first cost component incurred is the cost of damage, the cost of the damage is from raw materials that are not suitable for production, usually in a month the raw materials are not feasible there is 1 kg with the price of raw material for tapioca flour per kg is Rp. 11,000. then for the cost of the next component, namely the cost of electricity, the costs incurred by the company are around Rp. 100,000 per month.

Then, for depreciation costs because the company has its own warehouse so there is no need to rent a warehouse, there is a depreciation of the amount of costs that must be incurred by the company every month, which is Rp. 111,000 later in 1 year the company can spend Rp. 1,332,000.

$$H = \frac{Total\ Biaya\ Penyimpanan}{Persediaan\ Bahan\ Baku} \tag{1}$$

$$H = \frac{1.332.000}{3230\ kg}$$

= 412,3 / kg / year

The cost of storing tapioca flour raw materials per kg per year issued by Cireng and Cimol Nella is Rp. 412.3/kg/year. Next will be calculated using the Economic Order Quantity (EOQ) method.

d. *Economic Order Quantity* **(EOQ)**

After knowing the demand for raw materials in 2020-2021, ordering costs, storage costs, then the optimal quantity that can be ordered by Cireng and Cimol Nella in 2020-2021 for tapioca flour raw materials is as follows:

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

$$EOQ = \sqrt{\frac{2(3230)(50.000)}{412,3}}$$

= 885,1 / kg / tahun

So, it can be seen that the optimal number of orders for tapioca flour raw materials can be ordered by the company when using the Economic Order Quantity (EOQ) method. The optimal order quantity for tapioca flour is 885.1/kg/year with a demand for raw materials of 3230 kg, the ordering cost is Rp. 50.000 for one message and storage fee is Rp. 412.3 /kg/year issued by the company. It can be concluded that this quantity is the quantity made by the company if the company applies the Economic Order Quantity (EOQ) method.

Furthermore, if the company wants to know how many orders must be made in one year using the Economic Order Quantity (EOQ) method, it can calculate the number of orders frequency in one year with the following formula:

$$N = \frac{D}{Q*} \qquad (3)$$

Based on the formula listed above, the frequency of orders that cireng and cimol can make in 2020-2021 for tapioca flour raw materials are:

$$N = \frac{3230}{885,1} = 3,6 \sim 3$$

Based on the results of the above calculations, it can be seen that the frequency of orders that can be made by the company in 2020 for tapioca flour raw materials is 3 times the order and the amount of tapioca flour raw materials that can be ordered based on the Economic Order Quantity (EOQ) method is 885.1 kg / year.

Safety Stock (SS)

The company may experience shortages in inventory due to increased demand than originally expected or due to delays in receiving inventory that has been ordered. Therefore the company needs safety stock to avoid stock out. To have a safety stock, a service level is required.

Based on the results of interviews with company owners, it can be seen that the company rarely experiences a shortage of raw materials because the company has a service level of 95% which shows that the tolerance limit for a shortage of raw material supplies is only 5% and the company is able to meet consumer demand by 95%, the standard deviation value is normal. is 1.65. Before calculating the safety stock, it is necessary to know in advance the average demand for raw materials, the standard deviation of the demand for raw materials, the average lead time, the standard deviation of the lead time, the standard deviation of the use of raw materials, as follows:

a) Average demand for raw materials in days ($\bar{D}$)

The data used by the author is daily usage data in January 2021 for 10 days starting from the 2nd, 7th, 8th, 10th, 13th, 17th, 20th, 21st, 25th, 29th January 2021, as follows:

Table 3 Use of Tapioca Flour Raw Materials

Date	Use	Date	Use
02/01/2021	10	17/01/2021	30
07/01/2021	20	20/01/2021	40

08/01/2021	30	21/01/2021	10
10/01/2021	20	25/01/2021	30
13/01/2021	20	29/01/2021	20

It can be seen in table 3 that the author only uses data on the use of raw materials in January and takes a sample of 10 days, and the use of tapioca flour in each day is different. The highest demand occurred on January 20, 2021 as much as 40 kg and at least on January 2 and 21, 2021, namely 1 kg. Here is the formula to find the average demand for raw materials in days:

$$\bar{D} = \frac{\Sigma D}{n} \tag{4}$$

$$\bar{D} = \frac{230}{10} = 23 \text{ kg}$$

So the average daily demand for tapioca flour is 23 kg. Then, we will discuss the calculation of the standard deviation of the demand for raw materials as follows:

b) Standard Deviation of Weekly Raw Material Usage **(σ_D)**

To find out the standard deviation of the use of raw materials can be seen in table 4 data, then according to Assauri (2011:274) the following formula is needed:

$$\sigma_D = \text{Average range X Faktor koreksi } (F_N) \tag{5}$$

$$\sigma_D = \frac{(30-10)+(40-10\,)}{2} \text{X } 0{,}94 = 23{,}5$$

From the calculation above, it can be seen that the standard deviation of the use of tapioca flour raw materials per week is 23.5

c) Average *Lead Time*

To calculate the average lead time, lead time data experienced by the company is needed during the ordering process. The data used is the date of ordering raw materials until the order arrives every month for 12 months, the data are:

Table 4 Lead Time of Tapioca Flour Raw Material

No.	Order Date	Arrival Date	*Lead Time*	No.	Order Date	Arrival Date	*Lead Time*
1.	04/04/2020	06/04/2020	2	7.	27/10/2020	30/10/2020	1

2.	15/05/2020	18/05/2020	1	8.	17/11/2020	19/11/2020	2
3.	01/06/2020	06/06/2020	3	9.	08/12/2020	13/12/2020	3
4.	27/07/2020	29/07/2020	2	10.	10/01/2021	14/01/2021	1
5.	09/08/2020	13/08/2020	1	11.	21/02/2021	24/02/2021	1
6.	24/09/2020	28/09/2020	1	12.	18/03/2021	20/03/2021	2

It can be seen in table 4, the company orders tapioca flour raw materials once a month, and it can be seen that the longest lead time for raw materials occurs in column numbers 3 and 9. The longest delivery is 3 days due to raw materials from suppliers piling up year-end deliveries or Certain events, such as a new menu, are caused by the delivery of other raw materials and also unfinished raw materials. In other months the longest is 1 to 2 days. To find out the average lead time of raw materials experienced by the company according to Assauri (2011:274) can be known by the formula:

$$\bar{L} = \frac{\Sigma L}{n} \tag{6}$$

$$\bar{L} = \frac{20}{12} = 1{,}6 \sim 1 \text{ day}$$

The lead time experienced by the company for tapioca flour is 1 day.

d) Standard Deviation *Lead Time* (σL)

In table 5 there is a standard deviation of lead time experienced by the company, according to Assauri (2011: 274) it can be calculated by the following formula:

$$\sigma_L = Average\ range \text{ X Faktor koreksi } (F_N) \tag{7}$$

$$\sigma_L = \frac{(3-1)+(3-1)}{2} X\ 0{,}94 = 1{,}88 \sim 1$$

From the calculation results above, it can be seen that the standard deviation of the lead time experienced by the company is 1 day.

e) Standard Deviation Raw Material Usage

The standard deviation of the use of tapioca flour raw materials can be calculated according to Assauri (2011:272) with the following formula:

$$\sigma_U = \sqrt{\bar{L}(\sigma D)^2 + \bar{D}^2(\sigma L)^2} \tag{8}$$

$$\sigma_U = \sqrt{\bar{1}(23{,}5)^2 + \overline{23}(1)^2} = 46{,}5 \text{ kg}$$

From the calculation results above, it is known that the standard deviation of the use of tapioca flour is 46.5 kg. Then calculate the safety stock with the formula used according to Assauri (2011:272) as follows:

$$SS = K\sigma T \qquad (9)$$
$$SS = 1,65 \times 46,5 = 76,725 \text{ kg}$$

With the results of the above calculations, the safety stock that should be owned by Cireng and Cimol Nella for tapioca flour raw materials is 76,725 kg. The company will be able to avoid raw material shortages caused by unpredictable increases in demand. The company should apply the safety stock method to protect and maintain the possibility of raw material shortages

Reorder Point

Perform reorder point calculations, must use safety stock, lead time and also the average amount of usage. So it must be known in advance the average amount of usage because Cireng and Cimol Nella produce every day, the number of working hours in a month is 234 hours, then the number of working hours in a year is 2,808. To find the level of daily raw material usage for the year 2020-2021 using the following formula:

$$d = \frac{D}{t} \qquad (10)$$
$$d = \frac{3230}{2.808} = 1,15 \text{ kg}$$

From the results of these calculations, it is known that the average demand for raw materials per day is 1.15 kg. Then the results of the safety stock and lead time that have been calculated previously, cireng and cimol nella can place orders again for tapioca flour raw materials, according to Heizer and Render (2015: 575) as follows:

$$ROP = d \times L + SS \qquad (11)$$

$$ROP = 1,15 \times 1 + 76,725 = 77,87 \text{ kg}$$

From the results of the above calculations, the company can determine the reorder when the raw material inventory of tapioca flour is 77.87 kg. The results of the reorder point can be taken into consideration by the company in order to avoid shortages of raw materials caused by an unexpected increase in demand.

With the calculations that have been done, it is known that the optimization of inventory control that can be applied by the company using the Economic Order Quantity, Safety Stock, and Reorder Point methods.

Table 5 Calculation Results of Economic Order Quantity, Safety Stock, Reorder Point

Economic Order Quantity	*Safety Stock*	*Reorder Point*
885,1 kg	76,725 kg	77,87 kg

Based on table 5 regarding Economic Order Quantity, Safety Stock, Reorder Point for tapioca flour raw materials 2020-2021, it can be seen that the number of orders using EOQ is 885.1 with a purchase frequency of 1 time a year. Furthermore, safety stock with a tolerance limit of 5% above the estimated 5% below the estimate with a value of 1.65. The 5% has been determined by Cireng and Cimol Nella. For raw material for tapioca flour, the company must provide as much as 76,725 kg.

Then the determination of the reorder point made by the company when the stock of tapioca flour in the company was 77.87 kg. Economic Order Quantity, Safety Stock and Reorder Point are interrelated things to be able to find out the most optimal order quantity. The results of Shofa, Marlyana, & Bernadhi, (2019) study stated that by using the EOQ method on MSMEs of Zee Chicken Cetar Chicken Outlets in the calculation of raw material control is more optimal for the total cost of inventory in its application. Research conducted on Bolmond Bread SMEs also shows that the EOQ method can save on inventory costs Pratama, Wahyudin., & Fauzan, (2022) The results of research on Sunda Chicken food stalls using the EOQ method show that there is a significant difference compared to before using the EOQ method in controlling inventory, so it is recommended to use the EOQ method because it is an easy method to use. Koo, Afandi & Munandar (2022).

So it can be concluded according to Hikam (2022) on Sundanese bird cage craftsmen SMEs, that with research and data processing that has been carried out, namely using EOQ analysis is more profitable where using the EOQ method results in savings of 29% and with this EOQ method the company can also estimate the time it will take appropriate for reordering raw materials and providing useful safety materials. When there are unexpected orders, the production process can still run because of these safety materials.

5.   Conclusion and Suggestion

Based on the results of calculations using the Economic Order Quantity (EOQ) method, the company is able to provide more optimal inventory than using company policies. By using the Economic Order Quantity (EOQ) method, the company makes 3 orders in a year with a total order of 885.1 kg per order, while the purchase of raw materials before using the EOQ method is carried out every month.

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